ASSET MANAGEMENT in the Water and Wastewater Industry

Fundamentals of Asset Management

Robert Secrest, P.E.

Registered Professional Civil Engineer

Utilities Manager – Asset Management Group

Speaker Bio

20 years experience in asset management and civil engineering

- Master of Business Administration, MBA
- Registered Professional Civil Engineer, P.E.
- Project Management Professional, PMP
- Leadership in Energy and Environmental Design Accredited Professional, LEED A.P.
- Qualified SWPPP Developer, QSD
- Certified Cost Engineer, CCE
- Chartered Financial Analyst Level 1 Candidate, CFA
- Certified Lean Six Sigma Black Belt, LSSBB

Outline

Asset Management

- Purpose, benefits
- Process lifecycle
- Maturity models
- Leverage Technology

“Campus Main Break” NBC News July 2014

What happened?

Facts:

- 10 Million gallons lost
- 3.5 hours to isolate
- Damages – millions

Why 3.5 hours to isolate

- Leverage GIS – RFID
- Condition assessment
- Manage risk

Figure 5: Average Estimated Service Lives by Pipe Materials (average years of service)

Derived Current Service Lives (Years)	CI	CICL (LSL)	CICL (SSL)	DI (LSL)	DI (SSL)	AC (LSL)	AC (SSL)	PVC	Steel	Conc & PCCP
Northeast Large	130	120	100	110	50	80	80	100	100	100
Midwest Large	125	120	85	110	50	100	85	55	80	105
South Large	110	100	100	105	55	100	80	55	70	105
West Large	115	100	75	110	60	105	75	70	95	75
Northeast Medium & Small	115	120	100	110	55	100	85	100	100	100
Midwest Medium & Small	125	120	85	110	50	70	70	55	80	105
South Medium & Small	105	100	100	105	55	100	80	55	70	105
West Medium & Small	105	100	75	110	60	105	75	70	95	75
Northeast Very Small	115	120	100	120	60	100	85	100	100	100
Midwest Very Small	135	120	85	110	60	80	75	55	80	105
South Very Small	130	110	100	105	55	100	80	55	70	105
West Very Small	130	100	75	110	60	105	65	70	95	75

LSL indicates a relatively long service life for the material resulting from some combination of benign ground conditions and evolved laying practices etc.
SSL indicates a relatively short service life for the material resulting from some combination of harsh ground conditions and early laying practices, etc.

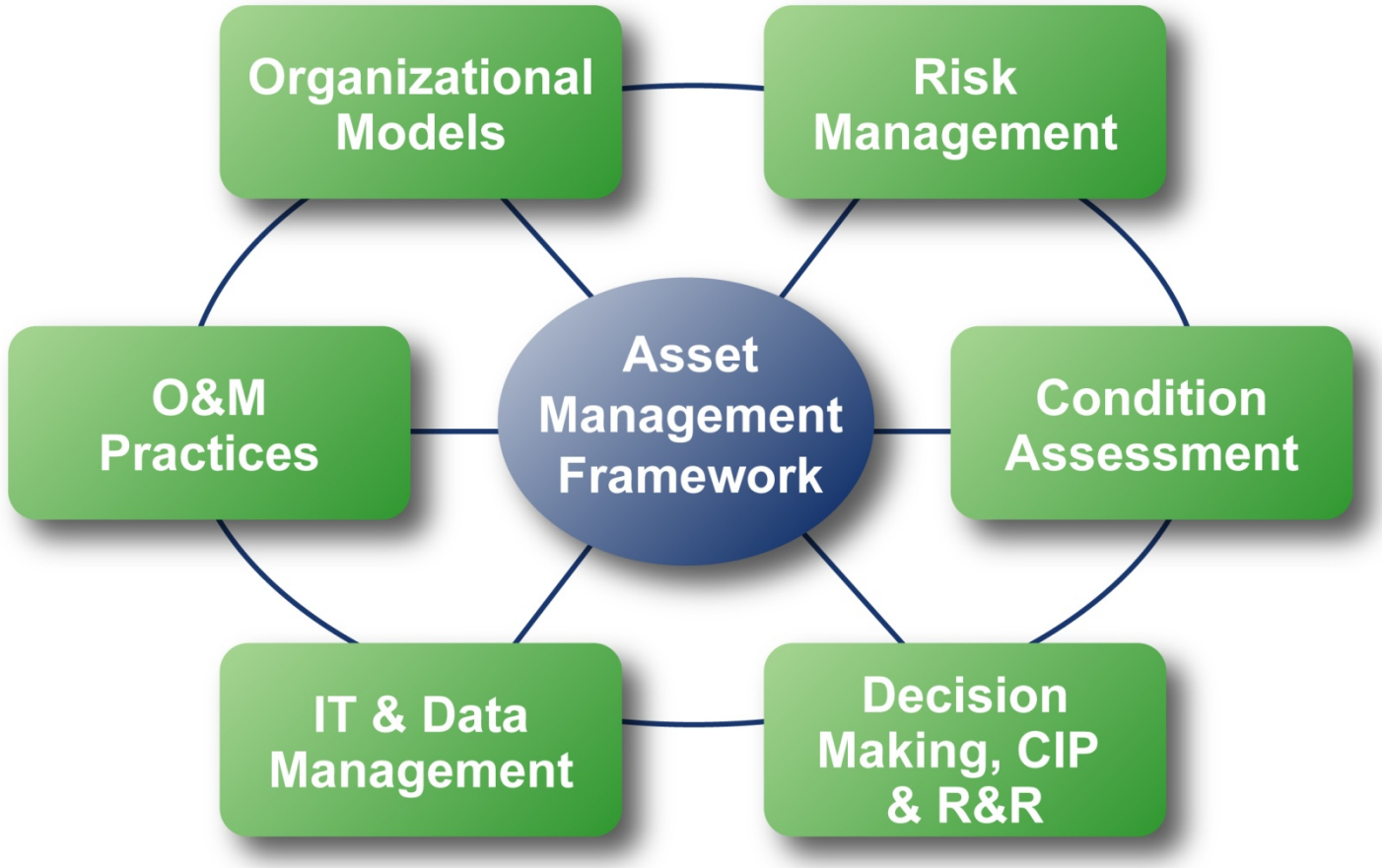
"Buried No Longer: Confronting America's Water Infrastructure Challenge" – AWWA Publications

Asset Management

Definition

Purpose

Benefits



What is Asset Management?

Asset Management

”Asset management is a systematic process of maintaining, upgrading, and operating physical assets cost-effectively. It combines engineering principles with sound business practices and economic theory, and it provides tools to facilitate a more organized, logical approach to decision-making. Thus, asset management provides a framework for handling both short- and long-range planning.”

Asset Management: Advancing the State of the Art Into the 21st Century Through Public-Private Dialogue, FHWA and AASHTO, 1996

Purpose

Asset Management programs are defined as asset management services designed to reduce the total cost of ownership through objective-based condition assessment and financial analysis, using a standardized methodology and software.

Manage risk

Improves transparency

Communicate requirements

Maintain level of service

Benefits

Service Level

Share information

Improve condition

Minimize outages

Reactive to preventative

Financial

Rehab prior to failure

Helps prioritize

Justify financial plans

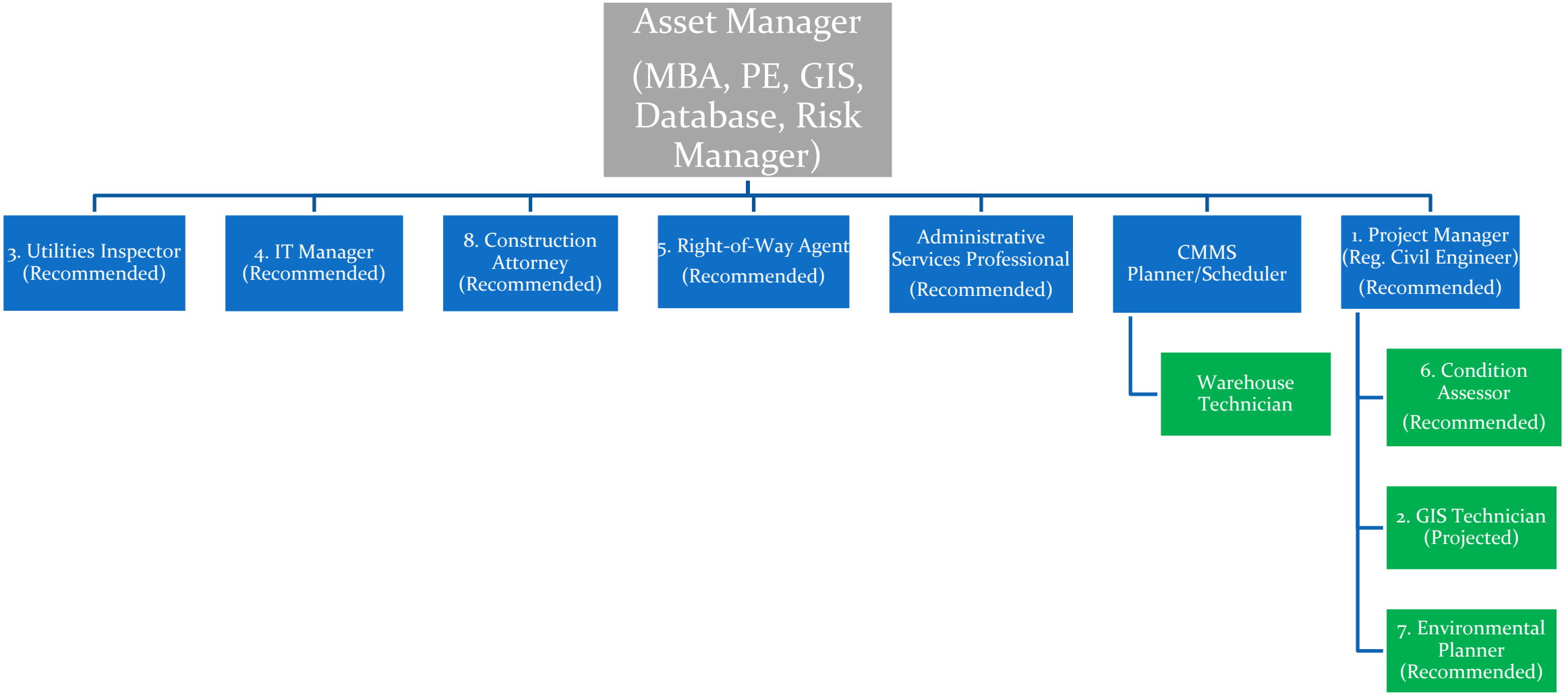
Extends useful life

Systematic decision-making

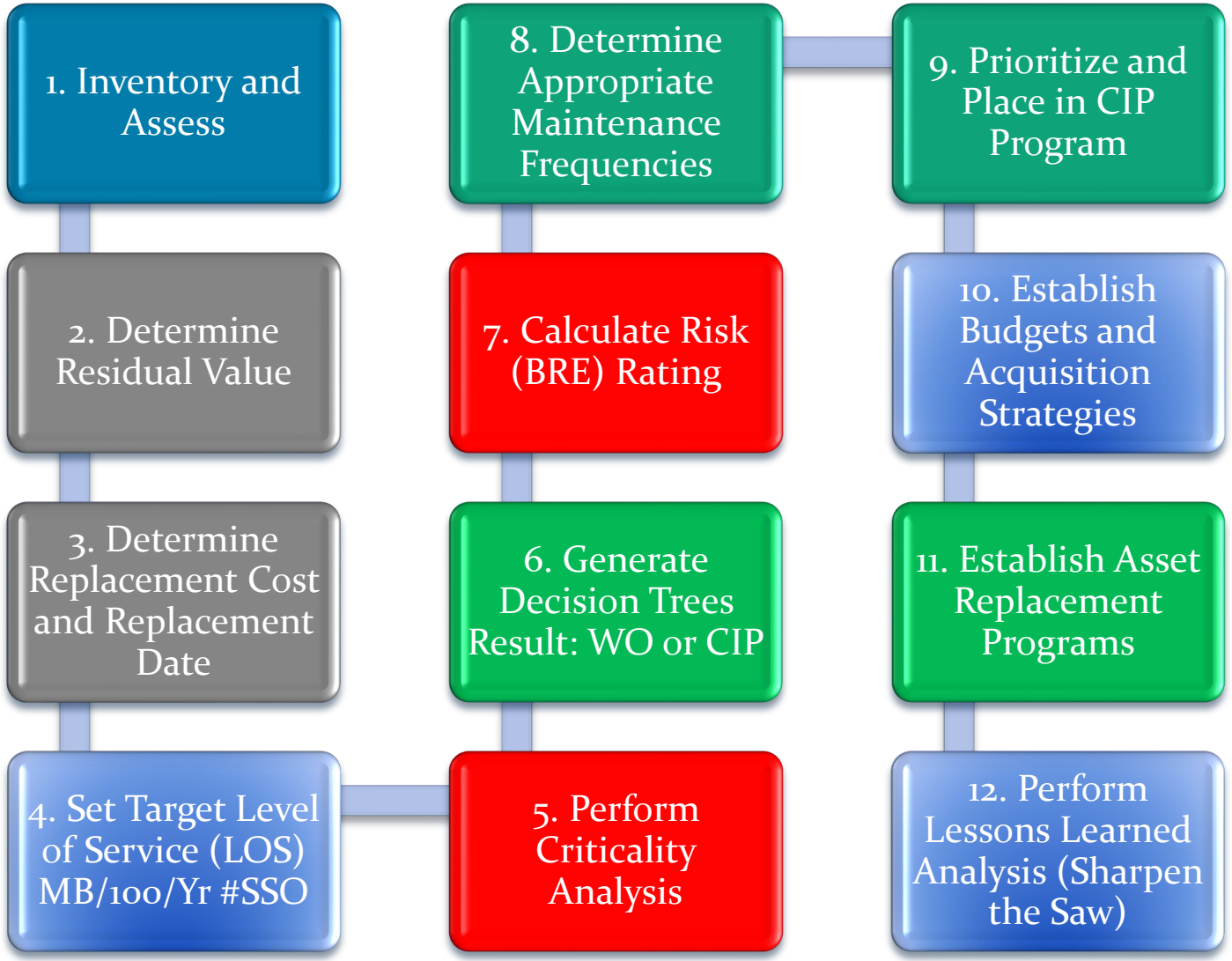
Systems Overview
Carlsbad

Asset Management Program Development

Organizational Chart



Process Steps



Key Components

Inventory

Risk Assessment

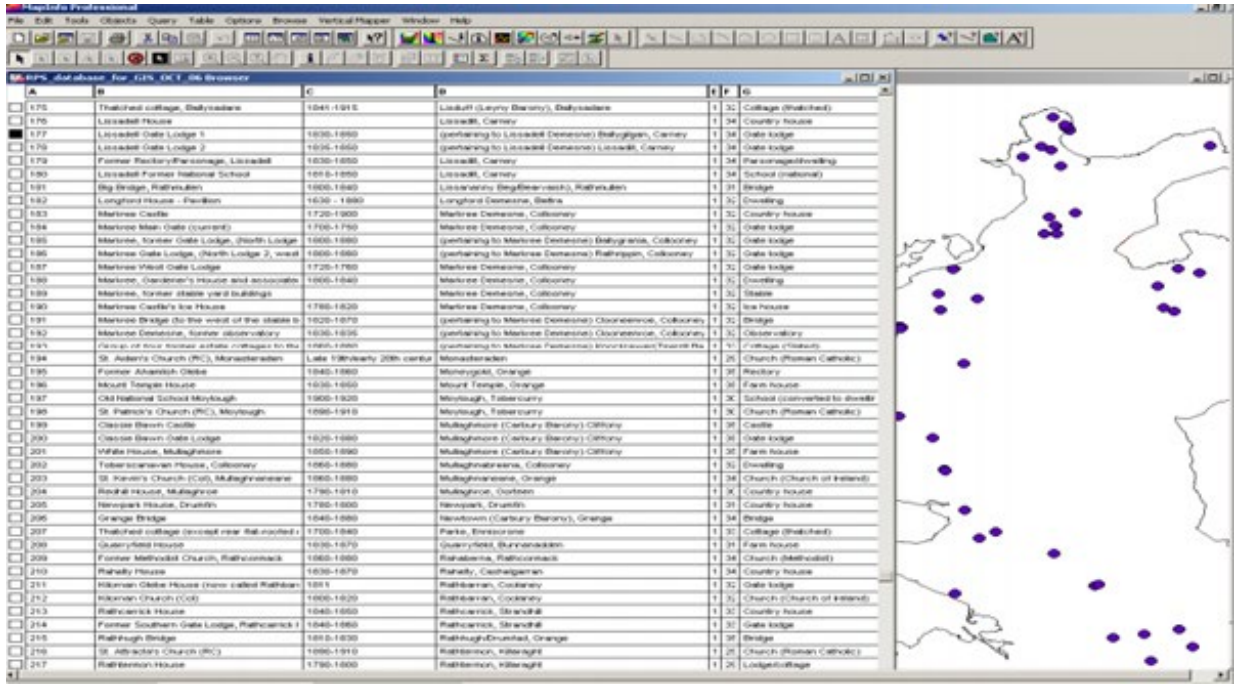
Condition Assessment

Data Analysis

Action

Inventory

- ✓ What do I own
- ✓ What is the value
- ✓ How long is it designed to last



Risk Assessment

Purpose

Identify assets that present the greatest risk

Identify and prioritize assets for condition assessment

Results

Prioritize projects to optimize use of limited resources

Provides systematic risk-based mitigation strategies

Consequence of Failure (CoF)

Scores

Scale: 1 – 10 10 = highest impact

Based upon

Triple bottom line impacts

- Environmental
- Economic
- Social/Community

Triple Bottom Line

Environmental

- Spill/flood/Odor
- Permit Compliance

Economic

- Financial
- Economic

Social/Community

- Loss of Service
- Safety
- Agency Image

Condition Assessment

- ✓ Repeatable
- ✓ Verifiable
- ✓ Auditable
- ✓ Trainable

Condition Assessment

Water Assets

- Valves
- Mains
- Tanks
- Facilities

Wastewater Assets

- Gravity mains
- Access holes
- Force mains
- Lift stations

Condition Assessment

Water

Valve Maintenance (AWWA M44)

Description	Frequency
Critical Valves	12 months
Transmission Mains	48 months
Distribution Mains	36 months

Condition Assessment

Water (future AWWA M77)

- Mains
  - Leak detection program
  - CCTV and other
- Tanks
  - CCTV – visual
  - Non – destructive testing

Condition Assessment

Wastewater

Gravity Mains – CCTV

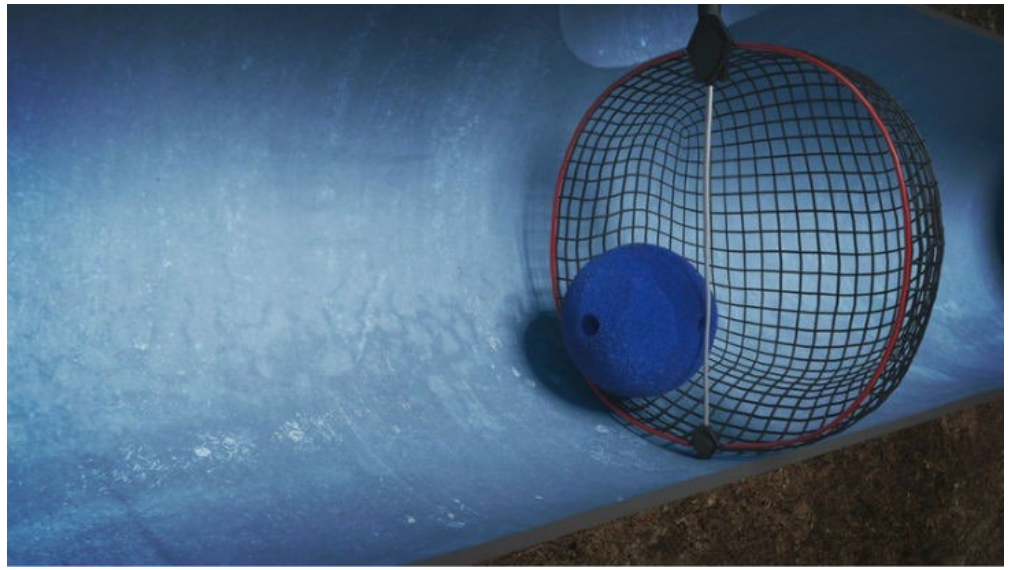
Description of Area	Frequency of CCTV
Steep slopes, new infrastructure	36 months
Older areas, new infrastructure	24 months
Older areas, small diameter, relatively low slope	12 months
Older areas, fats, oils, grease (FOG) issues, relatively low slope	12 months

Condition Assessment

Wastewater

Access holes – crews

Force mains – consultants



Condition Assessment

Facility Assets

- Buildings
  - Exterior/Roofing
  - Electrical/Mechanical
  - Plumbing/Fire protection
  - Structural/Architectural

Transportation Assets

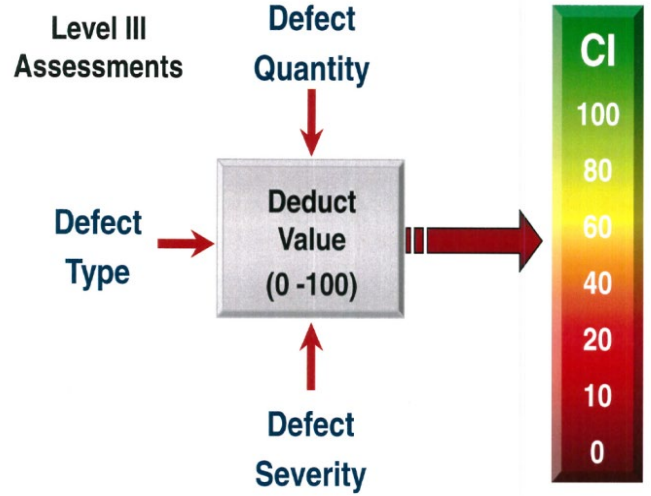
- Pavement/Street lights

Goal: Condition Assessment activities deliver condition scores

Condition Scores

Condition Scores

Scale: 1 – 10 10 = failed



Based upon:

General assessment– age, condition, visual

Level III: Detailed assessment– quantity and severity of defects

Next: Convert Condition Scores to Probability of Failure (PoF)

Condition Scores converted to PoF

Element	1	3	5	7	9	10
Technical Performance	Substantially exceeds current requirements	Exceeds current requirements	Meets current requirements but with room for improvement	Obvious concerns; cost/benefit questions	Inefficient; becoming ineffective, obsolete	Failing; not capable of sustaining required performance
Operational Performance	Negligible attention required	Exceeds current requirements	Meets current requirements but with room for improvement	Obvious concerns; costs/benefits questions	Difficult to sustain performance	Failing; not capable of sustaining required performance
Reliability	As specified by manufacturer	Infrequent breakdown	Occasional breakdown	Periodic Breakdown	Continuous recurrent breakdown	Virtually inoperable
Availability	Virtually always operational	Out of service only for very short periods	Out of service for moderate period; moderately difficult to return to service	Increasingly difficult to return to service; parts becoming a challenge	Extensive downtime duration; difficult to return to service; parts difficult to acquire, rare skills required	Virtually impossible to return to service; parts no longer available trained personnel
Maintainability	Easily maintained; OEM maintenance is straightforward	Largely preventive maintenance with some corrective maintenance beginning to show up; baseline monitoring	Increasing minor maintenance required; periodic corrective maintenance including some repair shortening of monitoring intervals	Scheduled maintenance becoming frequent; more experienced trades people required for maintenance; frequency of work orders increasing substantially with short monitoring	Work orders well above average for type of asset; recurrent minor repair; close monitoring required; most senior people required to sustain performance	Maintenance is frequent with recurrent patterns of failure; asset must be virtually constantly monitored to sustain performance
% Physical Life Consumed	Almost new; up to 10% consumed	Up to 30% consumed	Up to 50% consumed	Up to 70% consumed	Up to 90% consumed	Virtually completely consumed, imminent failure
Condition Score	1	3	5	7	9	10
Probability of Failure	0.1	0.3	0.5	0.7	0.9	0.99

Business Risk Exposure

Probability of Failure (PoF) **X** Redundancy Factor **X** Consequence of Failure (CoF) **=** Risk Score (BRE)

Remaining Useful Life

Adjust for:
- Design Standard
- Construction Quality
- Material quality
- Operational history
- Maintenance History
- Operating environment

Consider:
- Failure Mode
- Condition, Reliability

Consider:
- Peak vs. average
- Failure mode
- Operating environment

Redundancy	Factor
Single	0.7
Multiple	0.5
Zero	1.0

Consider:
- Safety, health
- Environmental Impact
- Process criticality
- Repair cost
- Revenue impact

Analytics

Analytics

Analytics aspects

Risk matrix

Maintenance strategies

Failure modes and effects analysis, FMEA

Life cycle costs – penalty costs

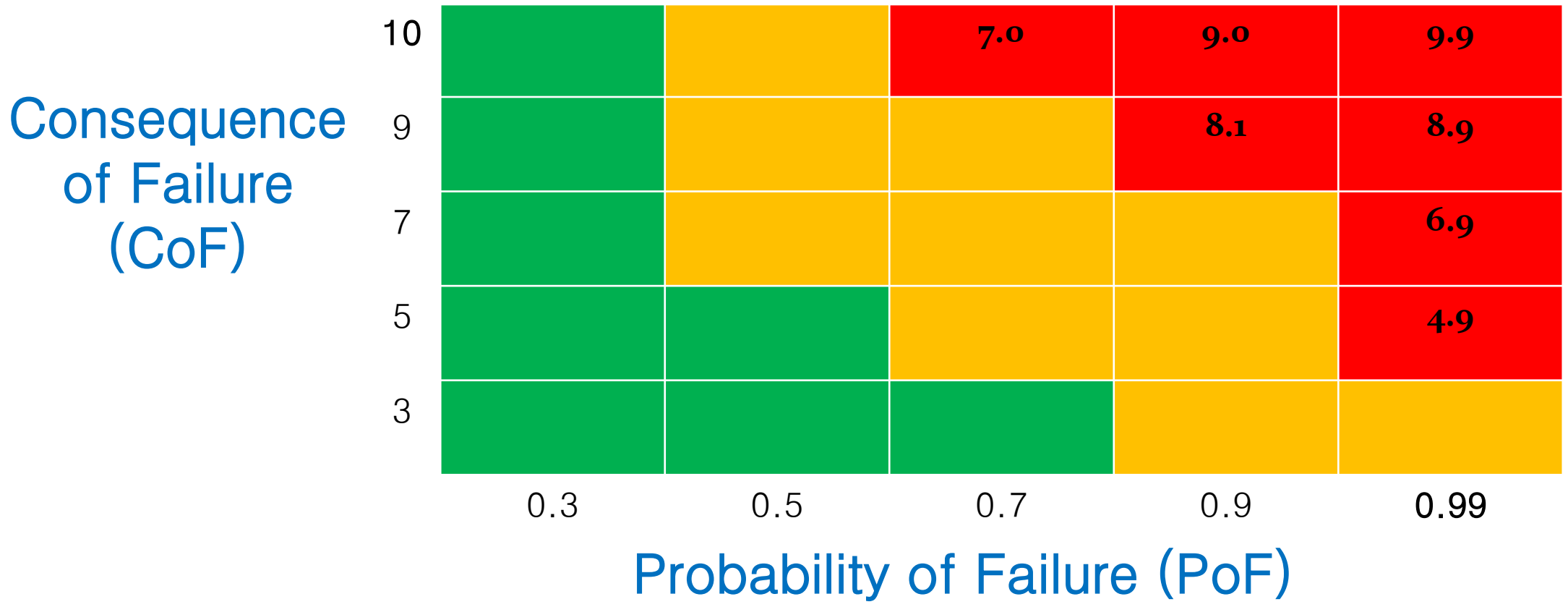
Decision logic trees

Analytics to action

Analytics

- ✓ Automation and optimization
- ✓ Budget and/or staff constrained
- ✓ Multiple what-if scenarios
- ✓ Return on investment
- ✓ Risk assessment

Risk Matrix


Consequence of Failure (CoF)
10
9
7
5
3
7.0
9.0
9.9
8.1
8.9
6.9
4.9
0.3
0.5
0.7
0.9
0.99
Probability of Failure (PoF)

Maintenance

Reactive

Not recommended

Preventative – CMMS

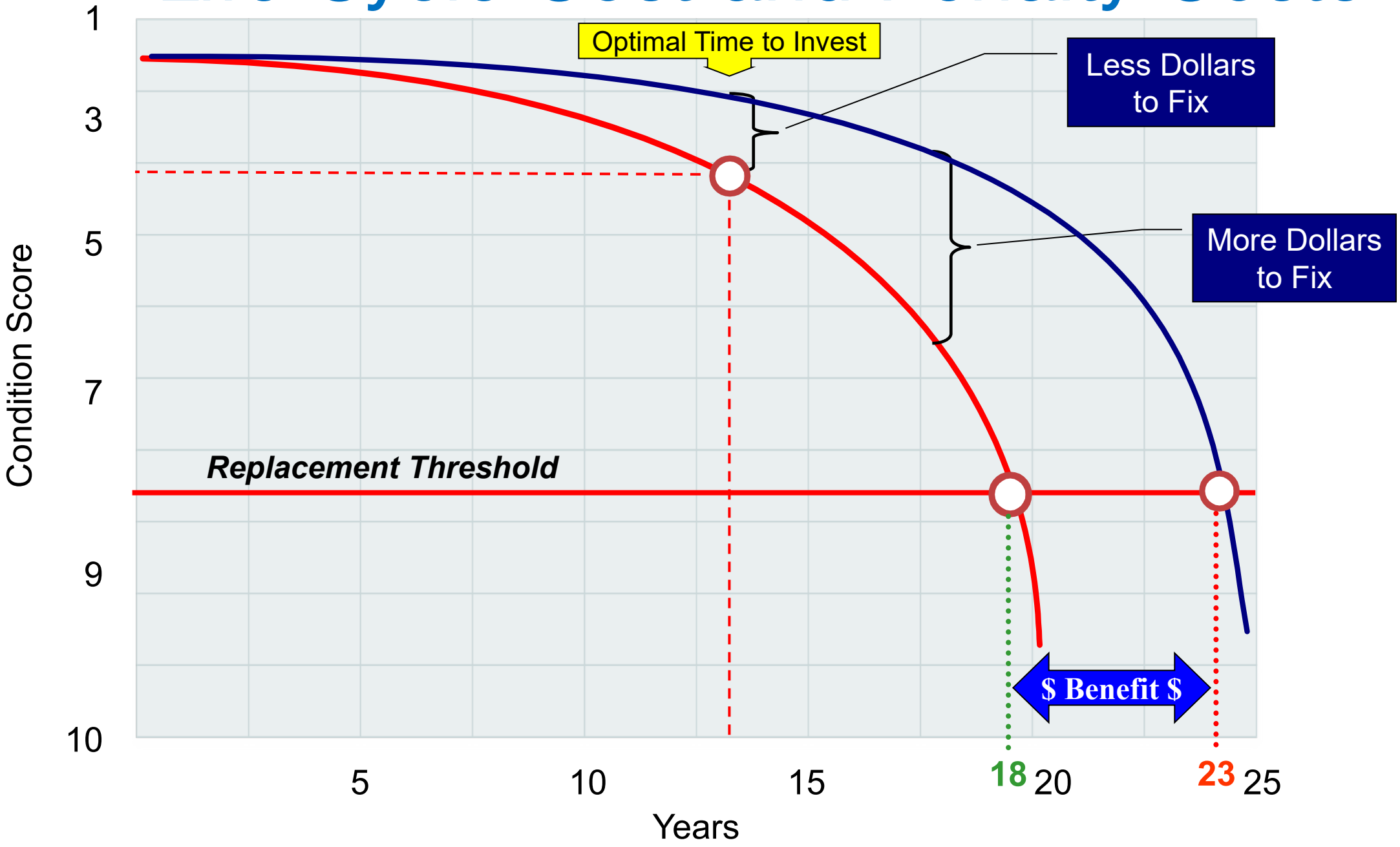
Activities scheduled and carried–out to protect and prevent deterioration

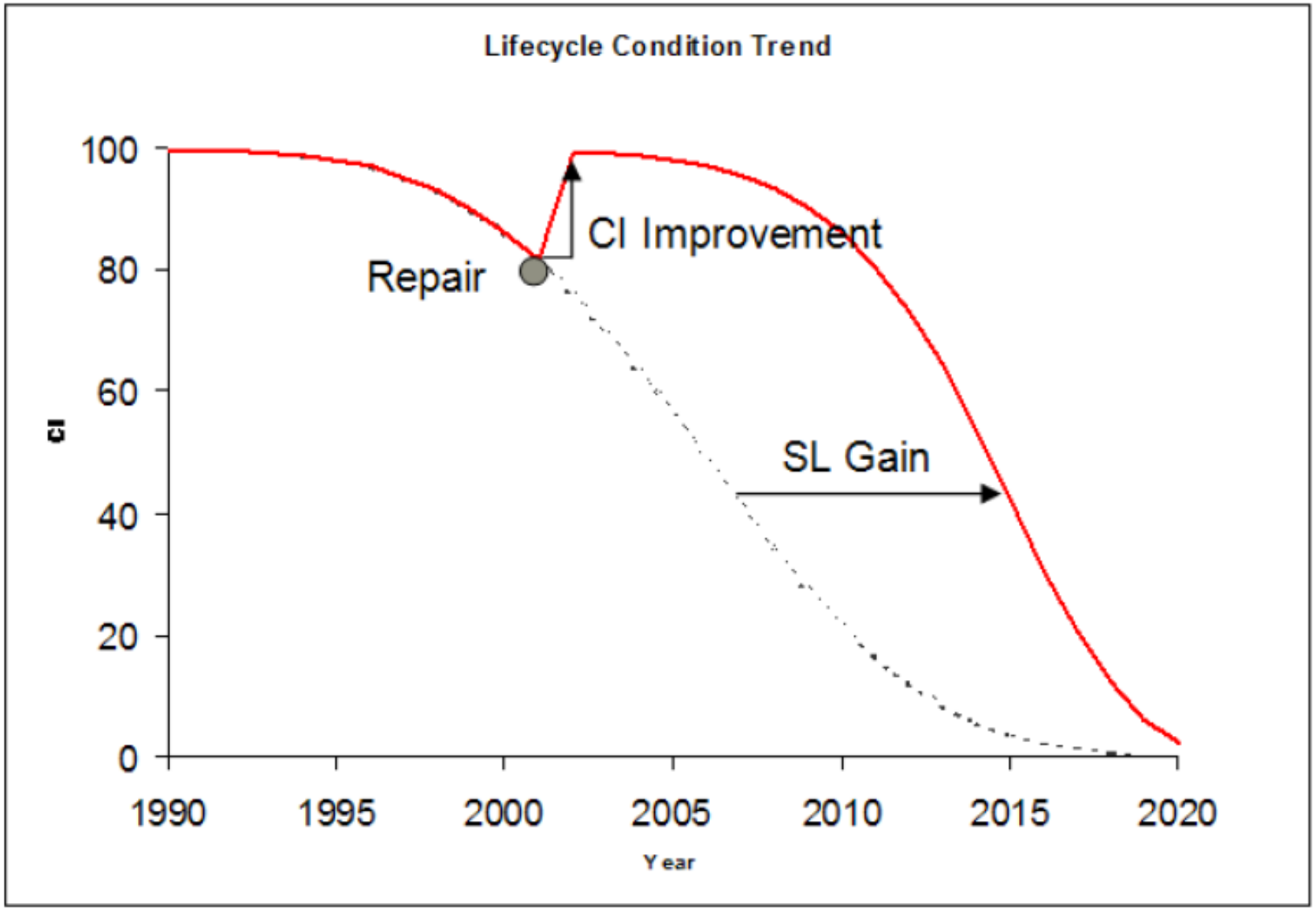
Predictive – SCADA

Activities scheduled after observing signs of deterioration or impending failure

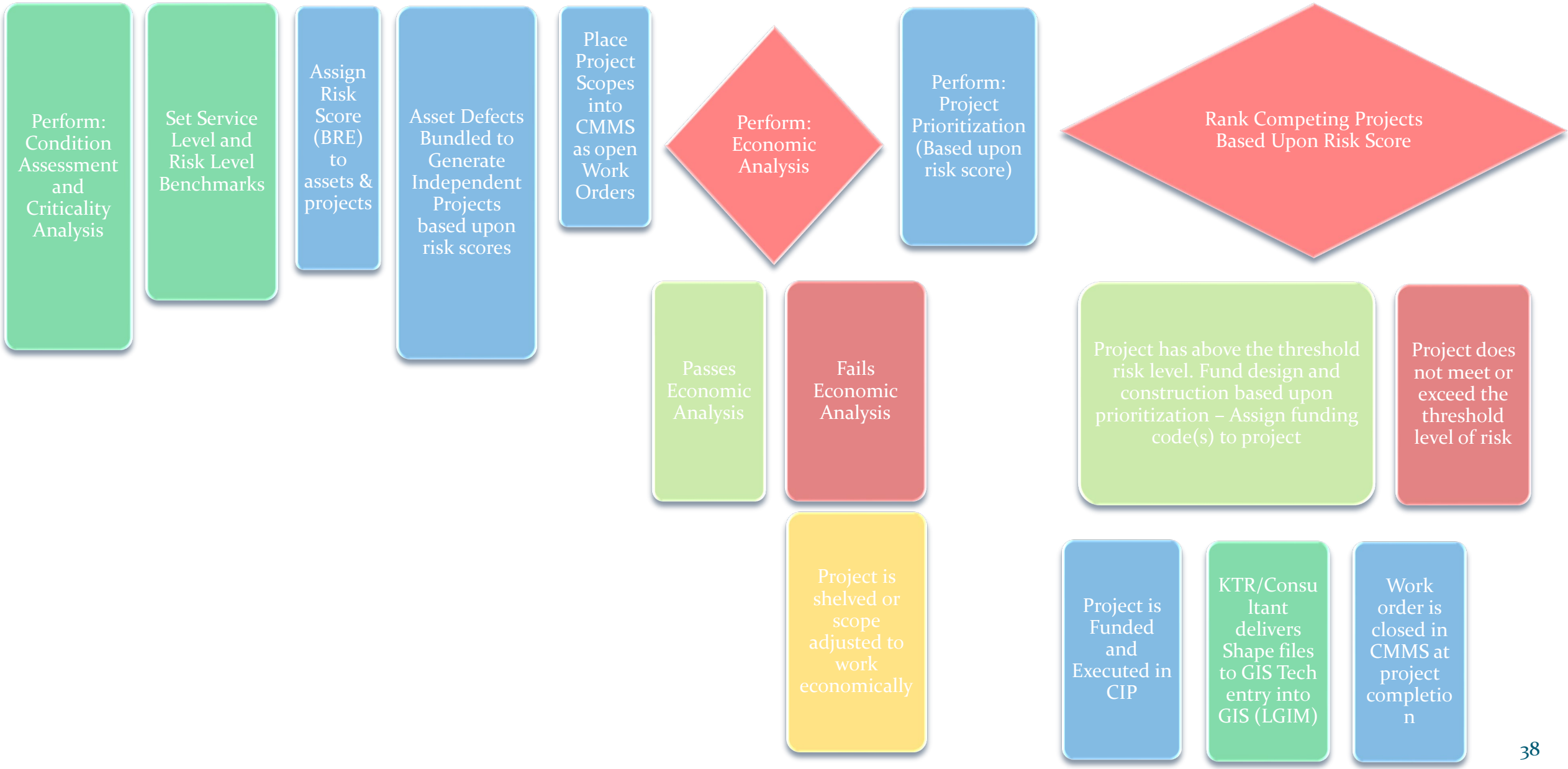
Failure Mode and Effects Analysis (FMEA)	***Definition***	***Tactical Aspects***	***Management Strategy***
Capacity (Operational Failure)	Volume of demand exceeds design or operational capacity	Growth, system expansion	Redesign
Level of Service (Operational Failure)	Functional requirements exceed design capacity	Codes & permits: NPDES, Breaks/100 miles/year, SSOs, outages, OSHA, noise, odor, life safety, service, etc.	O&M optimization renewal
Mortality (Structural Failure)	Consumption of asset reduces performance below acceptable level. End of useful life	Physical deterioration due to age, usage, (including operator error), corrosion, environment, or nature	O&M optimization renewal
Financial Efficiency	Operations costs exceed that of feasible alternatives	Payback period	Replace

Life Cycle Cost and Penalty Costs




Lifecycle Condition Trend
100
80
60
40
20
0
CI
Repair
CI Improvement
SL Gain
1990
1995
2000
2005
2010
2015
2020
Year

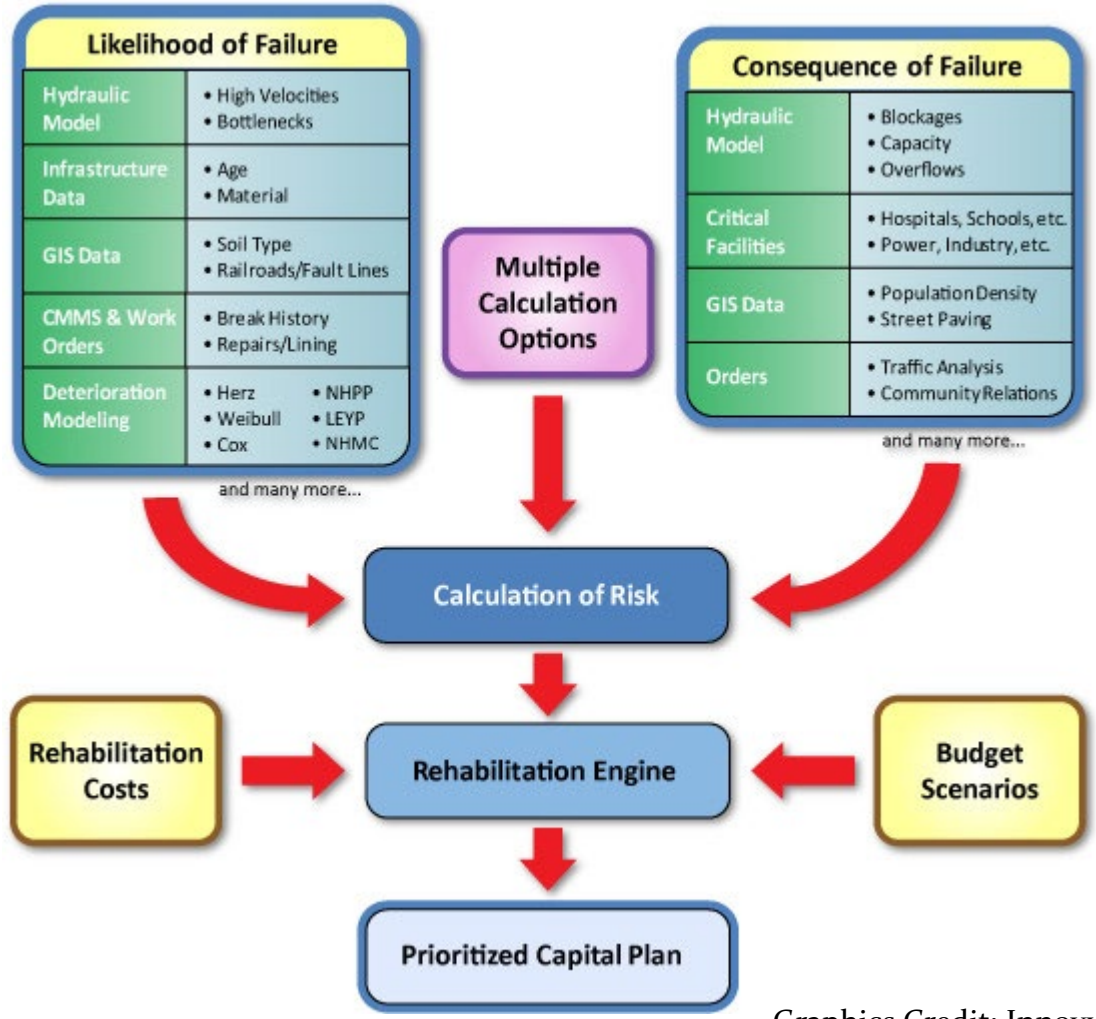
Capital Projects Decision Logic Network



Analytics to Action

Analytics program

- Shape files – layers
  - Sensitive customers
  - Soils
  - Streets moratorium
  - Main break
  - Models
  - Leak logger



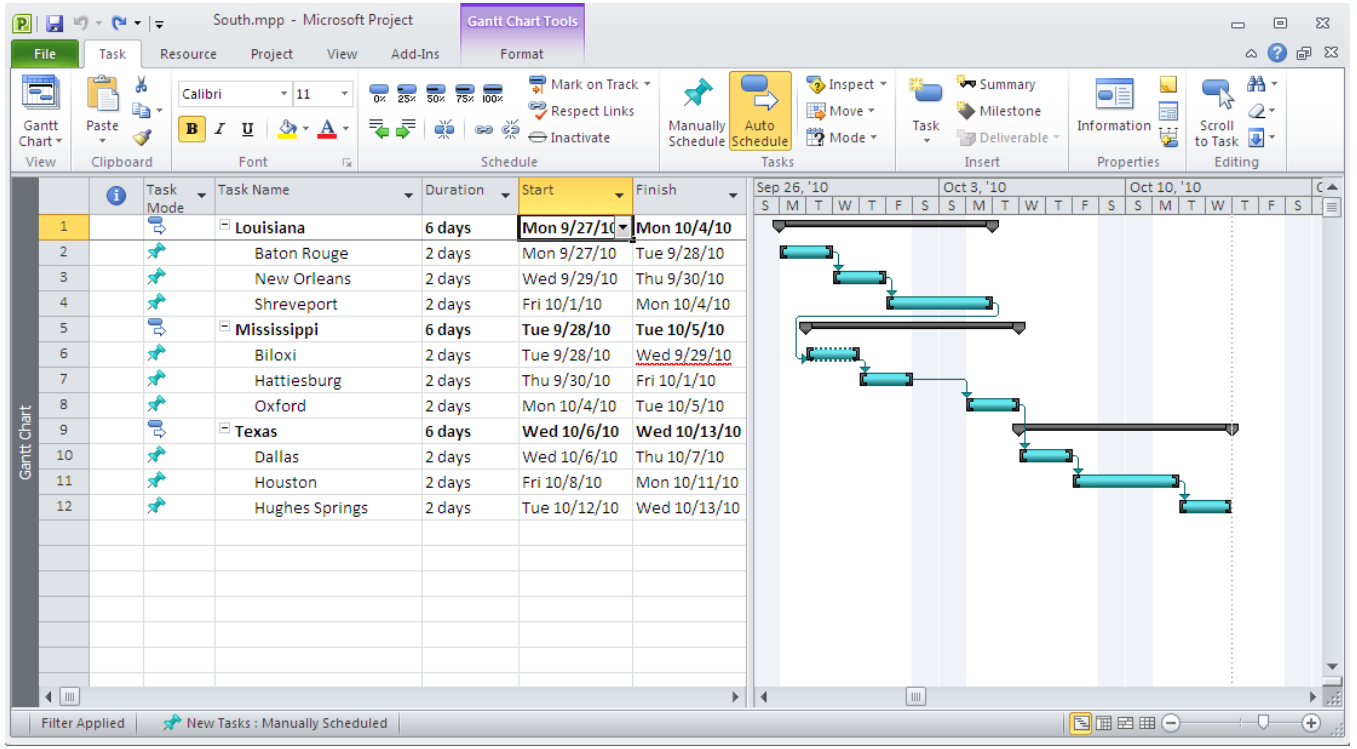
Graphics Credit: Innovyze

Action

- ✓ Generate scope and cost
- ✓ Prioritize alternatives
- ✓ Establish budgets

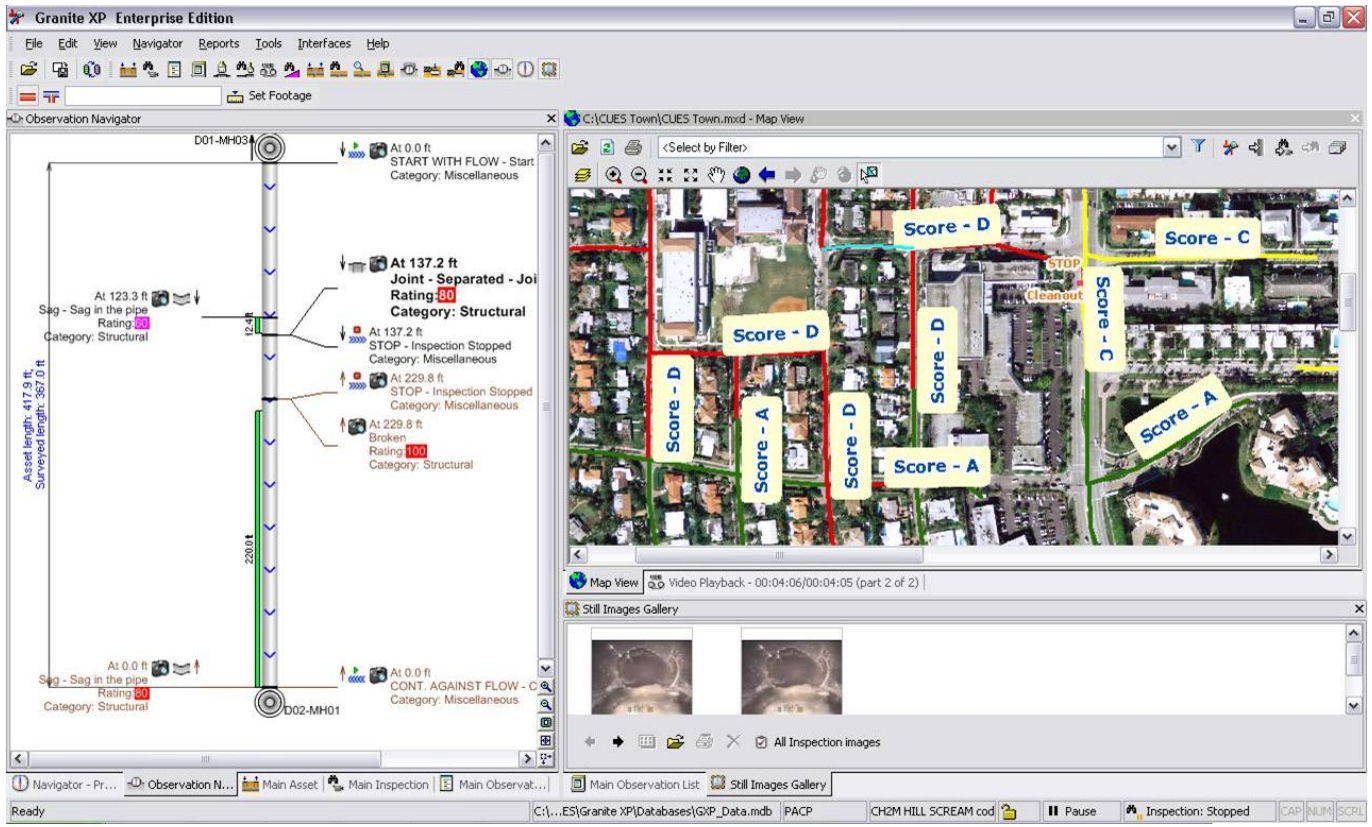
Action – Water

- Leak detection program (Leak-Logger)
  - JOC contractors
- Pump replacement
- Valve replacement
- Condition Assessment
  - Valves, hydrants
  - Pumps
  - Tri-agencies Pipeline



Action – Wastewater

- Pump replacement program
- Access hole program
- CIPP program
- Condition assessment
  - Gravity mains
  - Access holes
  - Facilities and roofs
  - Force Main



P3M3 Maturity Model

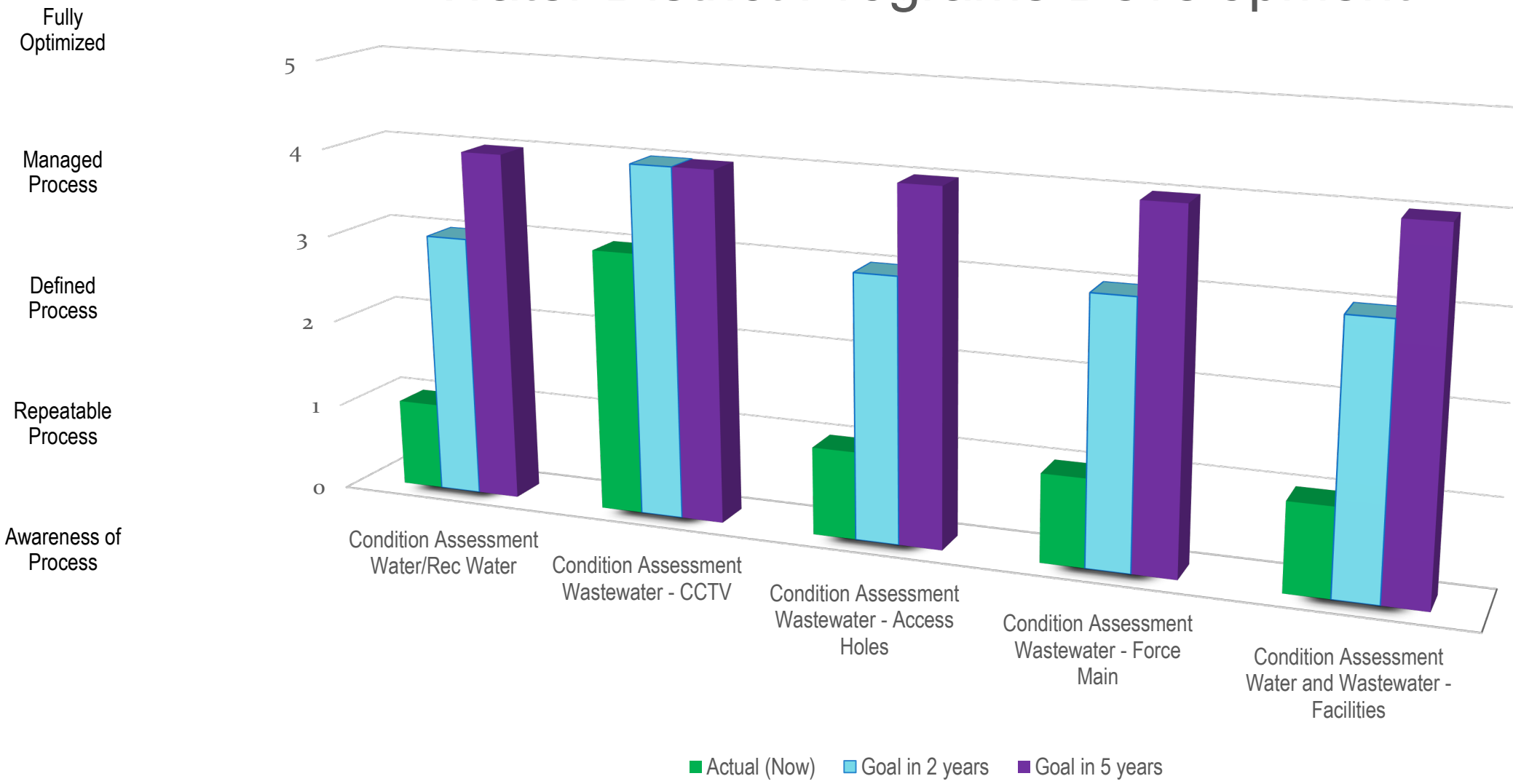
P3M3 Maturity Model

Water District Programs Development

Forecasting Program Development across several Categories

P3M3 Maturity Model

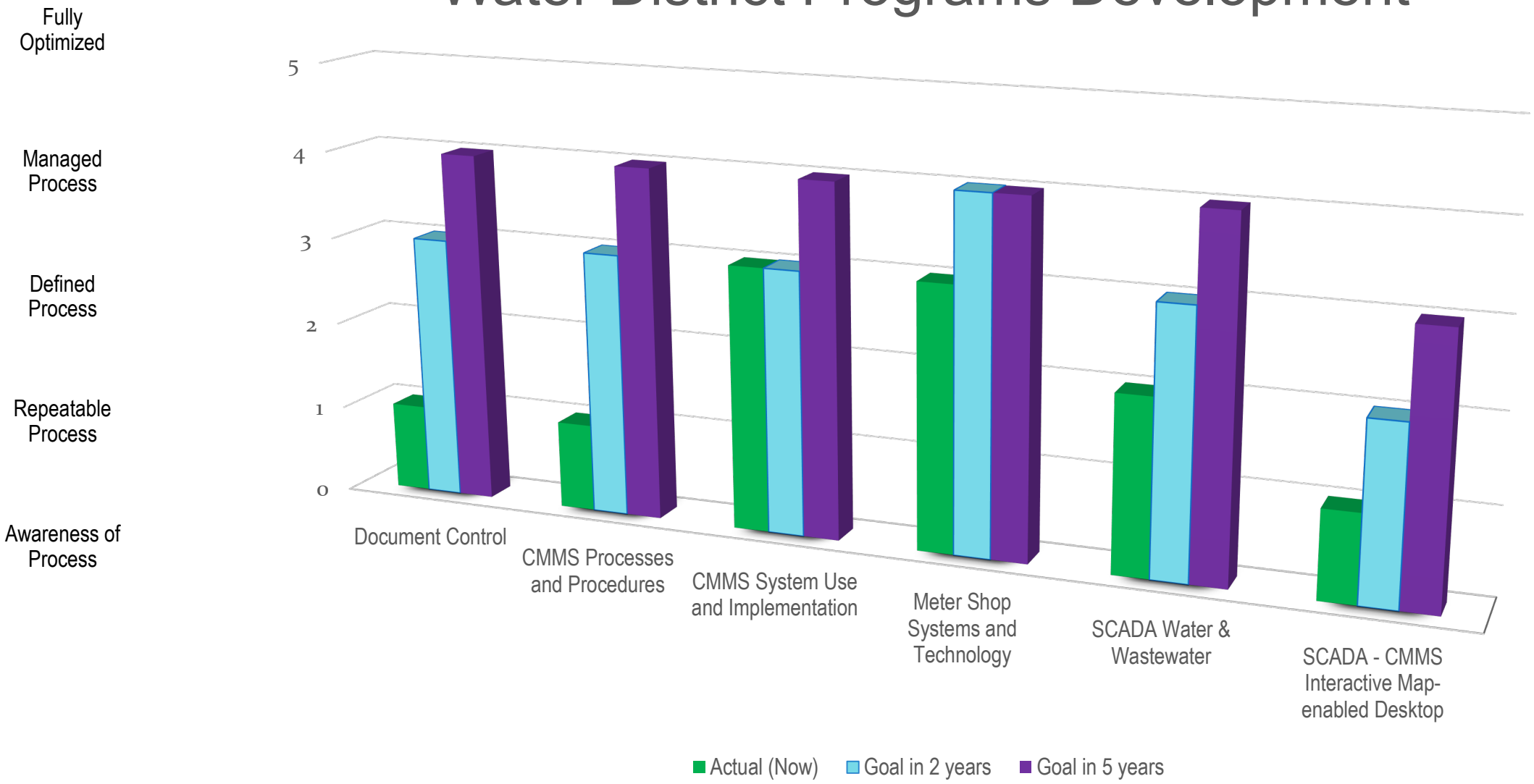
Water District Programs Development



Forecasting Program Development across several Categories

P3M3 Maturity Model

Water District Programs Development



Forecasting Program Development across several Categories

How to Leverage Technology

Bringing it all Together

Global Information System – GIS

- Data gaps
- Layers
- Standardized database format
- Scope and cost – escalated

GIS-centric Platforms

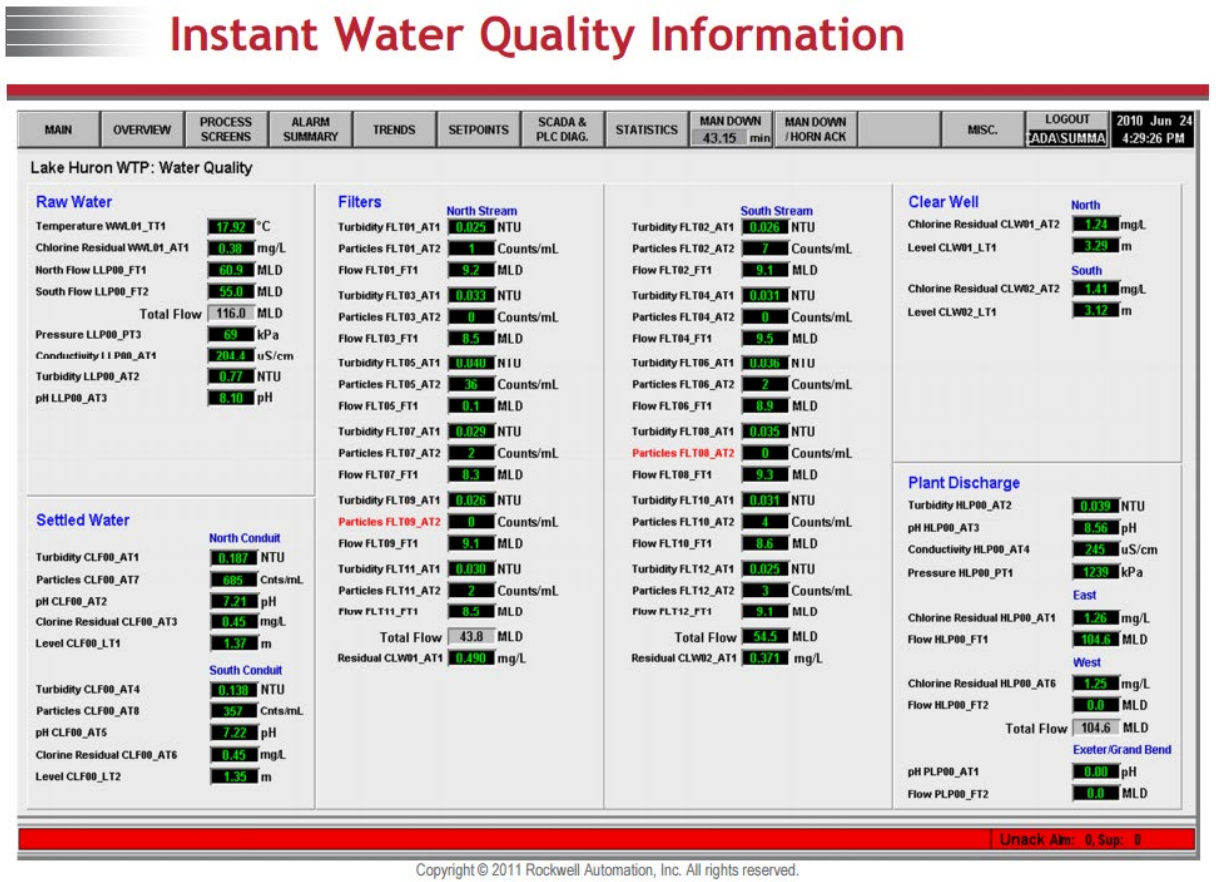
Supervisory Control And Data Acquisition (SCADA)

Master plan

Monitor and control

Real-time

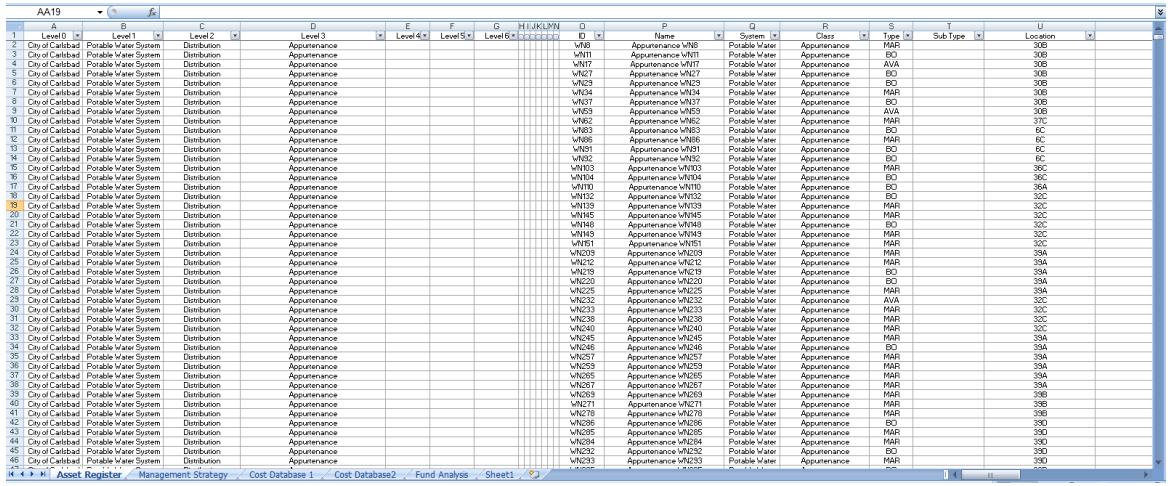
Interactive map desktop



GIS-centric Platforms

Computerized Maintenance Management System – CMMS

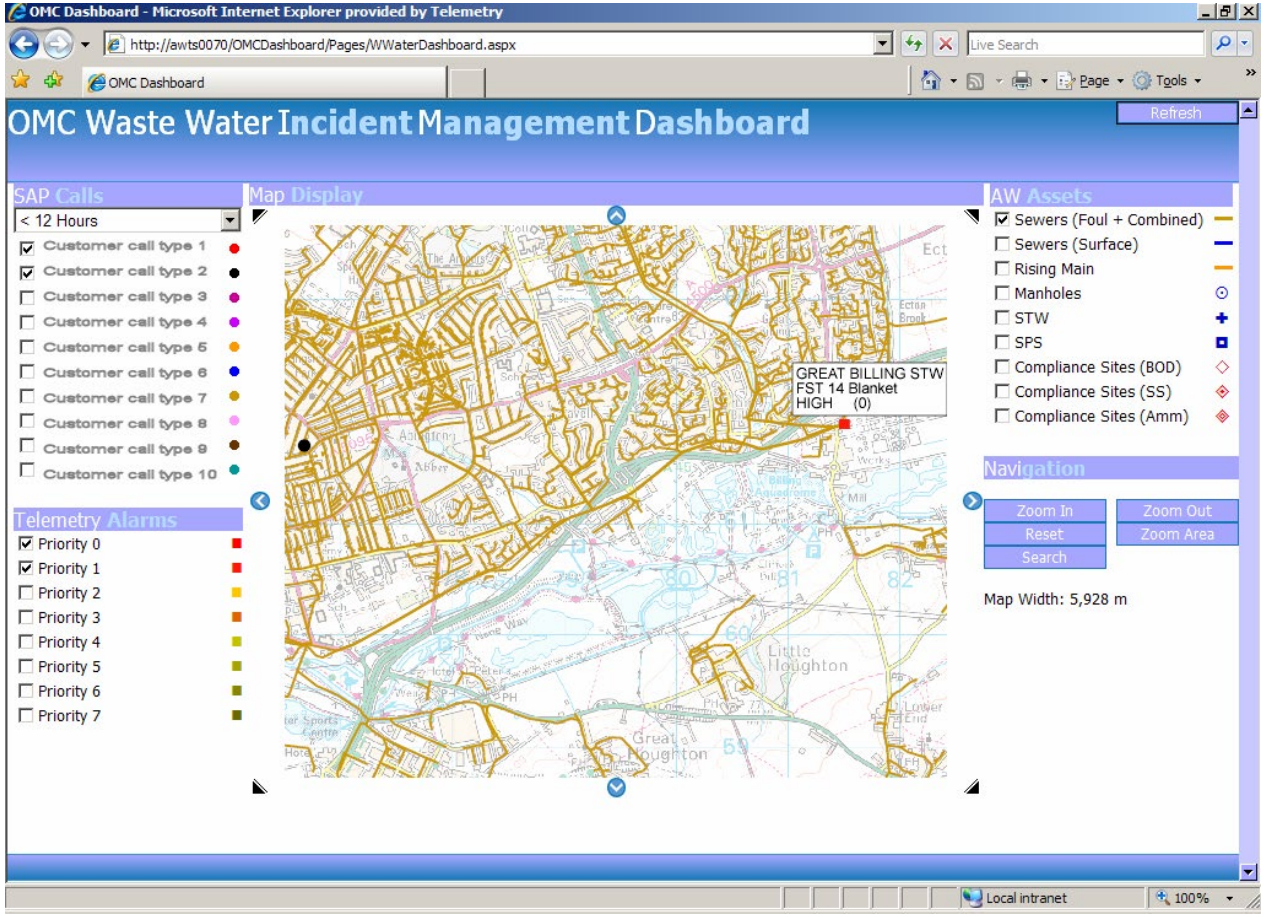
- Maintenance frequencies – automated
- Obtain asset data – as-built submittals
- CMMS linked to SCADA



SCADA linked to CMMS

Optimization Drivers

- Customers
  - Rapid response
- Regulatory
  - Increasing requirements
    - Water quality
    - Leakage reduction
- Business
  - Demands on producing at lower costs
  - Reduce high profile incidents



Documents

EPA Check-up Program for Small Systems, EPA – CUPSS

Manual of Practice Condition Assessment of Water Mains (AWWA M77)

{not yet out for distribution}

Distribution Valves: Selection, Installation, Field Testing and Maintenance (AWWA M44)

EPA Asset Management: A Best Practices Guide (April 2008)

Guide to Water and Wastewater Asset Management Underground Infrastructure Management (UIM)

Asset Management CoC Standard Specification (coming soon)

Open Discussion