City of San Antonio
Utilizing Advanced Technologies for Stormwater System Mapping and Condition Assessments

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Prepared by
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Agenda

• Stormwater Management Purpose
• City of San Antonio Stormwater Inventory Project
• Advanced Technologies
  – *Data Collection*: Mobile LiDAR
  – *Condition Assessment*: 360° Manhole Inspection with IBAK Panoramo
  – *Defect Analysis*: InfoMaster Sewer
• Questions
Stormwater Management

• Stormwater management is a major and growing challenge nationwide.

• Stormwater pollution, aging infrastructure, flooding and other issues impose serious impacts on public safety, water quality, public health and local economies.

• As communities continue to grow, the need to develop a comprehensive and effective stormwater management program increases.
Many communities have a stormwater system, however:

- They do not have a comprehensive understanding of where their storm assets are located
- The condition of the existing system largely unknown
- Reactive vs. Proactive approach to stormwater management
- Unable to fund stormwater improvements

First step is to develop a Stormwater Asset Management Plan
CITY OF SAN ANTONIO
STORMWATER PROJECT CASE STUDY
COSA Stormwater Project Purpose

Portions of the City of San Antonio storm sewer system are approaching 100 years old and a City-wide understanding of where the storm assets are located is incomplete.

Additionally, the condition of the existing pipes is largely unknown and the City would like to tie all condition assessment data to into the City of San Antonio’s GIS and Cartegraph system.
COSA Stormwater – Pilot Project

**Project Objective:** Conduct mapping and video inspection of the storm sewer infrastructure

- Develop Stormwater GIS database structure
- Perform field survey, CCTV and Condition Assessment
- Integrate all project deliverables into a comprehensive GIS Database, PipeLogix database and Cartegraph system
Pilot Area

- Storm Sewer – 30,000 lf
- Inlets – 260
- Manholes – 100

<table>
<thead>
<tr>
<th>COSA Stormwater</th>
<th></th>
</tr>
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<tbody>
<tr>
<td>COSA GIS Pipe</td>
<td>30,000</td>
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<tr>
<td>Suspected Pipe</td>
<td>42,000</td>
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COSA Stormwater – Pilot Project

**Challenges:** Project RFQ was released February 2105, RJN was selected in early May and the project was approved by Council late May 2015. The full project had to be completed by the end of the 2015 Fiscal Year (September 2015)

- The existing storm GIS layers from the City were incomplete and many assets were not mapped or missing attribute information
- The accelerated timeline of 5 months, required efficient data collection and analysis procedures to complete the project within the outlined schedule
COSA Stormwater – Pilot Project

**Solutions:** Project utilized multiple advanced technologies and software programs throughout each phase of the project to efficiently map and analyze the stormwater system, including:

- Mobile LiDAR
- 360° Manhole Inspection with IBAK Panoramo
- InfoMaster Sewer
Advanced Technologies

- **Data Collection:** Mobile LiDAR
- **Condition Assessment:** 360° Manhole Inspection with IBAK Panoramo
- **Defect Analysis:** InfoMaster Sewer
What is Mobile LiDAR?

Mobile Mapping System

- **Light Detecting And Ranging**
- A vehicular based imaging and LiDAR data collection system
- 200,000 points collected per second
Mobile LiDAR Point Cloud

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<th>Distance from LS</th>
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Mobile LiDAR Data Extraction

- Extract Inlets and Manholes from Mobile LiDAR Point Cloud
  - Inlet Manhole Lid Elevation
  - Inlet Throat Elevation
  - Inlet Top of Curb Elevation
Mobile LiDAR Benefits

• Capture accurate geo-referenced imagery and LiDAR point cloud safely
• Survey Grade Accuracy
• Reduced field time
  – COSA Project – collected 54 street miles of data in 1 day
• Produce higher quality data than traditional asset surveys
• Cost Effective
• Can be used for future 2D Hydraulic modeling
MANHOLE CONDITION ASSESSMENT
IBAK PANORAMO SI
360° Panoramic Manhole Inspections

- RJN Purchased and began using the IBAK Panorama in April 2016.
- Allows for quick, accurate and detailed MACP surveys of each structure.
- This mobile system captures a complete 360° perspective record of the inside of the structure.
360° Panoramic Manhole Inspections

- **Panoramic view** of the manhole
360° Manhole Survey Benefits

- Capture accurate inspection information safely
- MACP Inspection defect coding
- Produce higher quality data than traditional asset surveys
- More efficient data collection equates to cost savings
- Locate unknown line connections and laterals
DEFECT ANALYSIS
INFOMASTER SEWER
InfoMaster Sewer Defect Analysis

CCTV video inspection was completed for approximately 70,000 linear feet of stormwater pipe within the Pilot Area. All observations were coded using the most recent version of the NASSCO PACP guidelines.

- Identification of condition of the sewer.
- Identification of any connections from storm laterals (catch basins and inlets)
- Identification of any defects which are cost-effective to repair.
- Identification of maintenance issues such as debris, grease, and roots
InfoMaster Sewer Defect Analysis

- **InfoMaster** is a decision support tool that uses user defined asset data and field investigation data along with analysis tools to prioritize assets and determine condition assessment rehabilitation decisions for an entire system.
Data Wizard
Data Wizard does a quality check of the data, scores defects, and develops a draft rehabilitation plan

Consequence of Failure (COF)
Consequence of Failure of an asset based on parameters set by user

Likelihood of Failure (LOF)
Likelihood of Failure of an asset based on parameters set by user

Risk
Customizable Matrix of the Consequence of Failure to the Likelihood of Failure

Rehabilitation Plan
Rehabilitation Plan for the Asset
CCTV QA/QC and Geocode Defects

- Simplified CCTV import
- Streamlined CCTV QA/QC and geocode
  - Performed in one step
  - Checks for continuous defects that are not closed
- Enhanced QA/QC
- Pre-loaded with all the PACP defect codes
GIS Validation Errors

- E.g. Missing MH, Missing Pipe, Pipe Length Errors, etc.

Validation "SEW_Valid1"

<table>
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<tr>
<th>Enabled</th>
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<th>Criteria</th>
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<td>NA-008</td>
<td>Manhole is missing rim elevation</td>
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<td>Manhole</td>
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<td></td>
<td>NA-009</td>
<td>Manhole is missing invert elevation</td>
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<td>Manhole</td>
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<tr>
<td></td>
<td>ER-007</td>
<td>Manhole maximum depth is either too high or too low</td>
<td></td>
<td>Manhole</td>
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<td></td>
<td>ER-001</td>
<td>Pipe diameter is either too high or too low</td>
<td>0.25 &lt;= Value &lt;= 10</td>
<td>Gravity Main</td>
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<tr>
<td></td>
<td>ER-005</td>
<td>Unusual setting for pipe slope</td>
<td>0 &lt;= Value &lt;= 0.02</td>
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<td>ER-012</td>
<td>Suspicious pipe length (it may have lots of bends or is shorter than...</td>
<td>nodal distance - 0 &lt;= Value &lt;= nodal...</td>
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<tr>
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<td>NA-029</td>
<td>The drop across the pipe cannot exceed its length</td>
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<td>Gravity Main</td>
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<td>NA-006</td>
<td>Pipe is missing US Node</td>
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<td>Gravity Main</td>
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<tr>
<td></td>
<td>NA-007</td>
<td>Pipe is missing DS Node</td>
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<tr>
<td></td>
<td>NA-004</td>
<td>Pipes are crossing/intersecting each other</td>
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<td>Gravity Main</td>
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<tr>
<td></td>
<td>ER-023</td>
<td>Invert elevation of outgoing pipe is higher than that of incoming...</td>
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<td>Manhole</td>
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<tr>
<td></td>
<td>NA-001</td>
<td>Node is not connected to any link</td>
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<td>Manhole</td>
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<td></td>
<td>DP-001</td>
<td>Facility id is duplicated</td>
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<td>All Facility Types</td>
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<td></td>
<td>DP-002</td>
<td>Facility id is invalid</td>
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After completing the PACP coding of all defects, the tabular condition assessment data was brought into InfoMaster Sewer and GIS for analysis:

- Spatially linked with the GIS
- Visual representation of PACP defects shown geographically along the asset line
- GIS-linked defect images and CCTV videos inspections
- Simplified access to CCTV videos through the GIS interface
InfoMaster Sewer Defect Analysis
### Project Results

#### COSA Stormwater Infrastructure

<table>
<thead>
<tr>
<th>Pilot Area</th>
<th>Original COSA GIS</th>
<th>Post-Pilot GIS</th>
<th>Percent Increase</th>
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<tbody>
<tr>
<td>Inlets</td>
<td>264</td>
<td>298</td>
<td>13%</td>
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<tr>
<td>Manholes</td>
<td>104</td>
<td>170</td>
<td>63%</td>
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<tr>
<td>Pipe (linear feet of mains)</td>
<td>29,753</td>
<td>72,802</td>
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Conclusions: By utilizing multiple advanced technologies and software programs throughout the Pilot Project, our team was able to efficiently map and analyze the stormwater system within the outlined schedule and budget.

We recently finished Year 2 of this project and have starting Year 3.

<table>
<thead>
<tr>
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<th>CCTV (lf)</th>
<th>PACP Coding (lf)</th>
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<tbody>
<tr>
<td>Pilot</td>
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<tr>
<td>Year 2</td>
<td>76,000</td>
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<td>Year 3</td>
<td>130,000</td>
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<tr>
<td>TOTAL</td>
<td>278,000</td>
<td>230,000</td>
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COSA Stormwater CCTV Master Plan

- During Year 3 the City has decided to develop a long-term plan for conducting CCTV and condition assessment for all the storm pipe in the City
  - Integrate LOF and COF into the risk assessment to identify the high risk assets for priority CCTV
    - Corrugated Metal Pipe
    - Soil Type
      - Highly acidic soils
      - Soils with high plasticity

- Currently developing the CCTV Master Plan criteria
  - Roadway Type
  - Critical Facilities
  - Low Water Crossings
Utilizing Advanced Technologies for Stormwater System Mapping and Condition Assessments

QUESTIONS?

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