Introduction to Asset Management Processes and Tools

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Today's Agenda

- Introductions
- Asset Management Overview
- The Asset Management Process
- Data Collection
- Asset Analysis
- Case Study

Asset Management

Chances are Asset Management exists in some basic form in every organization. Whether it is organized in a spreadsheet, located in a file cabinet or stored in the maintenance supervisor's head, access to this information is important and could include:

- **Construction Dates**
- **Original Project Costs**
- **Features**
- **Location**
- **Maintenance History**
- **Inspections**

At its core,
Asset Management Focuses on Resource Allocation and Utilization

Transportation Research Board - 2008

Why Manage Your Assets?

Performance and cost effectiveness
- **Deliver policy goals and objectives**
- **Lower long-term costs for infrastructure preservation**
- **Improved performance and service to customers**
- **Improved use of available resources**

Communication, accountability, and credibility
- **Improved communication within agency and with customers**
- **Improved credibility and accountability for decisions**

Applying Asset Management at Your Agency

Asset management is adaptable to different agency situations:
- **Organizational structure**
- **Management culture**
- **Funding environment**
- **Technological capability**

Fundamentals of asset management – generally applicable to all agencies

Implementing asset management – customization and tailoring to be expected

Service Requests

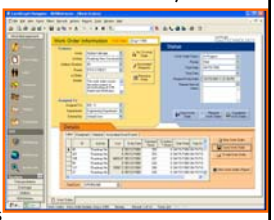
Service requests are the starting point for many work activities that originate internally or from citizen demands. Good service request management requires access to information such as:

- **Caller History**
- **Work Requests**
- **Similar Work Requests**
- **Pending Work Orders**

Work Orders

Work Management includes all of the scheduling and activities involved in maintaining assets at a predefined condition level, including:

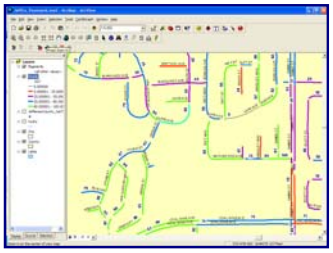
- **Work Orders**
- **Work Requests**
- **Maintenance**
- **Inspections**
- **Labor Cost**
- **Equipment & Material Costs**
- **Budgeting**
- **Performance Monitoring**



GIS Integration

GIS Integration displays information from underlying databases to spatially display and visually analyze asset infrastructure.

- **Colored Themes**
- **Clustering of Issues**
- **Location of Work Orders**
- **Maintenance Priorities**



The Asset Management Process

- Laying the Groundwork
- Getting Organized
- Performing the Initial Inventory
- Using the System (Hardware/Software)
- Planning for the Future

Laying the Groundwork

Identify Decision Makers:

- Executive Sponsor
- Project Champion
- Project Manager
- Support Personnel

Identify System Objectives:

- Full Integration
- Partial Integration
- Full Implementation
- Phased Implementation

Laying the Groundwork

Identify Data:

Format:

- Electronic
- Paper-based
- In the minds of individual workers

Quality:

- Recently collected
- Scheduled updates

Getting Organized

Business Process Mapping

- Documents how your agency conducts their day-to-day operations and work activities.
- Identifies opportunities to streamline operations.
- Identifies a "road map" for selecting an Asset Management software solution.
- Allows employees to identify bottlenecks and deficiencies in the current process.
- Identify the "Pain" of the Agency.

Getting Organized

Needs Assessment

- Identify the "Pain" of Your Agency
- Gap Analysis
  - Policies and Procedures
  - Hardware and Software
  - Personnel and Headcount

Data Development Manual

- Identify Data Types, Accuracies, and Attributes
- Standard Naming Conventions
- Standard Operating Procedures

Getting Organized

Operations and Maintenance Methodologies

- Risk – The likelihood and consequences of failure
- Condition – Based on inspection and predictive models
- Valuation – Based on current fiscal valuation
- Capital Improvement Planning – Prioritization based on available budget

Implementation and Strategic Planning

- Prioritized Action Items
- Implementation Timeline
- FEMA-Compliant Pre and Post-Disaster Inventory and Recovery Activities

Getting Organized

Asset **Types** to be Collected

- –Transportation Infrastructure
- –Utility Infrastructure
- –Facility Infrastructure

Asset **Attributes** to be Collected

- –Work the problem backwards
- –Identify the questions you need answered
- –Specify the information to be collected to answer these questions.

Getting Organized

Determine the Intended use of the Data

- –Flow Modeling
- –Engineering / Design
- –Maintenance Management

Determine the Accuracy

- –Mapping Grade (Visual Representation)
- –Sub-Meter
- –Centimeter

Getting Organized

- Determine the Storage Capacity of your current system.
- Pictures and video require large amounts of storage space.
- Get IT involved early on in the process.
- Number of Concurrent Users
- Network Capabilities
- Wireless Communications
- Desktop computer requirements

Putting The System Together - Software

- Conduct Vendor Demonstrations
- Review Software Capabilities
- Match Software Capabilities with Functional Requirements (Gap Analysis)
- Determine the Best Match of Software Capabilities and Functional Requirements

Putting The System Together - Hardware

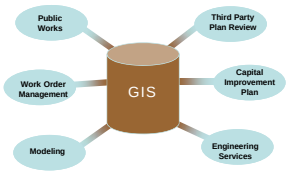
- AMS Server
  - Used to store all data related to AMS*
- User PCs
  - Must meet minimum standard
  - Recommended by vendor
- Network Capacity
- Field-Based Data Collection
  - Pen-based and laptop/notebook computers
  - Global Positioning System (GPS) Receivers
  - Bar Code Scanners
  - Distance measuring instruments (DMI)
  - Digital Cameras
  - Active Radio Frequency Identification (RFID)

Performing the Initial Inventory

- Review the System Goals
- Implement the Tools
- Begin a Pilot Program
- Perform Full-Scale Inventory
- Import the Data into a Computerized Maintenance Management System (CMMS)
- Maintain the Database with Work Orders

Using the System

- System Management
  - Maintenance
  - "Forgotten" Assets
  - Asset checkups
  - New Assets
  - Retired Assets
  - Additional Information
- Quality Control
- Training
- Funding



Planning for the Future

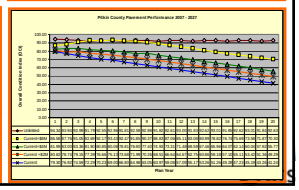
- Integration of Technology
  - Geographic Information Systems (GIS)
  - Internet
  - Mobile / Wireless
- System Expansion
- Compliance with Federal and State Requirements
  - Governmental Accounting Standards Board (GASB.34)
  - National Pollutant Discharge Elimination System (NPDES)
  - CMOM – Capacity, Management, Operations, and Maintenance
- Use of New Software Technology
- Addition of New Hardware

Examples

- Water Distribution Systems
- Wastewater Conveyance Systems
- Reclaimed Conveyance Systems

Examples

- Pavement Management
  - Inspection Methodology
  - Performance Modeling
  - Capital Improvement Planning
  - GIS Integration



Examples

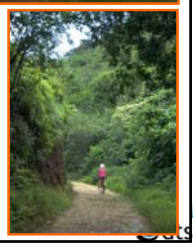
- Sidewalks
  - Length
  - Width
  - Slab Thickness
  - Condition
  - ADA Compliance
  - Trip Hazards
  - Other Features

Examples

- Traffic Control Devices
  - MUTCD Code
  - Components
  - Head Type
  - Orientation
  - Timing
  - Other Details

Examples

- Facilities
  - Benches
  - Pavilions
  - Playgrounds
  - Recreation
- Trails
  - Location
  - Surface Type
  - Length



Examples

- Roof Management System
  - Roof Area
  - Roof Type
  - Parapet Walls
  - Penetrations
  - Condition

Data Collection

- Asset Acquisition Methodology
  - Existing asset data from client
    - Vector Data
    - Raster Data
    - Work Order Data (Spatially Referenced)
  - Evaluate the condition of existing data
    - Salvage data that is current and maintained
    - Archive data that is correct, but no longer in use
    - Discard data that cannot be historically validated

Sample Features

Data Collection

- Asset Acquisition Methodology
  - Determine data collection approach
    - Identify standards for data collection
    - Determine the cost / benefit for each approach
    - Choose an approach
    - Conduct pilot data collection
    - Evaluate pilot results
    - Modify collection strategy to achieve desired results
    - Implement full-scale collection

Data Collection

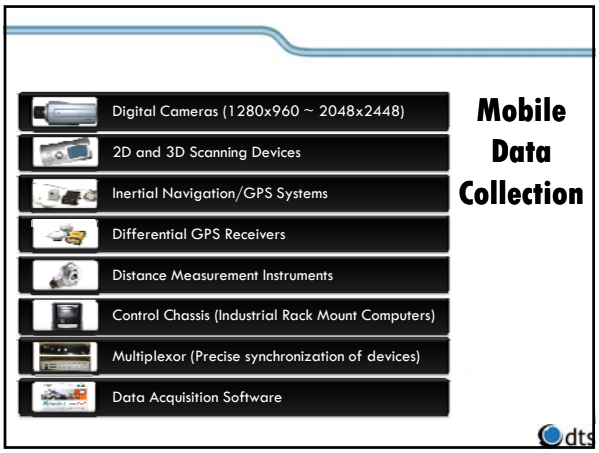
- Identify standards for data collection
  - Spatial Accuracies
  - Attribute Accuracies
  - Who Will Collect the Data
  - How Long Will it Take?
  - How Much Will it Cost?

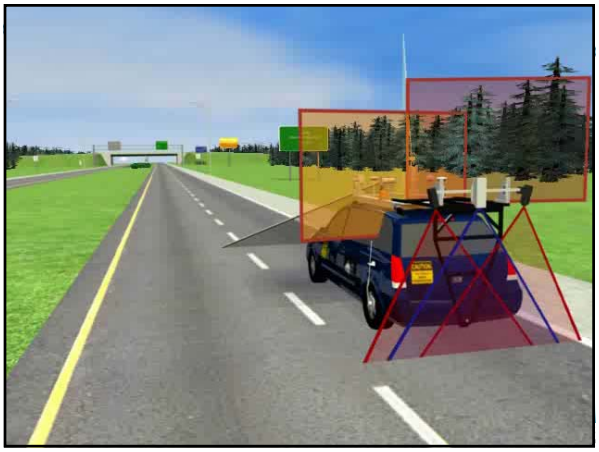
Data Collection

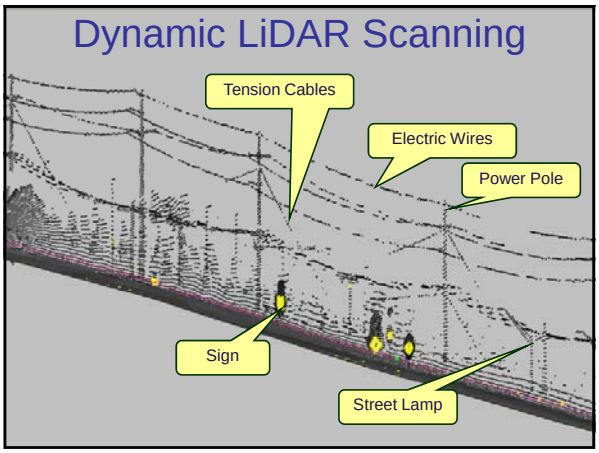
- Determine the cost / benefit of each approach
  - Can you afford centimeter-level positioning?
  - Do you really need it?
  - Consider how the data is going to be used for daily activities.
  - For example, are you going to model with the data or is it only going to be for mapping purposes?

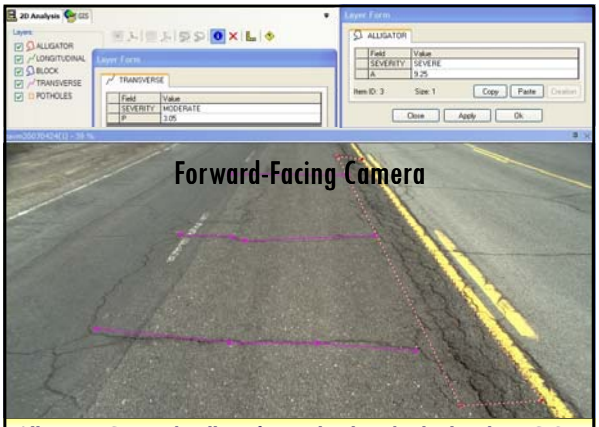
Data Collection

- Van-Based
  - Digital Video collected by moving vehicle
  - Assets are extracted at the desktop
  - Best suited where assets are clustered
- Field-Based
  - Ground crews are deployed to collect with GPS
  - Assets locations and pictures collected in the field
  - Cost-effective for large areas where assets are spread out
- Aerial-Based
  - Spatially referenced imagery used to collect features
  - Assets digitized at the desktop
  - Large features and QA/QC on collected data

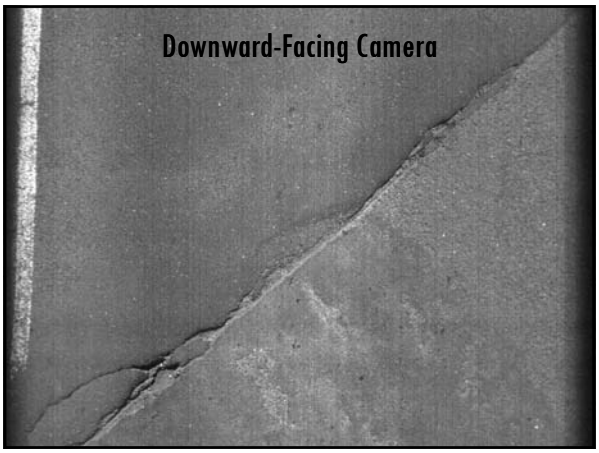

Mobile Data Collection
Digital Cameras (1280x960 ~ 2048x2448)
2D and 3D Scanning Devices
Inertial Navigation/GPS Systems
Differential GPS Receivers
Distance Measurement Instruments
Control Chassis (Industrial Rack Mount Computers)
Multiplexor (Precise synchronization of devices)
Data Acquisition Software
dts



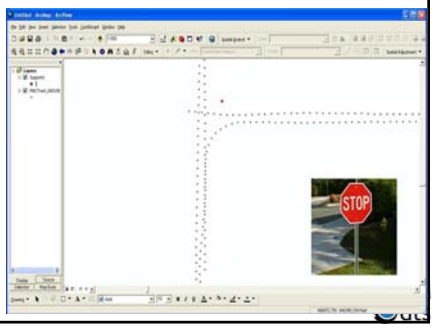




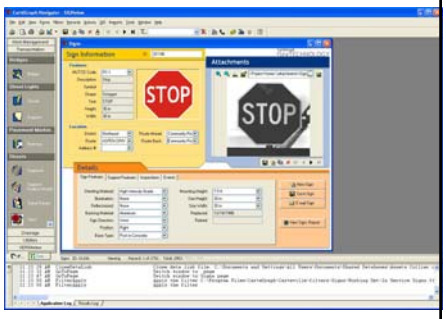
•All Data is Geographically Referenced and can be displayed in a GIS



- Data integrated with ArcMap



- Data imported into Asset Management System



Field Data Collection

Field Data Collection

- Equipment
  - **Fixed GPS (Vehicle-Mounted)**
  - **Handheld GPS**
  - **Traditional Surveying**
- Methods of Collection
  - **Bikes**
  - **ATV**
  - **Segway**
  - **Walking**

Data Collection Methods

- ATVs and bikes are efficient methods for collecting data in neighborhoods
- Segways work well in City Areas
- Bikes / Scooters can be used in subdivisions
- Normal Vehicles can be used on busier and longer roads

Asset Acquisition from Imagery

- Digitize Larger Features that can be seen in the Imagery
- Understand the Absolute Accuracy of the Imagery
- No Inspection Information

Quick AMS Recap

1. Applied to the ENTIRE PORTFOLIO of infrastructure assets at all levels of the organization
2. Seeking to MINIMIZE TOTAL COSTS of operating, maintaining and renewing assets within an environment of limited resources
3. Delivering the SERVICE LEVELS that customers desire and regulators require

Why Analyze?

- Citizen Response/Customer Satisfaction
- Fiscal Responsibility/Infrastructure Sustainability
- Retiring Workforce
- CMOM (Capacity, Management, Operation, & Maintenance)
- NPDES Phase II (National Pollutant Discharge Elimination System)
- FHWA Retroreflectivity (signage)

Risk: Loss of essential services

NYC pipe explosion, July 2007
Credit: Mario Tama, Getty Images

Federal Mandates

PACP / ASTM

Real-World Influences

O&M Issues

Operations and Maintenance

Wellhead that needs to be replaced
Credit: Rural Community Assistance Corporation

Failed booster pump results in well house flooding
Credit: Rural Community Assistance Corporation

Succession Planning

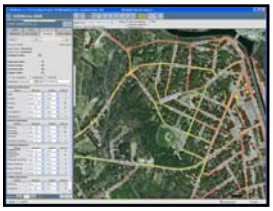
This guy…

=

Northstar Community Services District
www.northstarcsd.org

58

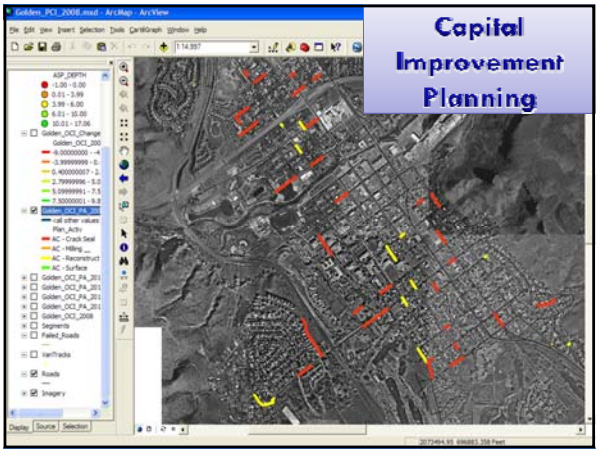
Spatial Interactions



PMS software is used to track details related to segments, maintenance, and inspections.

GIS data is directly linked to PMS for display and map-making capabilities.

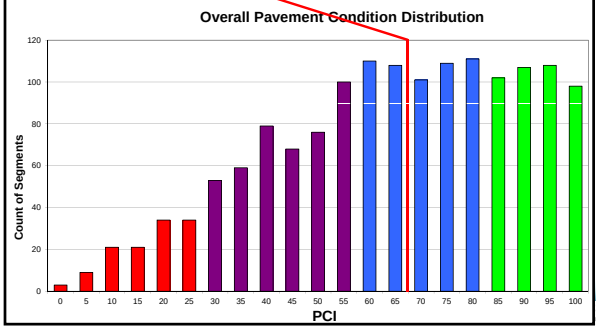
Capital Improvement Planning



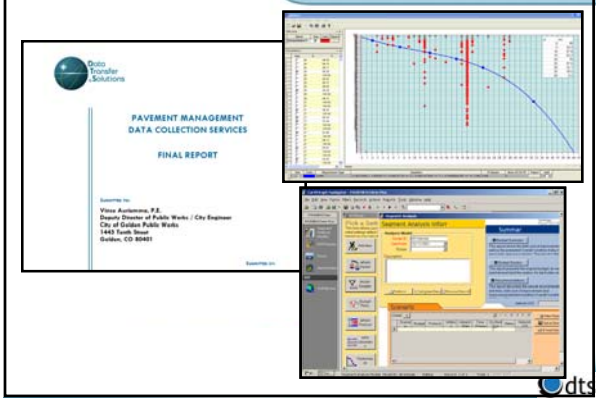
Data Access

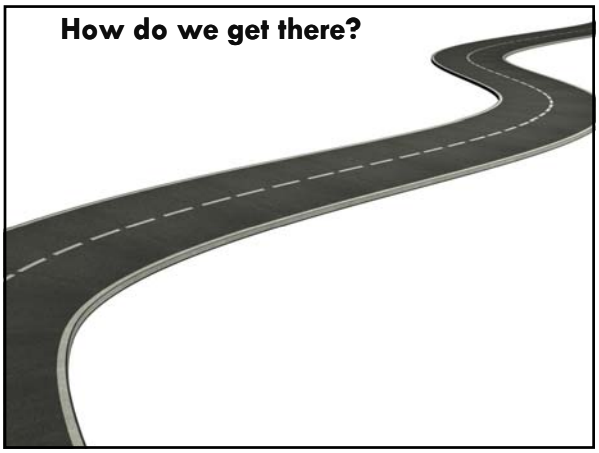
Project Results

- Network-Level Analysis of Road Network
  - Network PCI = 67



Management Plans




How do we get there?

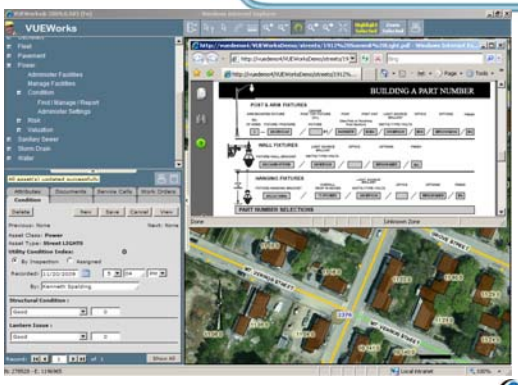
Executive
Sponsorship

Condition Assessment

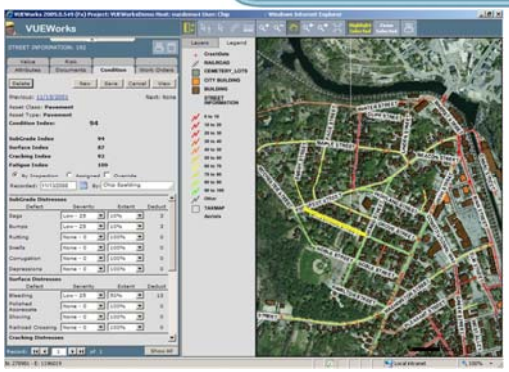
The Condition Assessment records the relative state of an asset and site against specific performance criteria established by the agency.

- Condition Assessment should be specific to the asset class and the asset type.
- Many Inspection Standards do Exist and Should be used to support repeatability in measurements

Condition Assessment



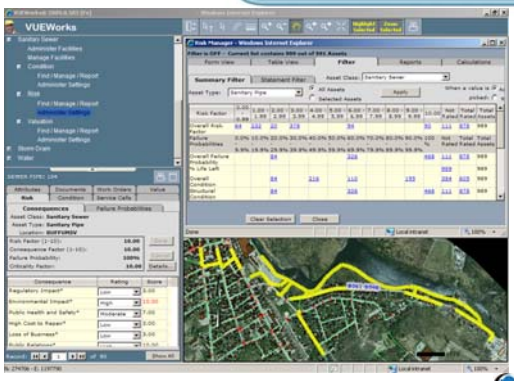
Condition Assessment



Risk Analysis

- Risk Analysis is the process of identifying the types of Failure Modes and their consequences for a particular Asset Class and Asset Type.
- It allows an agency to prioritize asset maintenance based on the criticality of their operation.

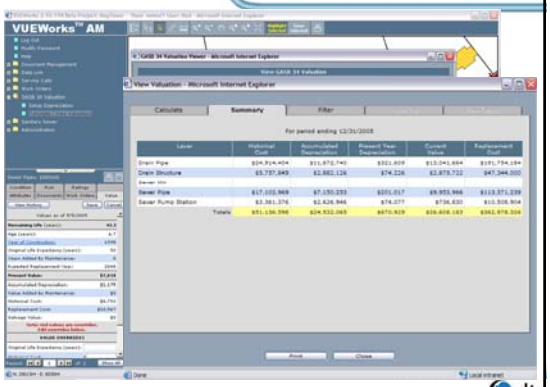
Risk Analysis



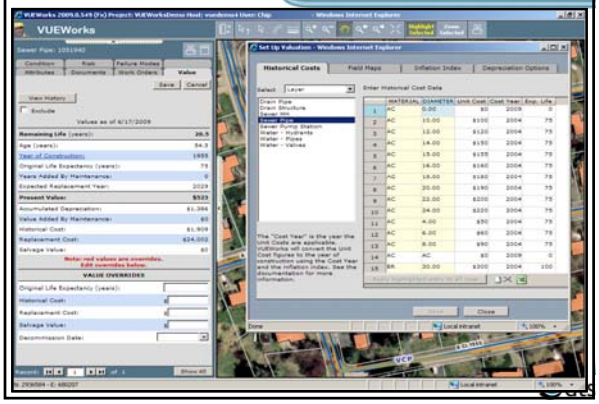
Asset Valuation

- Valuation allows the user to create reports that meet the Government Accounting Standards Board Statement No. 34 (GASB No. 34) requirements for maintaining and reporting value and depreciation of all your infrastructure assets.
- The value of an asset can be determined using the following methodologies:
  - Historical Installation Cost
  - Age of the Asset
  - Condition Inspection Results
  - Work Order Cost Information

Asset Valuation



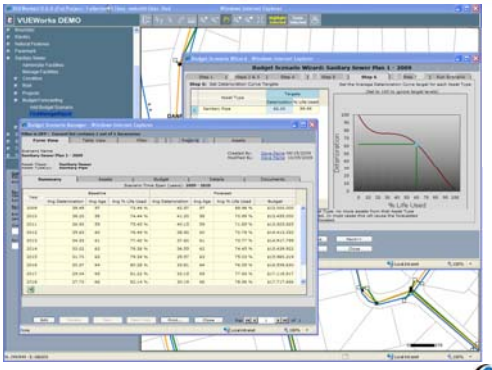
Asset Valuation



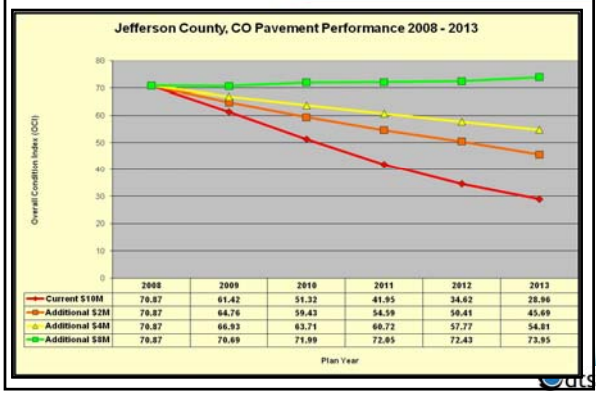
Budget Forecasting

- Budget Forecasting delivers a configurable multi-year capital improvement planning capabilities to help you determine your long term budget needs based on deterioration curves.
- 'What-if' budget scenarios can be created by adjusting budgets, project types, and prioritization criteria.
- Using your criteria you can run the forecasting model to see if your budget is enough to meet your level of service goals.

Budget Forecasting



Budget Forecasting

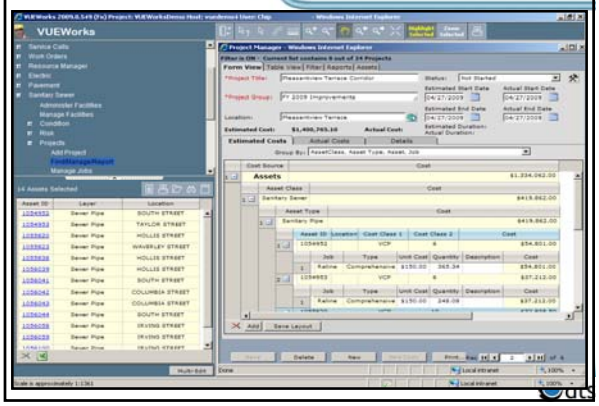


	2008	2009	2010	2011	2012	2013
Current $10M	70.87	61.42	51.32	41.95	34.62	28.96
Additional $2M	70.87	64.76	59.43	54.59	50.41	45.69
Additional $4M	70.87	66.93	63.71	60.72	57.77	54.81
Additional $8M	70.87	70.69	71.99	72.05	72.43	73.95

Project Planning

- Project Planning delivers capabilities to define projects, calculate estimated costs, group them for budgeting purposes and compare estimated costs with actual costs through integration with Work Orders.
- New features allow you to assign job costs for an entire asset, a portion of an asset, and/or multiple point repairs along an asset.
- Beyond what can be accomplished in a spreadsheet, Project Planning allows you to group and summarize projects hierarchically by asset class, asset type, and jobs through a simple interface.

Project Planning



Management Strategies

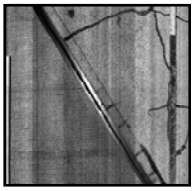
Collect
- Field Data Collection
- Imagery-Based Data Collection
- Mobile Data Collection

Update
- Historical Records
- Project-Level Data Collection
- Field Inspections

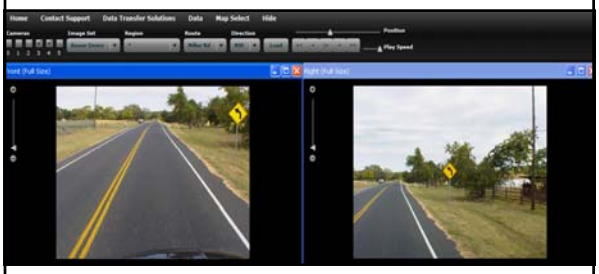
Maintain
- Standard Operating Procedures
- Preventative Maintenance Procedures
- Scheduled Network-Level Data Collection

Sign and Pavement Collection: Case Study

- Mobile Asset Collection Vehicle
  - LiDAR
  - Pavement Camera
  - Right-of-Way Cameras

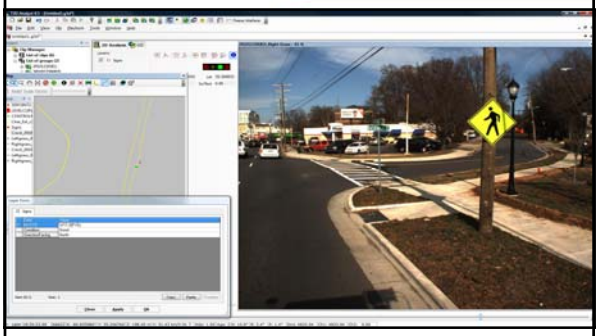


Data Collection



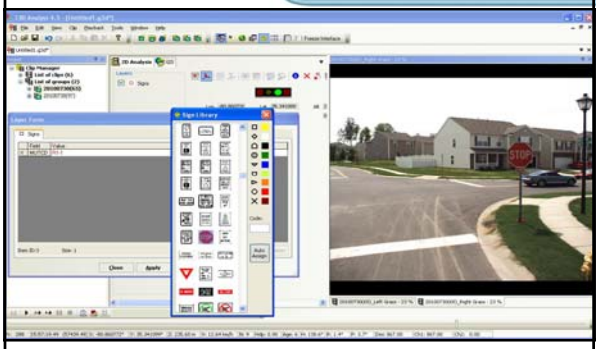
Sign Inventory

Data Extraction



Sub-Meter Accuracy

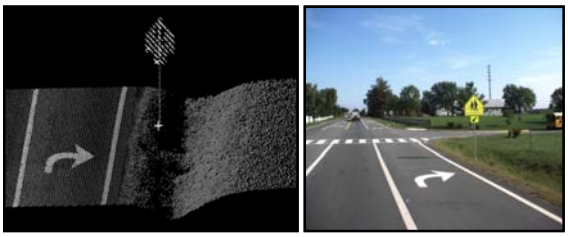
Data Extraction



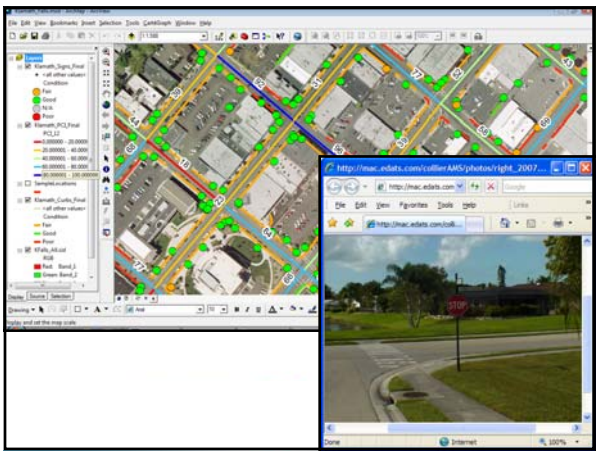
MUTCD Code Assignment

Sign Detection

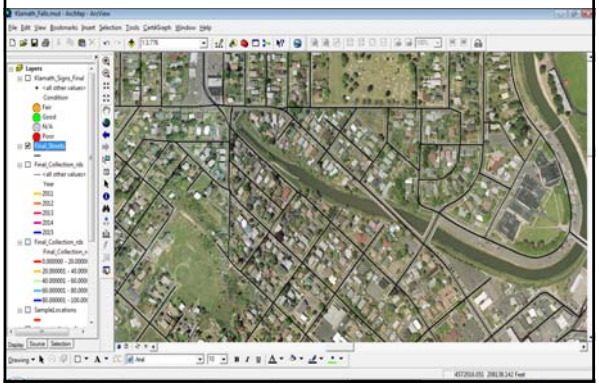
- Sign locations are analyzed through comparison to sign library, Imagery and LiDAR point cloud



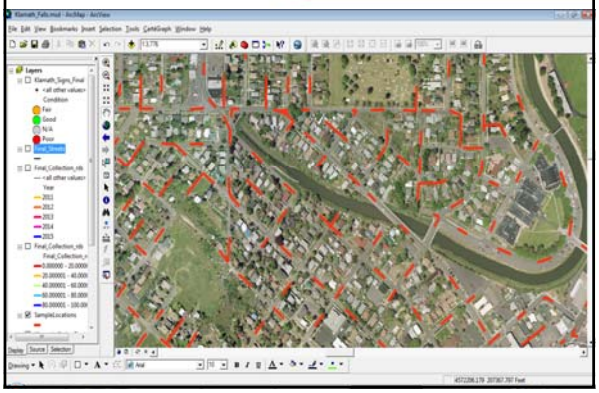
Sub-Inch Accuracy



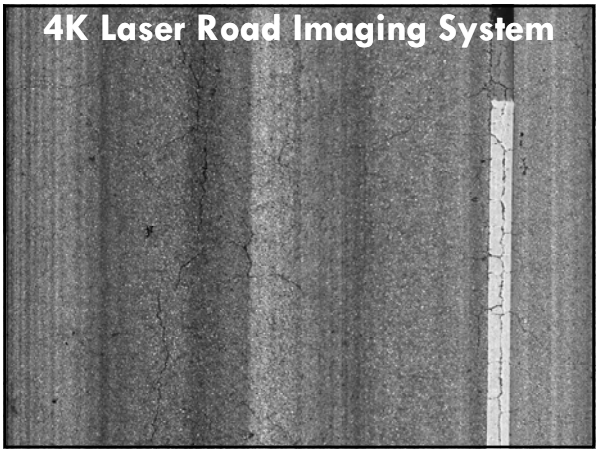
Step 1 – Identify Road Centerlines

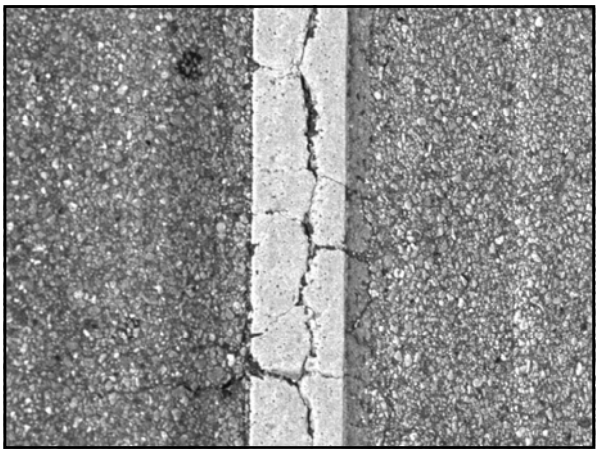


Step 2 – Set up Sample Areas



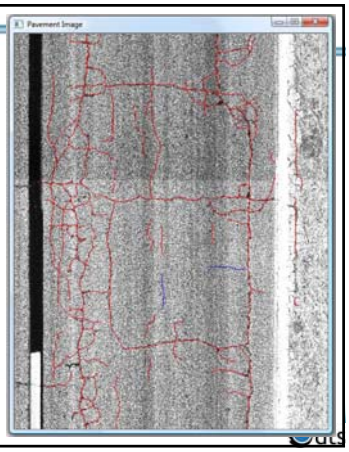
4K Laser Road Imaging System





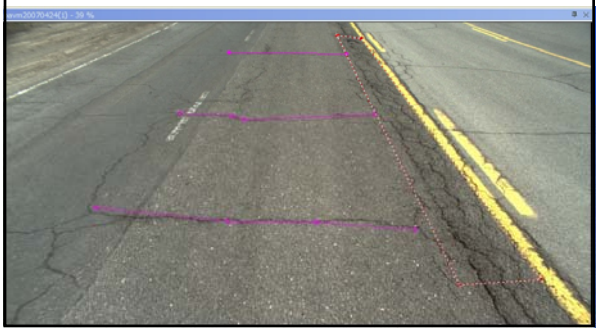
Automated Crack Detection

- Longitudinal
- Transverse
- Alligator Cracking



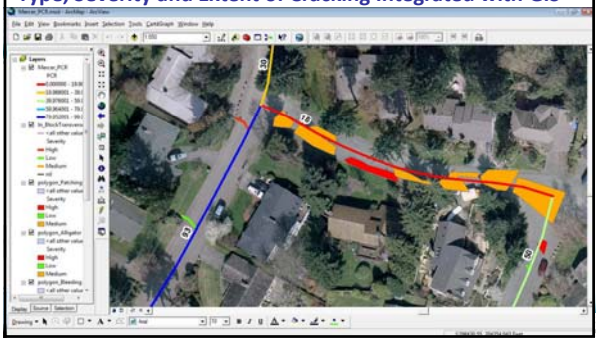
Accurate Measurements

- **High-Resolution Pavement Cameras (4K Line-Scan Camera)**
- **Cracking is Digitized in the Image**



Step 3 - Pavement Data Extraction

- **Digitized Cracks Integrated with GIS**
- **Type, Severity and Extent of Cracking Integrated with GIS**

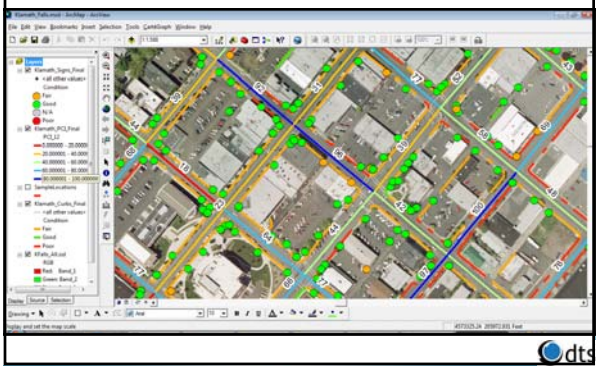


Step 4 – Calculate PCI

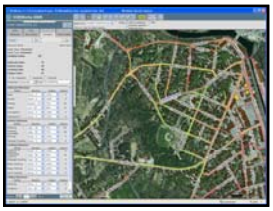
Pavement Rating Form

Distresses are measured in the field and the results are calculated in VUEWorks and linked to GIS

Step 5 – Link to GIS

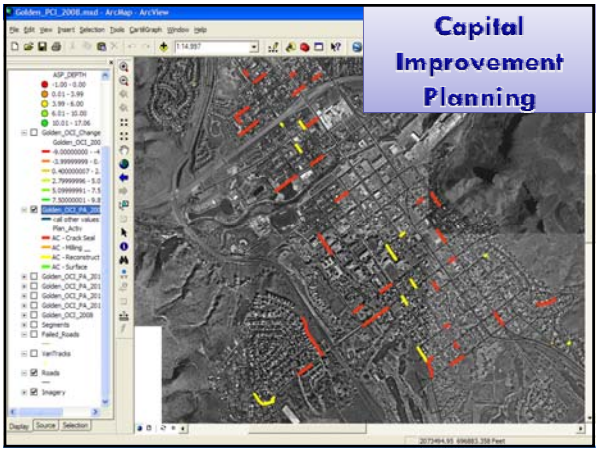


Step 6 – Integrate with PMS

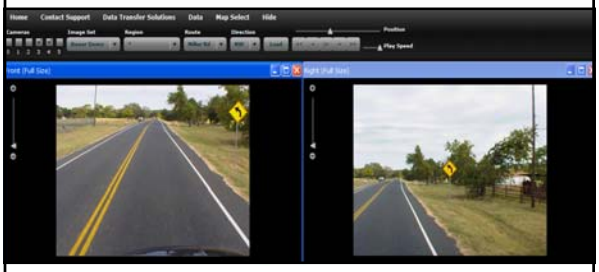


GIS data is directly linked to PMS for display and map-making capabilities.

PMS software is used to track details related to segments, maintenance, and inspections.



Step 7 – Link to Videologger



Case Study:
City of Charlotte, NC
Pavement Condition Rating Survey

Project Goals

- Provide a current pavement condition survey for all City maintained streets
- Provide a sidewalk inventory along all City maintained streets
- Input current pavement condition data into the City's Pavement Management Software – Hansen 8.0
- Deliver Right of Way Imagery in a video viewing application

Project Goals

- Inventory all Roads using Mobile Asset Collection (MAC) Vehicle
  - Left Camera
  - Right Camera
  - Pavement Camera
- Conduct Field Visual Assessment – MAC Vehicle
- Conduct Office Inspections using City-supplied PCR Deduct Values and Distress Types

Project Goals

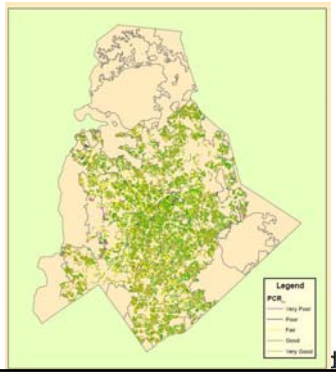
2,450 Centerline miles of Right of Way and Pavement Imagery Collected

2,014 miles of sidewalk Identified

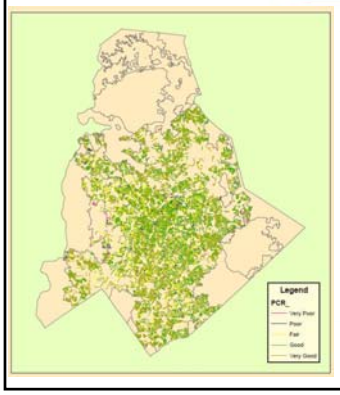
24, 590 Curb ramps Identified

2,007 Marked Crosswalks Identified

17,919 Unmarked Crosswalks Indentified



Data Collection



- **Request the most recent road centerline file.**
- **Verify with the agency that it is up-to-date and accurate.**
- **Preplan Optimal Routes for Collection.**
- **Start Data Collection.**

Data Attribution

Table 1

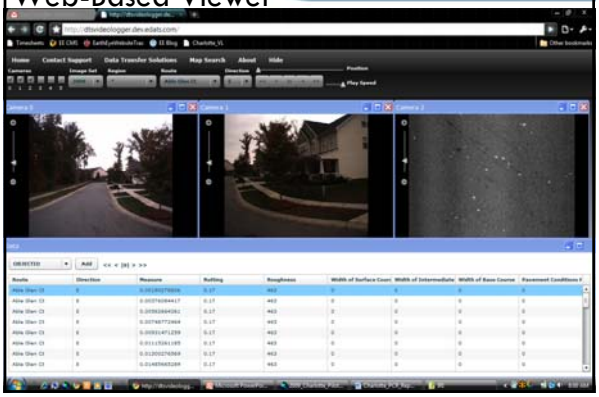
he street database will include the following fields:

Description	Obase Field Name	Access Field Name	Type
Fields Created for Data Collection			
Ownership of street segment	OWNERSHIP	OWNERSHIP	Character
Street Direction	D	DIRECTION	Character
Block number for street segment	BLOCK	BLOCK	Character
Name of the street	STREET	STREET_NAME	Character
Type of street (road, avenue, etc)	TP	TYPE	Character
Beginning description of Segment	BEG_DESC	BEGINNING	Character
Ending description of Segment	END_DESC	ENDING	Character
Type of pavement surface	P	PAVEMENT	Character
Number of lanes on segment	L	LANES	Numeric
Class of street (high or low volume)	CL	CLASS	Character
Length of street segment (feet)	LENGTH	LENGTH	Numeric
Width of street segment	WI	WIDTH	Numeric
Number of curbs on street segment	C	CURB	Numeric
Type of curb (if present)	CT	CURB_TYPE	Character
Distress type – % Big Alligator	AN	ALIG_NONE	Numeric
Distress type – % Light Alligator	AL	ALIG_LIGHT	Numeric
Distress type – % Moderate Alligator	AM	ALIG_MOD	Numeric
Distress type – % Severe Alligator	AS	ALIG_SEVERE	Numeric
Distress type – Block Cracking	BK	BLOCK_CRACK	Character
Distress type – Reflective Cracking	RF	REF_CRACK	Character
Distress type – Rutting	RT	RUTTING	Character
Distress type – Bleeding	WV	WAVELING	Character
Distress type – Bleeding	BL	BLEEDING	Character
Distress type – Ride Quality	RQ	RIDE_QUALITY	Character
Distress type – Patching	PA	PATCHING	Character
Number of utility cuts	UC	UTILITY_CUTS	Character
Height of asphalt above C&G (inch)	ASPHALT_HT	ASPHALT_HT	Character
Handicap Ramps Needed	HR	HANDICAP_RAMPS	Character
% of sidewalk on left side of street	LTSIDEPCT	SIDEWALK_LT	Character
% of sidewalk on right side of street	RTSIDEPCT	SIDEWALK_RT	Character
Identifies curb & gutter on left side	CG_LT	CURB_LEFT	Character
Identifies curb & gutter on right side	CG_RT	CURB_RIGHT	Character
Identifies one way streets	ONE_WAY	ONE_WAY	Character
Segments that are divided by median	DIVIDE	DIVIDED	Character
Severity of crack widths for block cracking	CRK_WIDTH	CRACK_WIDTH	Numeric
Identifies segments that have been C.S.	CRACK_SEAL	CRACK_SEAL	Character
Number of speed bumps per segment	SP_HUMPS	HUMPHUMPS	Numeric
Identifies type of roadway fence	HI_TYPE	HI_MIPTYPE	Numeric
Shoulders (Lane or Bike)	SHLD	SHOULDER	Character
Pavement Markings (Yes or no)	MARK	MARKINGS	Character
Additional comments for segment	COMMENTS	COMMENTS	Character
Date segment was surveyed	SURVEYDATE	SURVEYDATE	Date
Previous PCR rating for segment	RATING_PRE	RATING_PRE	Numeric
Fields Created by PMS Program			
Mileage Length	Miles	Miles	Numeric
PCR rating for segment	RATING	RATING	Numeric
Square yards of segment	SEG_SY	SEGMENT_SY	Numeric
SY of full depth patching (severe)	PAF_SY	FDP_PATCH_SY	Numeric
SY of skin patching (moderate)	PAF_SY_MOD	SK_PATCH_SY	Numeric
Primary maintenance activity	ACTIVITY	MAINT_ACTIVITY	Character
Priority of primary maintenance activity	PRIORITY	PRIORITY	Character
Cost of primary maintenance activity	ACT1_COST	ACT1_COST	Numeric
Secondary maintenance activity	ACTIVITY2	ACTIVITY2	Character
Cost of secondary maintenance activity	ACT2_COST	ACT2_COST	Numeric
Total cost of maintenance on segment	TOTAL_COST	TOTAL_COST	Numeric
Cost per mile	COST_MILE	COST_MILE	Numeric

- **Attributes to be collected based on the City's existing Pavement Management System Data Model**
- **Supplied by the City**
- **Over 30 Attributes Identified with Right-of-Way and Pavement Imagery**
- **Domains and Subtypes preserved during the data extraction process**
- **QA/QC enforced during the extraction workflow**

Project Goals

Web-Based Viewer



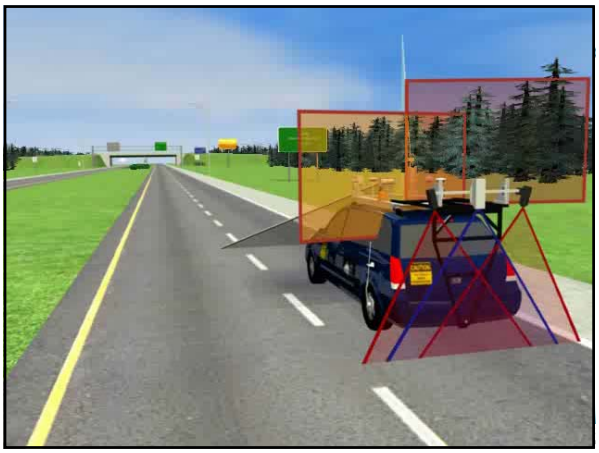
Technology Used

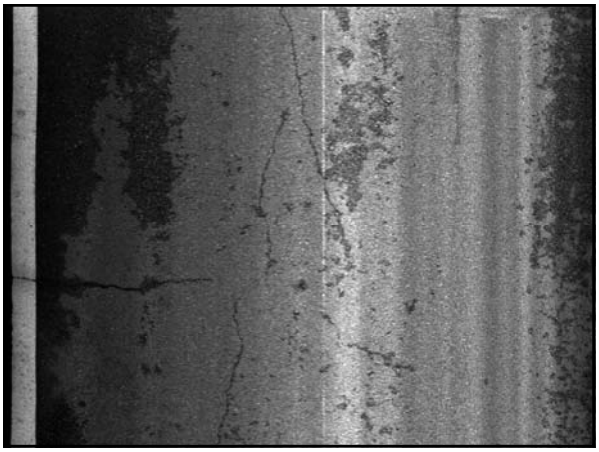
Equipment features on the MAC vehicle include:

- 2 High-Resolution Right-of-Way digital cameras- Grasshoppers
- Downward-Facing Line Scan Camera –high-resolution (4096 pixels per scan, 28000 lines/sec) Illumined pavement imagery
- Applanix POS 220 Inertial Measuring Unit (IMU) – Allows for centimeter-level positioning of the vehicle during data collection
- GPS Equipment - Used for precise positioning of the vehicle, heading information and positional tagging of images
- Server – Used for storing data, processing of imagery, GPS, and IMU data on-the-fly.

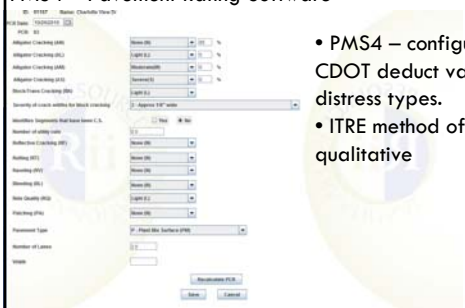
Pavement Camera

- Downward-Facing, Laser Illuminated, Linescan Camera





PMS4 – Pavement Rating Software

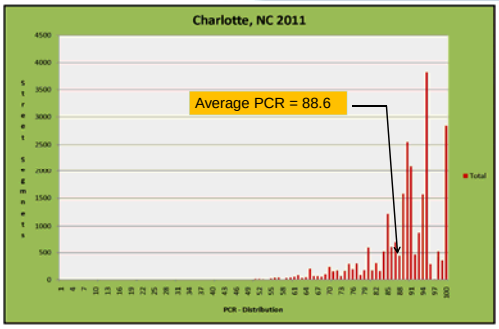


- PMS4 – configured to for CDOT deduct values and distress types.
- ITRE method of analysis - qualitative

Deduct Values/Distress Types

Pavement Distress	None (N)	Light (L)	Moderate (M)	Severe (S)
Alligator Cracking (AL,AM,AS)	0	25	60	99
Block/Trans Cracking (BK)	0	5	20	35
Reflective Cracking (RF)	0	5	10	20
Rutting (RT)	0	5	15	25
Raveling (RV)	0	5	25	35
Bleeding (BL)	0	5	15	25
Ride Quality (RQ)	-	0	10	25
Patching (PA)	0	5	10	15

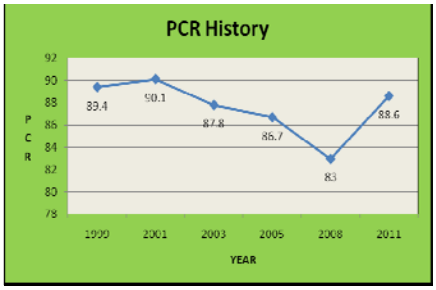
Results



Results

Condition	PCR
Poor	3%
Fair	11%
Good	34%
Very Good	52%

Results



Results

Pavement Maintenance Operations

	Low Volume Streets			High Volume Streets		
Pavement Distress	Light (L)	Moderate (M)	Severe (S)	Light (L)	Moderate (M)	Severe (S)
Alligator Cracking (AL)	None	4" Skin Patch	4" Full-Depth Patch	None	8' Skin Patch	8' Full- Depth Patch
Block/Trans Cracking (BK)	None	Crack Sealing	1" PM Resurfacing and BST Seal	None	1.5" PM Resurfacing	1" PM Resurfacing and BST Seal
Reflective Cracking (RF)	None	Crack Sealing	1.5" PM Resurfacing	None	1.5" PM Resurfacing	1.5" PM Resurfacing and BST Seal
Rutting (RT)	None	None	1" PM Resurfacing	None	1.5" PM Resurfacing	1.5" PM Resurfacing
Raveling (RV)	None	1" PM Resurfacing	1" PM Resurfacing	None	1.5" PM Resurfacing	1.5" PM Resurfacing
Bleeding (BL)	None	None	1" PM Resurfacing	None	None	1.5" PM Resurfacing
Ride Quality (RQ)	None	None	1" PM Resurfacing	None	None	1.5" PM Resurfacing
Patching (PA)	None	None	1" PM Resurfacing	None	None	1.5" PM Resurfacing

Lessons Learned

•Request the most current Road Centerline file at the Project Kickoff meeting to be used for the image collection

•No matter what time of day you drive, canopy roads just do not provide optimum light - educate the client on light conditions when collecting

•High Density of Neighborhoods = slow collection rates

•A curb is just a curb – get agreement on what types of features are to be extracted and the correct name of the feature from the client

Contact Information

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aibaugh@dtsgis.com

Thank You!

Questions?