Inlets to Outlets:
You May Be Surprised at What You Find...

TFMA Annual Conference
March 10, 2016

Presented by
Mike Keenum, PE, CFM
Jennifer Davidson, PE
Steven Nelson, PE, CFM
Erin Atkinson, PE, CFM, GISP
Ben Pylant, PE, CFM
Lubbock Stormwater GIS & Video Inspection Project
Project Objectives

- Locate stormwater assets and determine network connectivity
- Survey all above ground assets
- Perform condition assessment (CCTV inspection)
- Develop a comprehensive GIS database integrating the condition assessment
- Deliver CIP plan based on the GIS
Project Challenges

- The exact extent of the stormwater system was not known

- Potential conflicts during field work
  - Accelerate or delay field work based on City projects
  - Coordination with City work crews for manhole opening & raising

- Long term project issues
  - How do we keep the City informed?
  - How are intermediate deliverables handled?
Project Approach

- Divided stormwater network into 10 systems
- Grouped systems into 4 phases
- Project duration 4+ years
## Planned Inspection by Phase & System

<table>
<thead>
<tr>
<th>Phase</th>
<th>System Name</th>
<th>Planned Inspection (lf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td>Downtown</td>
<td>58,000</td>
</tr>
<tr>
<td>Phase 2</td>
<td>Arnett Benson</td>
<td>21,000</td>
</tr>
<tr>
<td>Phase 2</td>
<td>Avenue R</td>
<td>28,000</td>
</tr>
<tr>
<td>Phase 3</td>
<td>Clapp</td>
<td>17,000</td>
</tr>
<tr>
<td>Phase 3</td>
<td>I-27</td>
<td>23,000</td>
</tr>
<tr>
<td>Phase 3</td>
<td>Quaker</td>
<td>11,000</td>
</tr>
<tr>
<td>Phase 3</td>
<td>Stumpy I-27</td>
<td>22,000</td>
</tr>
<tr>
<td>Phase 3</td>
<td>Tech Stumpy</td>
<td>16,000</td>
</tr>
<tr>
<td>Phase 4</td>
<td>East 50th</td>
<td>20,250</td>
</tr>
<tr>
<td>Phase 4</td>
<td>Maxey Park</td>
<td>49,750</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>266,000</strong></td>
</tr>
</tbody>
</table>
Available Stormwater Asset Data

- **Types of data**
  - GIS
  - CAD
  - Design plans
  - Spreadsheets
  - Aerial imagery
  - Google street view

- **Sources**
  - City
  - TxDOT
  - Texas Tech University
Building the Initial GIS System

- Identified the required asset feature classes
  - Pipes, inlets, manholes & outfalls
- Combined all digital data sources
- Compared spatial alignment
- Compared attribution
- Removed duplicate data
- Supplemented gaps in digital data with plans
- Assigned unique ID to every feature
- Reviewed geodatabase with City staff
Record Drawing Mosaic
Lubbock’s Stormwater System

- **Existing GIS data**
  - 91 miles of pipe
  - 76 manholes
  - 1,124 inlets/infalls
  - 31 outfalls

- **Final GIS database**
  - 148 miles of pipe
  - 668 manholes
  - 2,194 inlets
  - 94 infalls
  - 164 outfalls
  - 5 vaults
Field Verification

- **AKA “Dashboard” Inspections**
  - Drive through system areas looking for missing assets
  - Condition assessment of surface features

- **Mobile GIS solution**
  - Real-time access to the GIS data
  - Locations based on GPS
  - Add new assets directly to the GIS
  - Modify existing GIS attributes
  - Attach photos to the assets
Survey Deliverables
CCTV Deliverables

<table>
<thead>
<tr>
<th>Mainline</th>
<th>Manhole</th>
<th>Lateral</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONNECTION_MH_DT066</td>
<td>LUBBOCK AVE Q &amp; 16TH ST</td>
<td>Light Highway</td>
</tr>
<tr>
<td>MH_5374_5064</td>
<td>LUBBOCK AVE Q &amp; 16TH ST</td>
<td>Light Highway</td>
</tr>
<tr>
<td>MH_DT066E_MH_DT065</td>
<td>LUBBOCK AVE Q &amp; 16TH ST</td>
<td>Light Highway</td>
</tr>
<tr>
<td>MH_DT066E_MH_DT065</td>
<td>LUBBOCK AVE Q &amp; 16TH ST</td>
<td>Light Highway</td>
</tr>
<tr>
<td>UNKNOWN_MH_DT066</td>
<td>LUBBOCK AVE Q &amp; 16TH ST</td>
<td>Light Highway</td>
</tr>
<tr>
<td>ECL_MH_3030A</td>
<td>LUBBOCK AVE Q &amp; 16TH ST</td>
<td>Light Highway</td>
</tr>
<tr>
<td>IN_DT371_IN_5445</td>
<td>LUBBOCK AVE A &amp; 13TH ST</td>
<td>Yard</td>
</tr>
<tr>
<td>IN_DT371_IN_DT371</td>
<td>LUBBOCK AVE A &amp; 13TH ST</td>
<td>Yard</td>
</tr>
<tr>
<td>MH_5445_JUNCTION BOX</td>
<td>LUBBOCK AVE A &amp; 13TH ST</td>
<td>Yard</td>
</tr>
<tr>
<td>MH_4002_MH_4265</td>
<td>LUBBOCK CRICKETS &amp; 13TH ST</td>
<td>Main Highway - Suburban/Rural</td>
</tr>
<tr>
<td>IN_4089_JUNCTION BOX</td>
<td>LUBBOCK BUDDY HOLLY &amp; 15TH ST</td>
<td>Sidewalk</td>
</tr>
<tr>
<td>MH_5342_MH_4096</td>
<td>LUBBOCK CORRADO &amp; AVE A</td>
<td>Light Highway</td>
</tr>
<tr>
<td>IN_DT233_MH_5071A</td>
<td>LUBBOCK AVE A &amp; 13TH ST</td>
<td>Yard</td>
</tr>
<tr>
<td>IN_DT380_MH_5034</td>
<td>LUBBOCK AVE J &amp; 5TH ST</td>
<td>Yard</td>
</tr>
<tr>
<td>IN_6004_IN_5003</td>
<td>LUBBOCK AVE J &amp; 5TH ST</td>
<td>Yard</td>
</tr>
<tr>
<td>INLET_MH_DT0588</td>
<td>LUBBOCK AVE J &amp; MAIN ST</td>
<td>Sidewalk</td>
</tr>
</tbody>
</table>

Search: 
Filter %: 
DC for 26 inspection(s) 

108.8 ft.

Obstacle External Pipe or Cable: 152.8 ft.

Broken Pipe: 127.5 ft.
Working the Puzzle

- Review all connections found during CCTV inspection
  - Taps reveal laterals to inlets
  - Main line connections identified
- Paved over/buried manholes and inlets
- Comparing field recon, survey and CCTV is similar to working a jigsaw puzzle!
Using GPR to Find Buried Assets

- Ground Penetrating Radar
- Detects metallic objects below the surface
- Good solution for finding paved over manholes or other buried assets
Interim Data Delivery

- Challenge – lots of data over several years

- Solution – GIS based web maps and access to mobile GIS

- Web maps
  - GIS data access using a standard internet browser
  - City was able to monitor project status
  - Data collected during survey and CCTV available as soon as processing was complete
  - Provided access to videos and asset photos
Justification for Erosion Control

USMH: IN_0414
DSMH: MH_3030

Access Point Manhole
MH_3030
0.0 ft.
Cross Connections
Cross Connections

USMH: DEAD END
DSMH: MH_3030

USMH: MH 3034
DSMH: 3034A

146.7 ft.
176.0 ft.
Collapsed Pipes
Leftover Forms
Inlets...
to “Outlets”...
Pipe Condition & Modeling
Capital Planning

- Final report identified several CIP planning opportunities
  - Manhole lid replacement
  - Inlet markers
  - Trunk line cleaning
  - Accessibility issues
  - Minor repair projects
  - Major repair projects

- Accessibility issues
  - Manhole access
  - Pipe obstructions
  - Water level

- 16,000 lf of pipe not inspected
- Recommended manhole installation locations
- Template design for modifying pipe around obstructions
- Dewatering requirements
# CIP Minor Repair Projects

- **List of pipe deficiencies requiring point repairs**

<table>
<thead>
<tr>
<th>Description</th>
<th>CCTV Image</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PROJECT COMPLETED JULY 2013</strong></td>
<td><img src="image1.png" alt="CCTV Image" /></td>
<td><img src="image2.png" alt="Location Image" /></td>
</tr>
<tr>
<td>CCTV Route - CCTV_20120925_45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upstream - MH_5227 (60 ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Downstream - MH_5229 (50 ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pipe Size – 30 inch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Description – Broken Pipe Soil Visible</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proposed – Backfill voids with flowable fill and patch hole with non-shrink grout.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intersection – 34th St. and Quaker Ave.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CCTV Route - CCTV_20121003_1</strong></td>
<td><img src="image3.png" alt="CCTV Image" /></td>
<td><img src="image4.png" alt="Location Image" /></td>
</tr>
<tr>
<td>Upstream - MH_5357 (150 ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Downstream - IN_4285 (230 ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pipe Size – 24 inch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Description – Broken Pipe Soil Visible</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proposed – Backfill voids with flowable fill and patch hole with non-shrink grout.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intersection – East of 19th St. and Birch Ave.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CIP Major Repair Projects

- List of pipe deficiencies requiring open cut repairs

<table>
<thead>
<tr>
<th>Rank</th>
<th>Description</th>
<th>CCTV Image</th>
<th>Location</th>
</tr>
</thead>
</table>
| 1    | CCTV Route: CCTV_20121008_10  
Upstream: IN_4282 (50 ft)  
Downstream: MH_5382 (190 ft)  
Pipe Size: 24 inch  
Description: Hole Void Visible  
Proposed: Open cut and replace pipe joint. Backfill with native soil or flowable fill where mechanical compaction is difficult  
Cost: $15,000 - $20,000  
Intersection: Near 20th St. and Southeast Dr. | ![CCTV Image](image1)  
![Map Image](image2) | ![Map Image](image3) |
| 2    | CCTV Route: CCTV_20130220_2  
Upstream: MH_5342 (50 ft)  
Downstream: MH_4956  
Pipe Size: 18 inch  
Description: Pipe has been damaged from above and is generally fractured all the way upstream to the manhole. Proposed: Open cut and replace 25 ft of 18 inch stormwater pipe.  
Cost: $10,000 - $15,000  
Intersection: Near 25th St. and Ash Ave. | ![CCTV Image](image4)  
![Map Image](image5) | ![Map Image](image6) |
Questions?