



# **ASSET MANAGEMENT**

## **in the Water and Wastewater Industry**

Fundamentals of Asset Management

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# 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.*

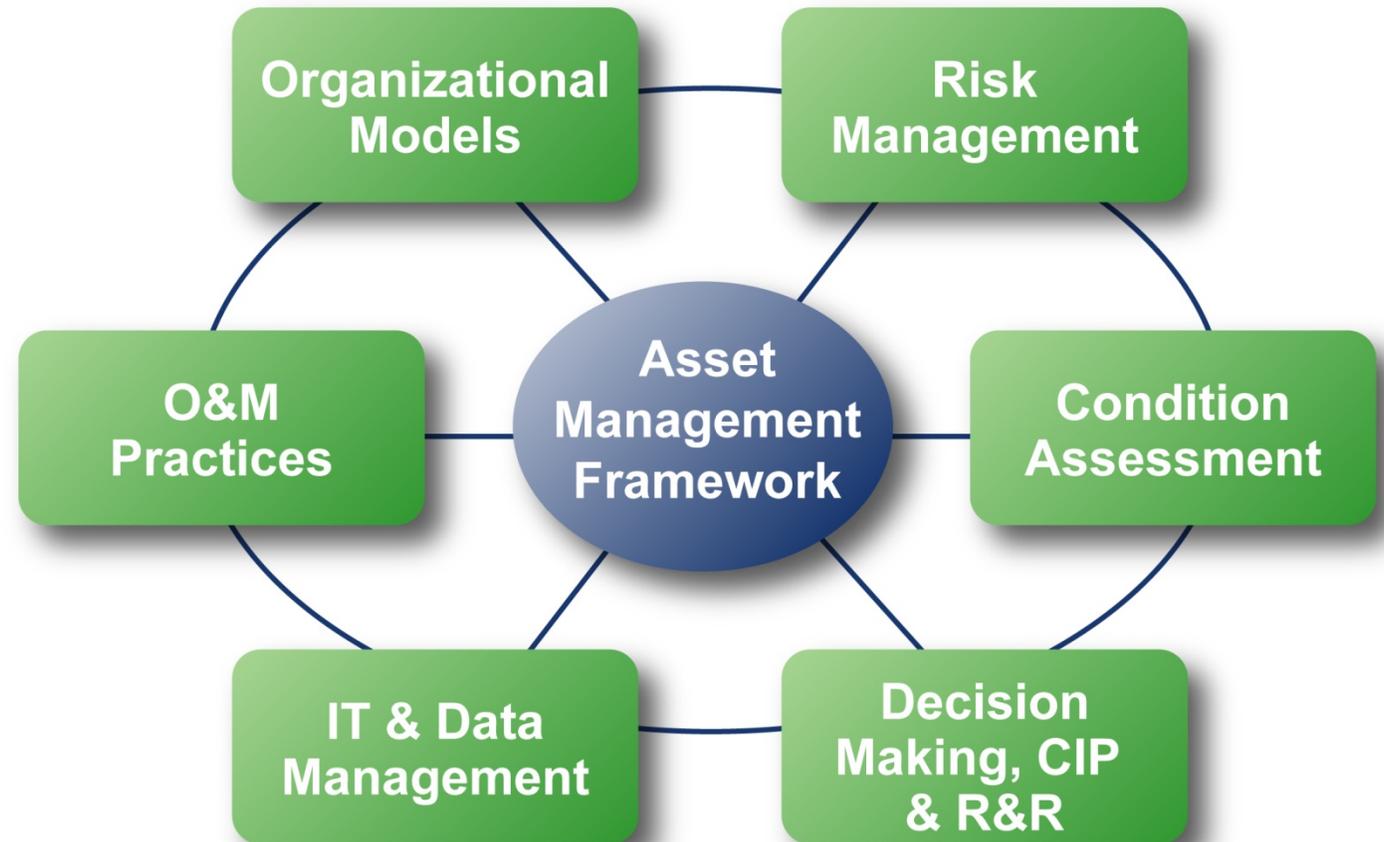
“Buried No Longer: Confronting America’s Water Infrastructure Challenge” – AWWA Publications

# 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

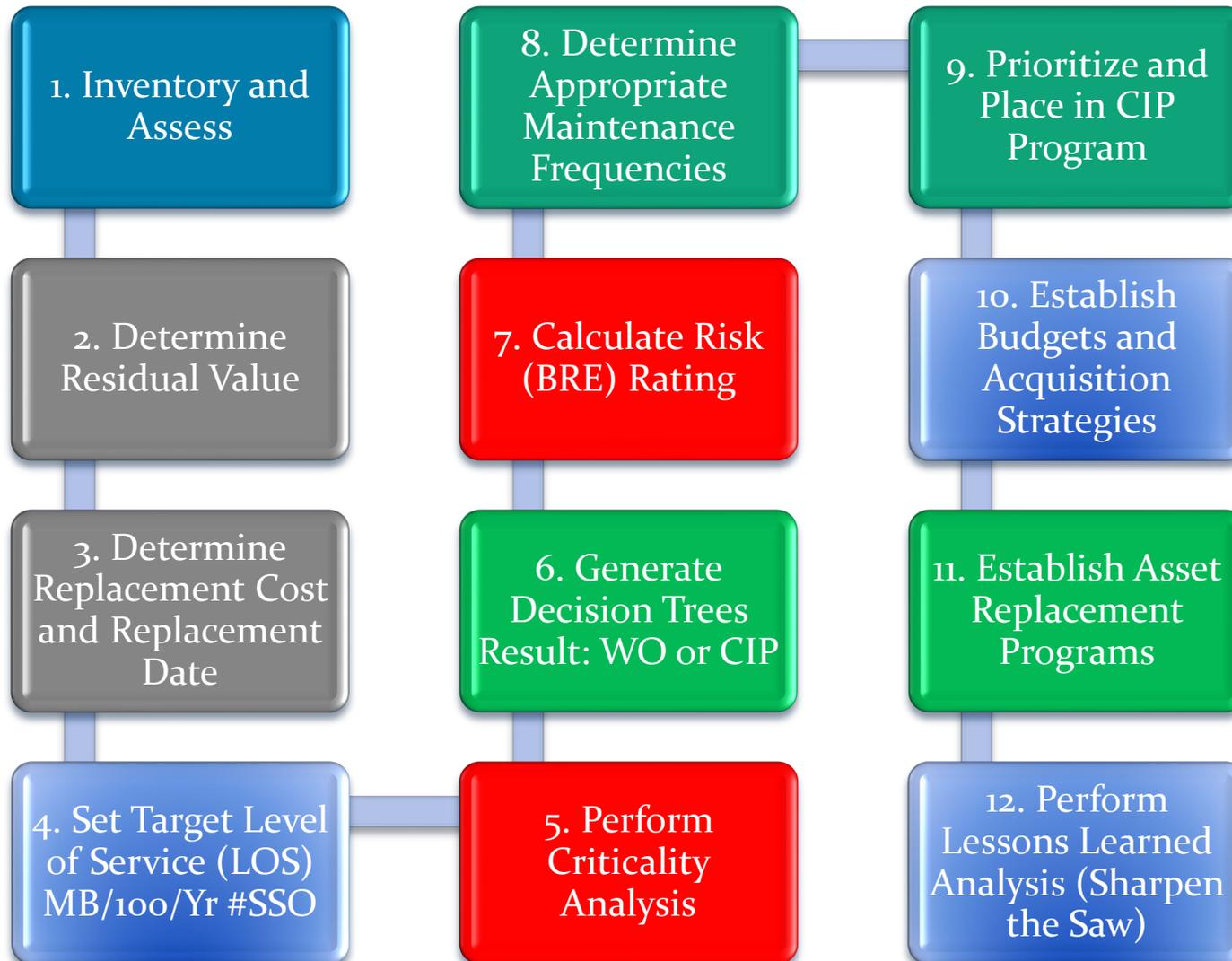


# Asset Management Program Development

# Organizational Chart



# Process Steps



# Key Components

A yellow CASE excavator is shown in the background, working on a large pile of rubble. The excavator's arm is extended, and its bucket is positioned over the debris. The scene is set against a clear blue sky. The text 'CASE' is visible on the excavator's arm.

Inventory

Risk Assessment

Condition Assessment

Data Analysis

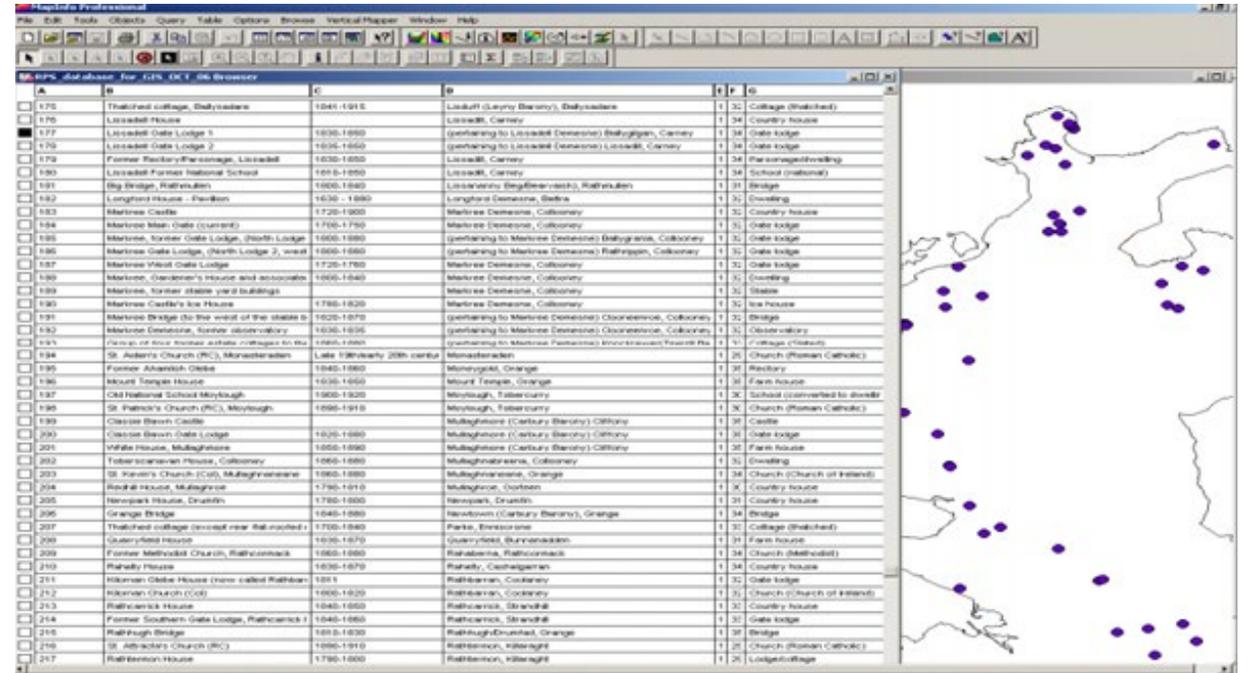
Action

# Inventory

✓ What do I own

✓ What is the value

✓ How long is it designed to last



The screenshot displays a software application window titled 'MapInfo Professional'. The main area is a table with columns A through G, listing various buildings and their details. The table includes columns for ID, Name, Date, Location, and other attributes. To the right of the table is a map of Ireland with several purple circular markers indicating the locations of the buildings listed in the table.

A	B	C	D	E	F	G
175	Thatched cottage, Ballysodare	1841-1815	Lisduff (Levyry Barnry), Ballysodare	1	32	Collage (thatched)
176	Lisduff House		Lisduff, Carney	1	34	Country house
177	Lisduff Gate Lodge 1	1830-1860	(pertaining to Lisduff Demesne) Ballygigan, Carney	1	34	Gate lodge
178	Lisduff Gate Lodge 2	1830-1860	(pertaining to Lisduff Demesne) Lisduff, Carney	1	34	Gate lodge
179	Former Rectory/Parsonage, Lisduff	1830-1860	Lisduff, Carney	1	34	Parsonage/rectory
180	Lisduff Former National School	1815-1850	Lisduff, Carney	1	34	School (national)
181	Big Bridge, Rathvulmin	1800-1840	Lisvanny (Big/Bear/cast), Rathvulmin	1	31	Bridge
182	Longford House - Farnham	1630 - 1880	Longford Demesne, Galtra	1	32	Cowling
183	Marine Castle	1720-1800	Marine Demesne, Collooney	1	32	Country house
184	Marine Main Gate (count)	1700-1750	Marine Demesne, Collooney	1	32	Gate lodge
185	Marine, North Gate Lodge, (North Lodge)	1800-1880	(pertaining to Marine Demesne) Ballygigan, Collooney	1	32	Gate lodge
186	Marine Gate Lodge, (North Lodge 2, west)	1800-1880	(pertaining to Marine Demesne) Rathgigan, Collooney	1	32	Gate lodge
187	Marine West Gate Lodge	1720-1780	Marine Demesne, Collooney	1	32	Gate lodge
188	Marine, Gardner's House and associated	1800-1840	Marine Demesne, Collooney	1	32	Cowling
189	Marine, former stable yard buildings		Marine Demesne, Collooney	1	32	Stable
190	Marine Carriage Box House	1780-1820	Marine Demesne, Collooney	1	32	Box house
191	Marine Bridge (to the west of the stable)	1820-1870	(pertaining to Marine Demesne) Cloonmore, Collooney	1	32	Bridge
192	Marine Demesne, stable (stables)	1830-1835	(pertaining to Marine Demesne) Cloonmore, Collooney	1	32	Obse/catory
193	Plan of four tower estate cottages to the	1860-1880	(pertaining to Marine Demesne) Cloonmore Forest Pa	1	31	Cottage (tower)
194	St. Adair's Church (RC), Monasteraden	Like 18th/early 20th centu	Monasteraden	1	25	Church (Roman Catholic)
195	Former Anasich Castle	1840-1860	Monaghan, Orange	1	28	Residenc
196	Mount Temple House	1830-1860	Mount Temple, Orange	1	28	Farm house
197	Old National School Moylagh	1900-1920	Moylagh, Tubercury	1	30	School (converted to church)
198	St. Patrick's Church (RC), Moylagh	1880-1910	Moylagh, Tubercury	1	30	Church (Roman Catholic)
199	Classe Bawn Castle		Mulghahre (Carbury Barnry) Clifony	1	38	Castle
200	Classe Bawn Gate Lodge	1830-1880	Mulghahre (Carbury Barnry) Clifony	1	38	Gate lodge
201	White House, Mulghahre	1850-1880	Mulghahre (Carbury Barnry) Clifony	1	38	Farm house
202	Tobershanan House, Collooney	1860-1880	Mulghahre, Collooney	1	32	Cowling
203	St. Kevin's Church (C), Mulghahre	1880-1880	Mulghahre, Orange	1	38	Church (Church of Ireland)
204	Revd's House, Mulghahre	1780-1810	Mulghahre, Corleen	1	38	Country house
205	Nearpark House, Drumfin	1780-1800	Nearpark, Drumfin	1	31	Country house
206	Grange Bridge	1840-1880	Newtown (Carbury Barnry), Orange	1	34	Bridge
207	Thatched cottage (west of Rathvulmin)	1700-1840	Patra, Bessmore, Collooney	1	32	Collage (thatched)
208	Quarryfield House	1830-1870	Quarryfield, Ballysodare	1	31	Farm house
209	Former Methodist Church, Rathvulmin	1860-1880	Rathvulmin, Rathvulmin	1	34	Church (Methodist)
210	Rathvulmin House	1830-1870	Rathvulmin, Rathvulmin	1	34	Country house
211	Hilman Gate House (now called Rathvulmin)	1881	Rathvulmin, Collooney	1	32	Gate lodge
212	Hilman Church (C)	1880-1820	Rathvulmin, Collooney	1	32	Church (Church of Ireland)
213	Rathvulmin House	1840-1860	Rathvulmin, Ballysodare	1	31	Country house
214	Former Southern Gate Lodge, Rathvulmin	1840-1860	Rathvulmin, Rathvulmin	1	32	Gate lodge
215	Rathvulmin Bridge	1810-1830	Rathvulmin/Drumfin, Orange	1	38	Bridge
216	St. Adair's Church (RC)	1880-1910	Rathvulmin, Ballysodare	1	25	Church (Roman Catholic)
217	Rathvulmin House	1780-1800	Rathvulmin, Ballysodare	1	26	Lodge/cottage

# 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

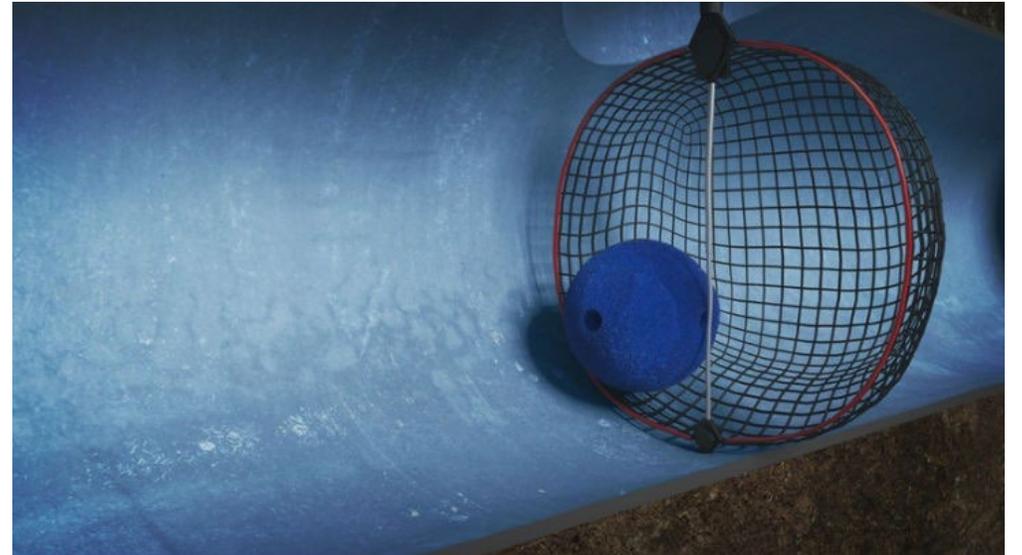
Description of Area	Frequency of CCTV
Steep slopes, new infrastructure	36 months
Older areas, new infrastructure	24 months
Older areas, small diameter, relatively low slope	12 months
Older areas, fats, oils, grease (FOG) issues, relatively low slope	12 months

# 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

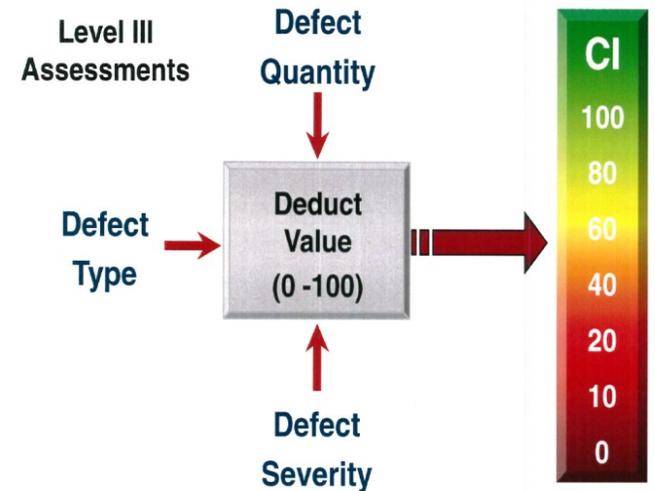
## Condition Scores

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

<b>Element</b>	<b>1</b>	<b>3</b>	<b>5</b>	<b>7</b>	<b>9</b>	<b>10</b>
<b>Technical Performance</b>	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
<b>Operational Performance</b>	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
<b>Reliability</b>	As specified by manufacturer	Infrequent breakdown	Occasional breakdown	Periodic Breakdown	Continuous recurrent breakdown	Virtually inoperable
<b>Availability</b>	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
<b>Maintainability</b>	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
<b>% Physical Life Consumed</b>	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
<b>Condition Score</b>	1	3	5	7	9	10
<b>Probability of Failure</b>	0.1	0.3	0.5	0.7	0.9	0.99

# Business Risk Exposure



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

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

Redundancy	Factor
Single	0.7
Multiple	0.5
Zero	1.0



# 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

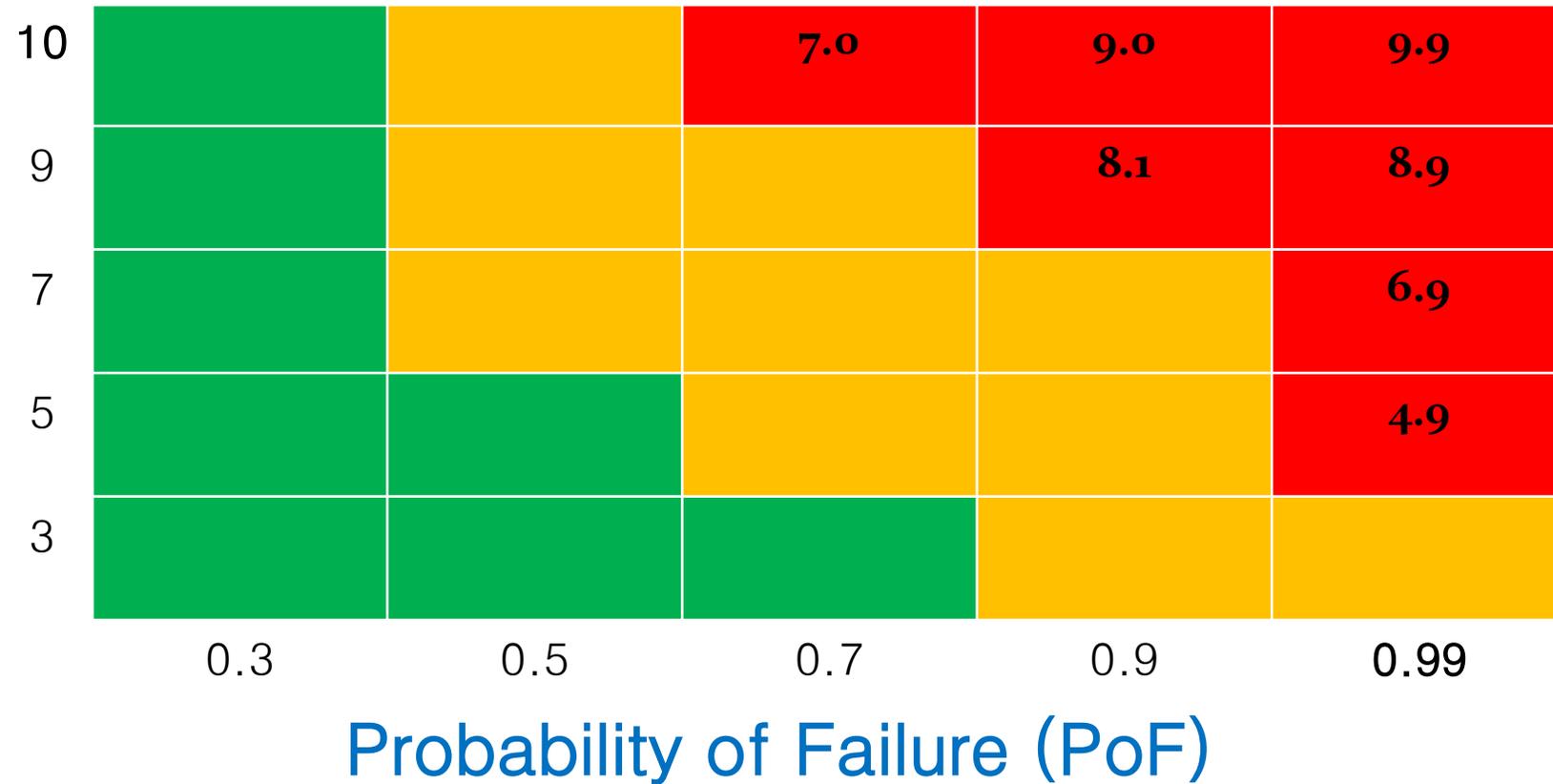
# Analytics

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



# Risk Matrix

Consequence  
of Failure  
(CoF)



# Maintenance

## Reactive

Not recommended

## Preventative – CMMS

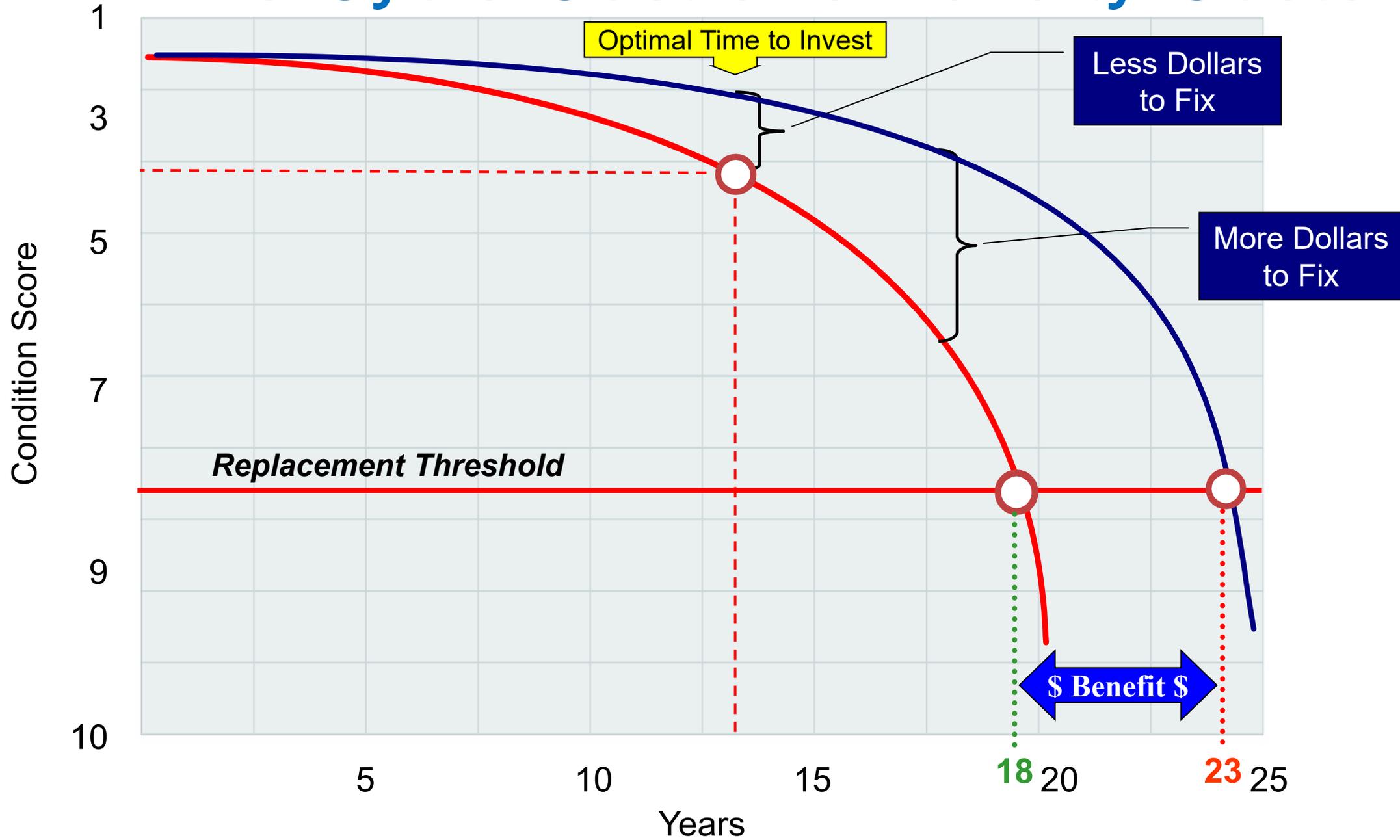
Activities scheduled and carried-out to protect and prevent deterioration

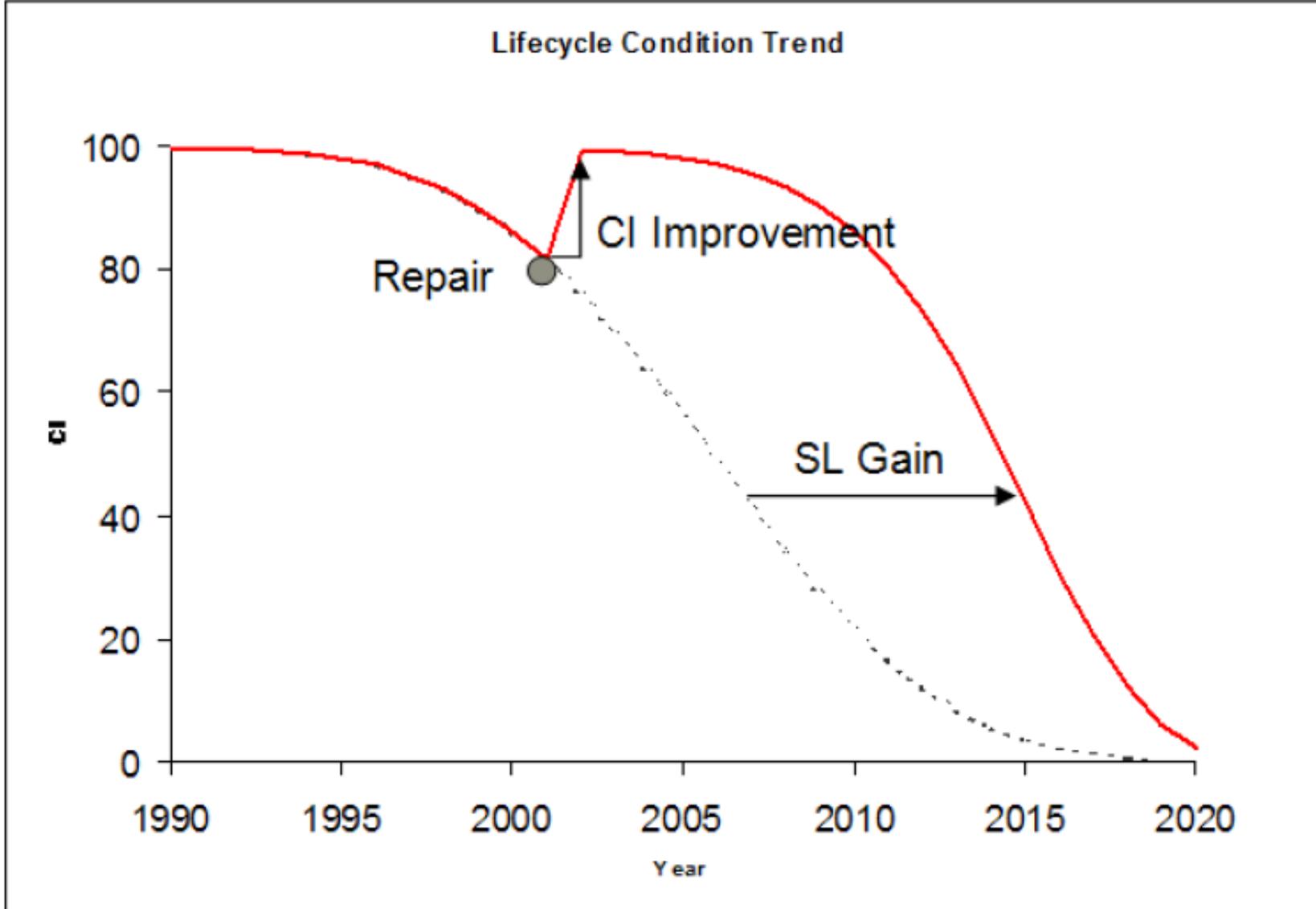
## Predictive – SCADA

Activities scheduled after observing signs of deterioration or impending failure

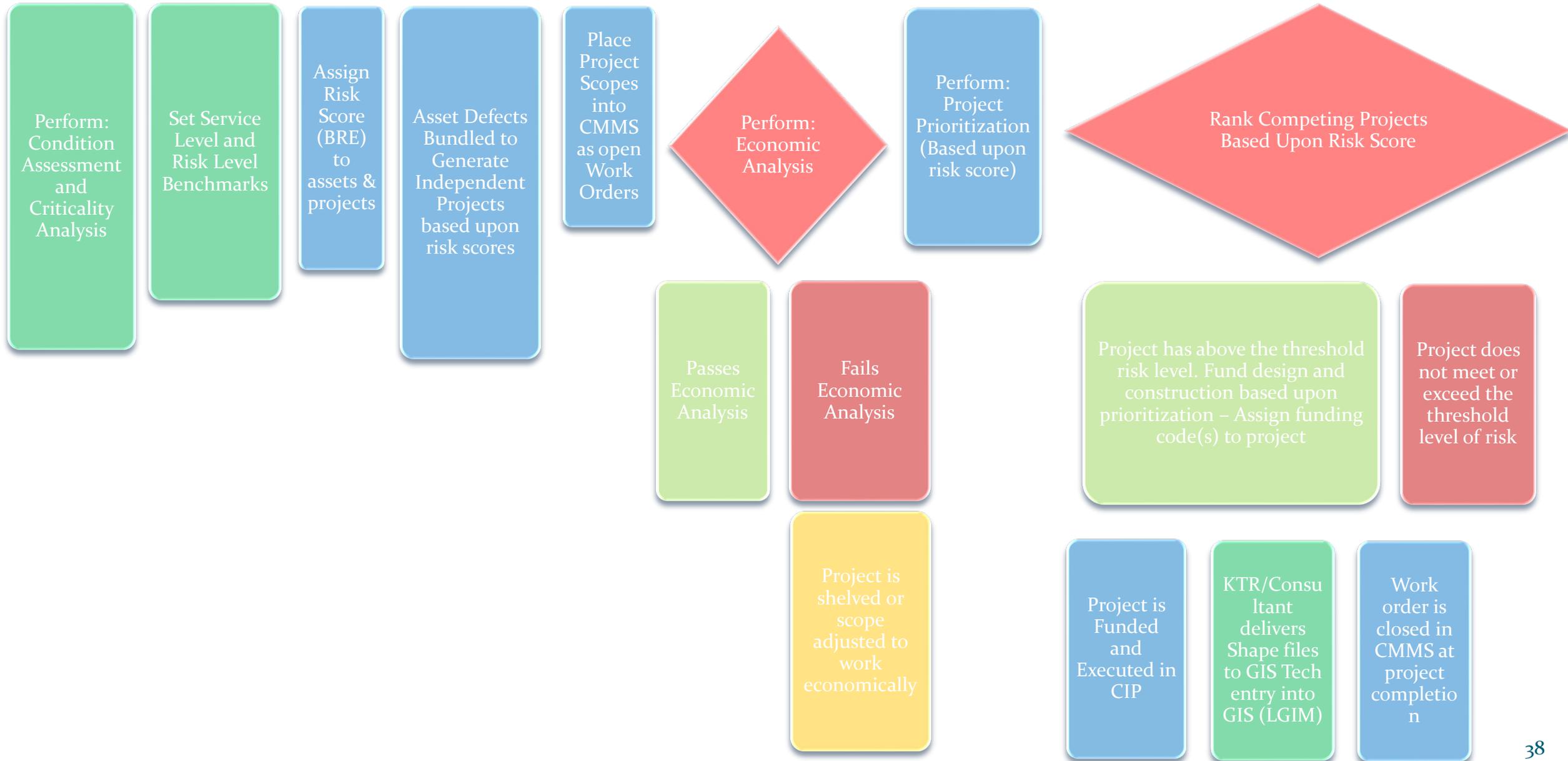
<b><i>Failure Mode and Effects Analysis (FMEA)</i></b>	<b><i>Definition</i></b>	<b><i>Tactical Aspects</i></b>	<b><i>Management Strategy</i></b>
<b><i>Capacity (Operational Failure)</i></b>	Volume of demand exceeds design or operational capacity	Growth, system expansion	Redesign
<b><i>Level of Service (Operational Failure)</i></b>	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
<b><i>Mortality (Structural Failure)</i></b>	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
<b><i>Financial Efficiency</i></b>	Operations costs exceed that of feasible alternatives	Payback period	Replace

# Life Cycle Cost and Penalty Costs





# Capital Projects Decision Logic Network



# Analytics to Action

## Analytics program

Shape files – layers

Sensitive customers

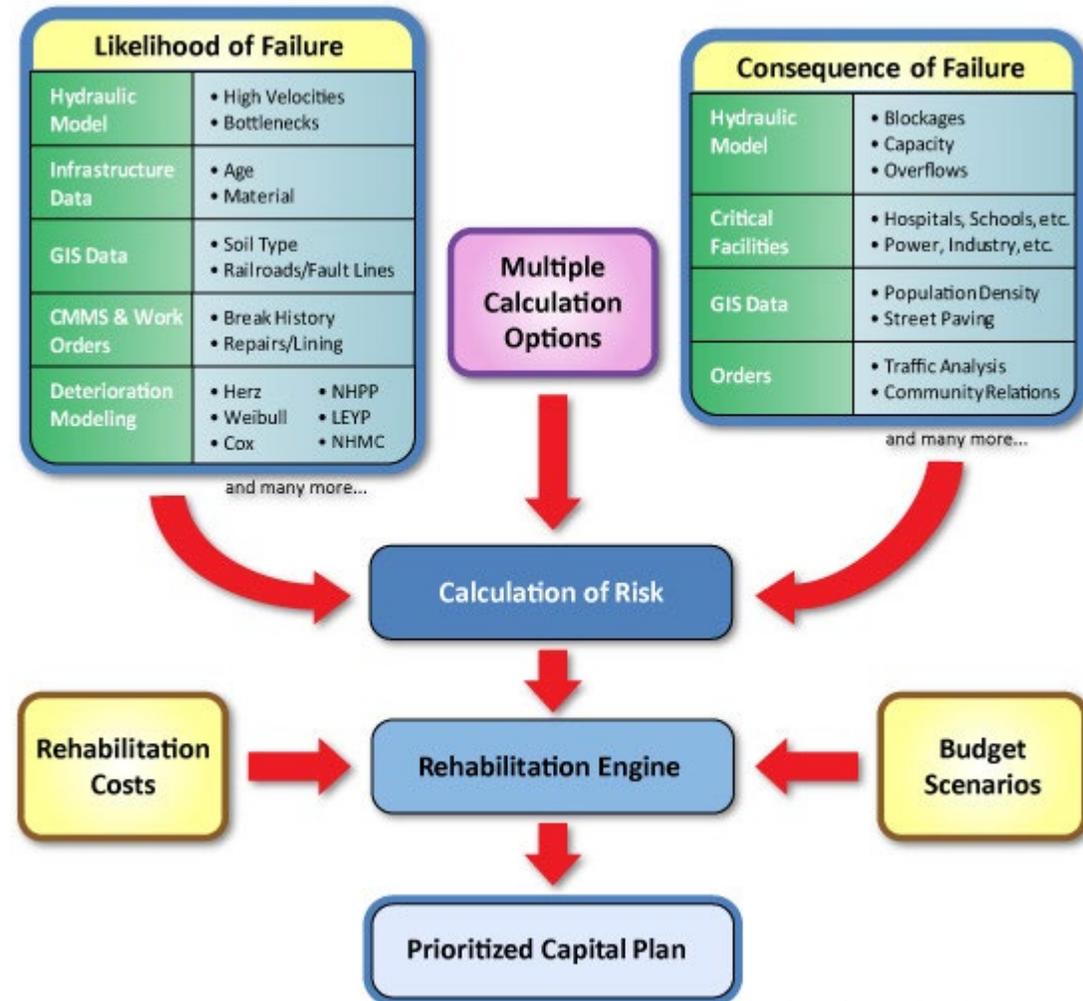
Soils

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

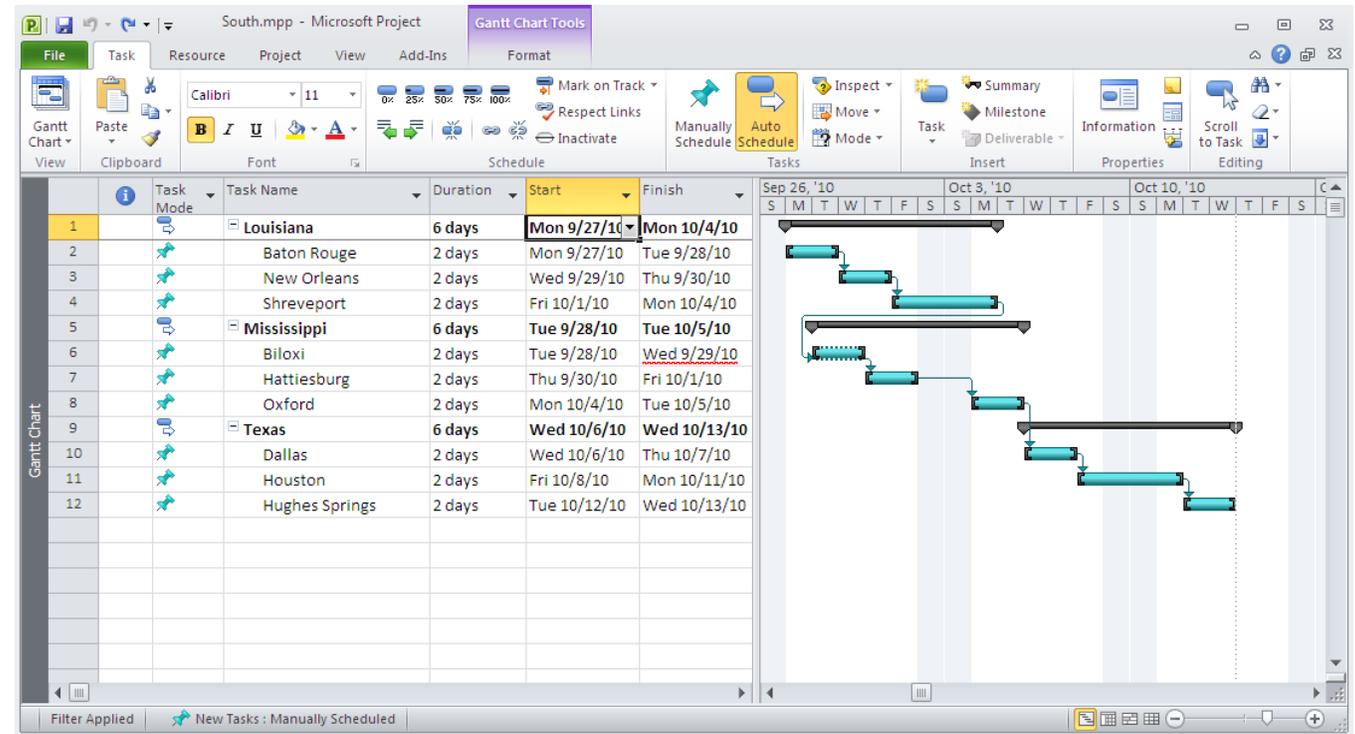
Valve replacement

Condition Assessment

Valves, hydrants

Pumps

Tri-agencies Pipeline



# Action – Wastewater

Pump replacement program

Access hole program

CIPP program

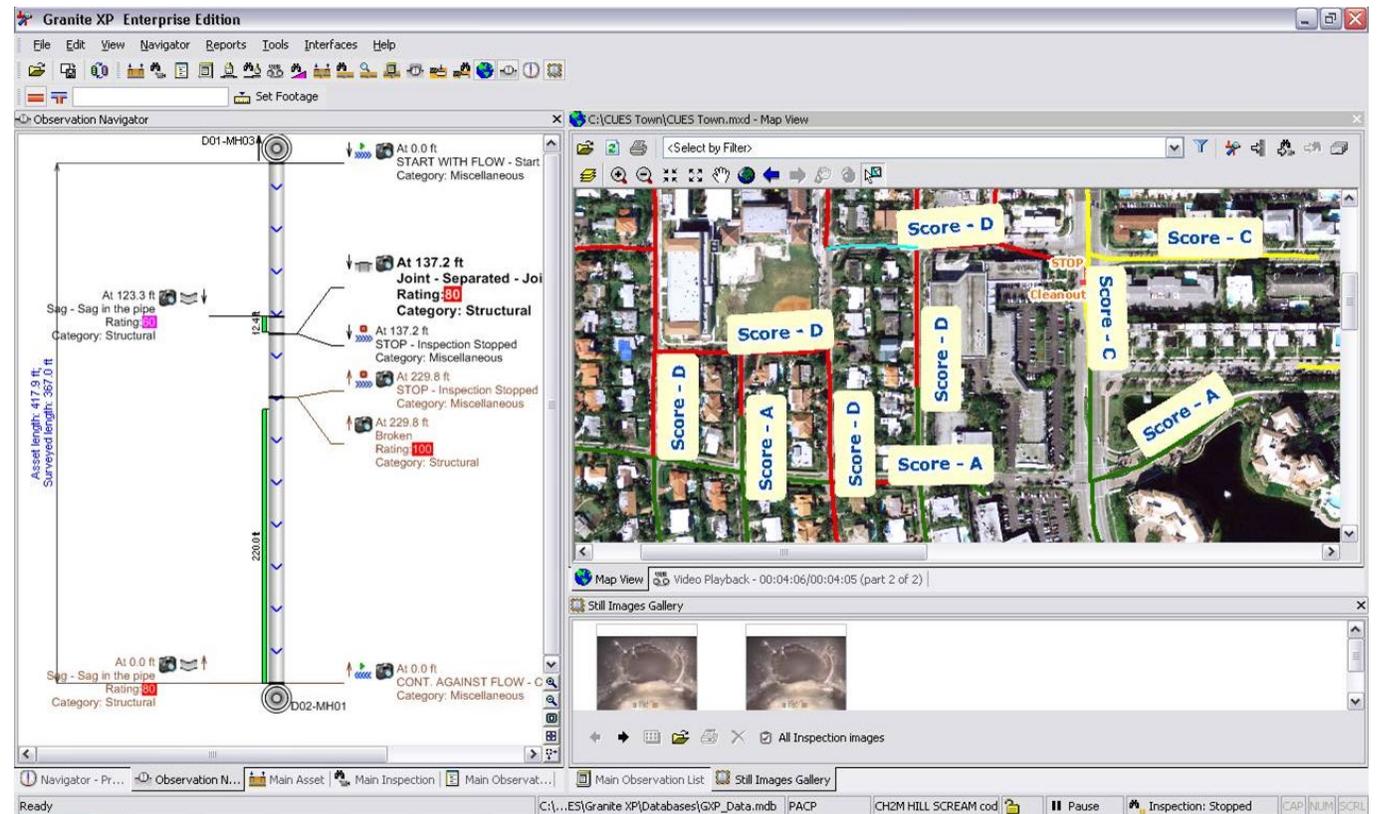
Condition assessment

Gravity mains

Access holes

Facilities and roofs

Force Main

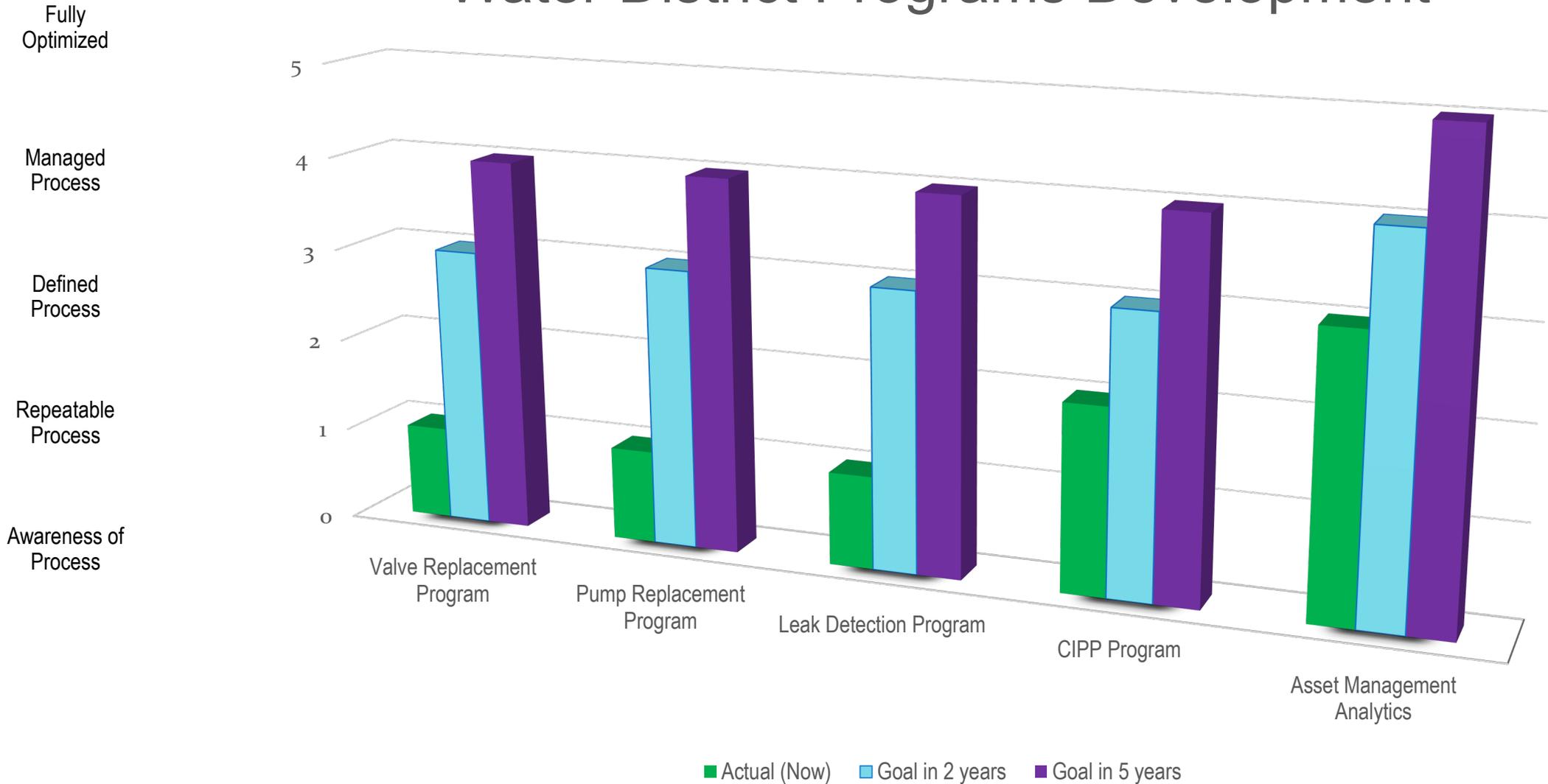




# P3M3 Maturity Model

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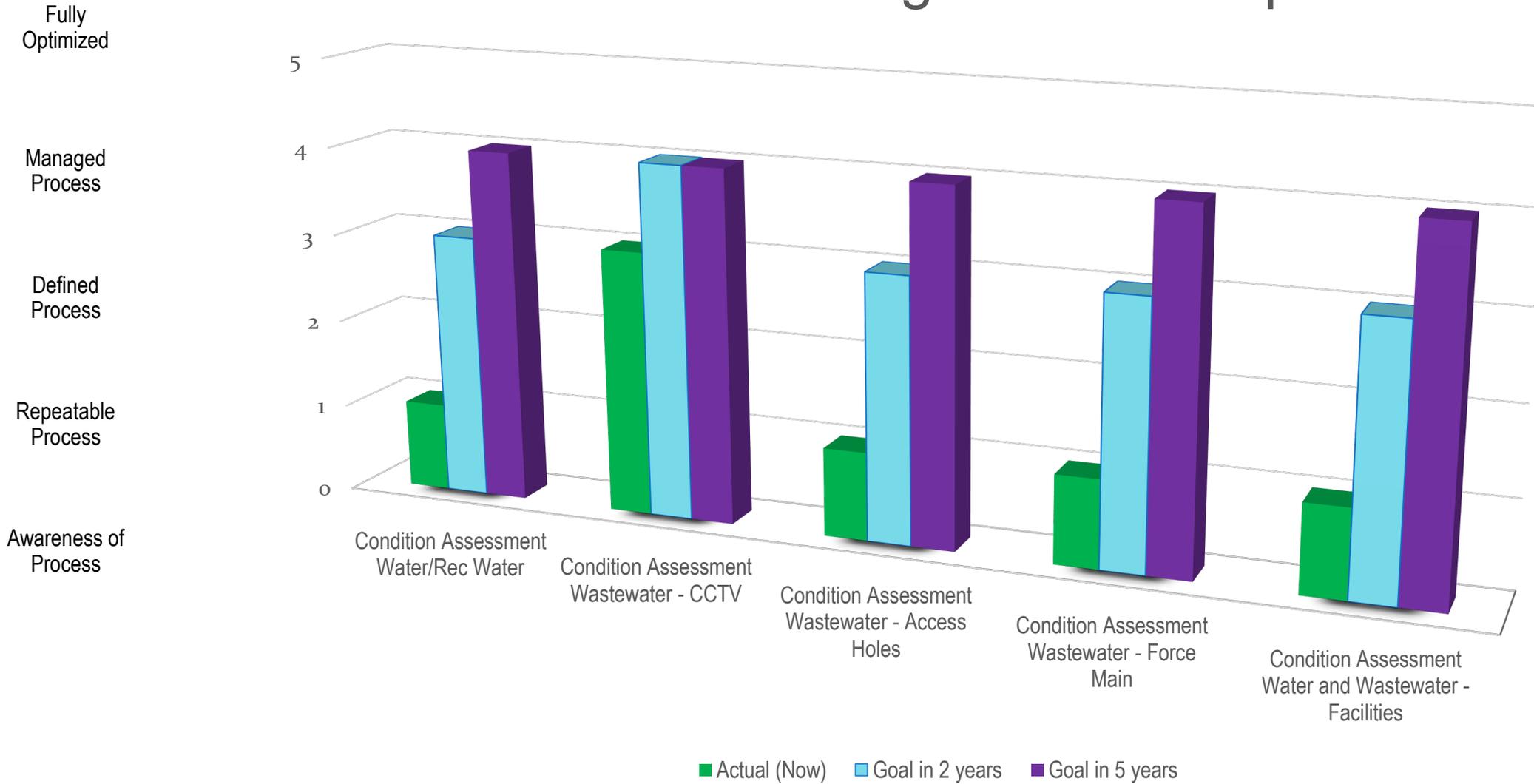
## Water District Programs Development



Forecasting Program Development across several Categories

# P3M3 Maturity Model

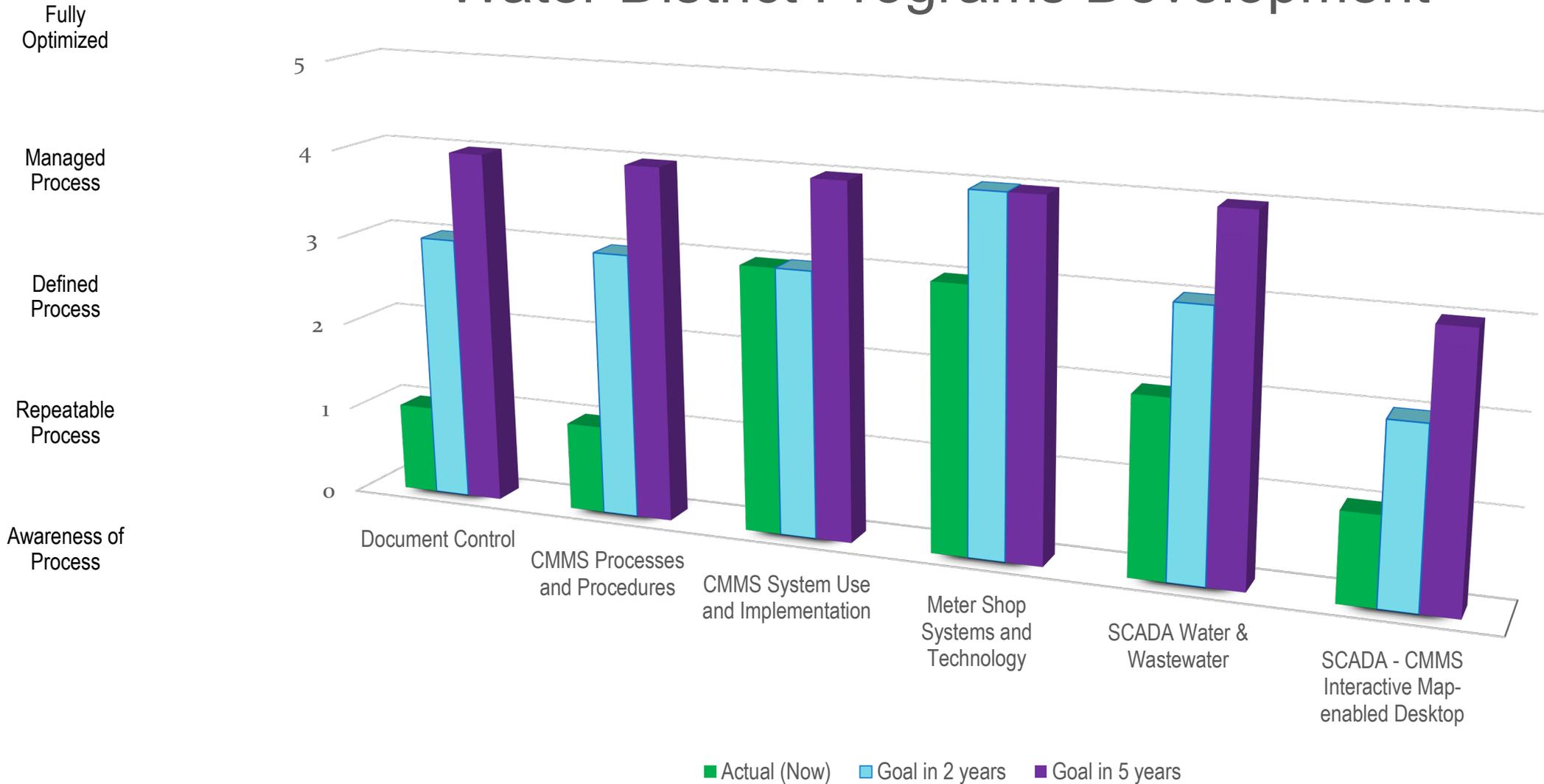
## Water District Programs Development



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)

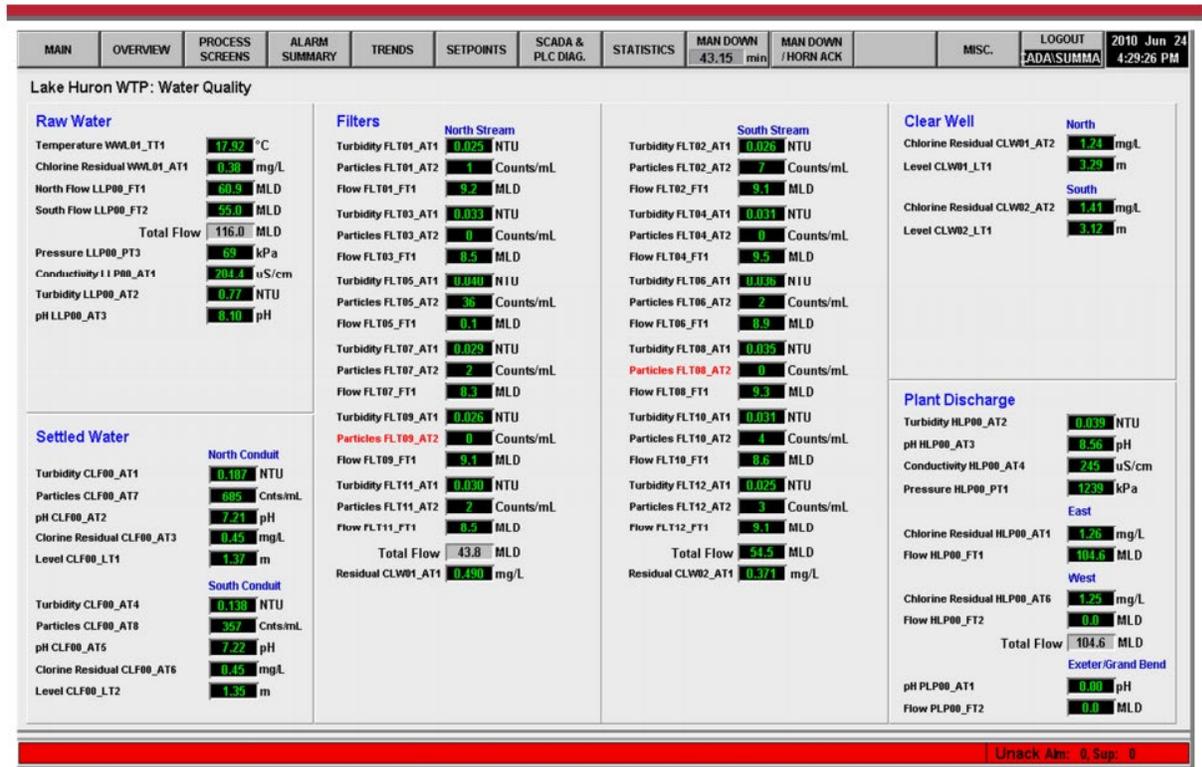
Master plan

Monitor and control

Real-time

Interactive map desktop

### Instant Water Quality Information



# GIS-centric Platforms

## Computerized Maintenance Management System – CMMS

Maintenance frequencies – automated

Obtain asset data – as-built submittals

CMMS linked to SCADA

The screenshot displays a spreadsheet with columns for asset hierarchy (Level 1 to Level 6), Name, System, Class, Type, Sub Type, and Location. The data lists various 'Appurtenance' items for 'Portable Water System' assets, including items like VNB8, VNB11, VNB17, VNB27, VNB29, VNB34, VNB37, VNB53, VNB62, VNB83, VNB86, VNB91, VNB92, VNB93, VNB94, VNB103, VNB104, VNB110, VNB132, VNB133, VNB145, VNB146, VNB149, VNB151, VNB209, VNB212, VNB219, VNB220, VNB225, VNB232, VNB233, VNB236, VNB240, VNB245, VNB246, VNB257, VNB259, VNB265, VNB267, VNB269, VNB271, VNB276, VNB286, VNB289, VNB294, VNB295, and VNB293.

Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Name	System	Class	Type	Sub Type	Location
1	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB8	Appurtenance VNB8	Portable Water	Appurtenance	MAR	306
3	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB11	Appurtenance VNB11	Portable Water	Appurtenance	BO	306
4	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB17	Appurtenance VNB17	Portable Water	Appurtenance	AVA	306
5	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB27	Appurtenance VNB27	Portable Water	Appurtenance	BO	306
6	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB29	Appurtenance VNB29	Portable Water	Appurtenance	BO	306
7	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB34	Appurtenance VNB34	Portable Water	Appurtenance	MAR	306
8	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB37	Appurtenance VNB37	Portable Water	Appurtenance	BO	306
9	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB53	Appurtenance VNB53	Portable Water	Appurtenance	AVA	306
10	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB62	Appurtenance VNB62	Portable Water	Appurtenance	MAR	37C
11	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB83	Appurtenance VNB83	Portable Water	Appurtenance	BO	6C
12	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB86	Appurtenance VNB86	Portable Water	Appurtenance	MAR	6C
13	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB91	Appurtenance VNB91	Portable Water	Appurtenance	BO	6C
14	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB92	Appurtenance VNB92	Portable Water	Appurtenance	BO	6C
15	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB93	Appurtenance VNB93	Portable Water	Appurtenance	MAR	36C
16	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB94	Appurtenance VNB94	Portable Water	Appurtenance	BO	36C
17	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB103	Appurtenance VNB103	Portable Water	Appurtenance	BO	36A
18	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB110	Appurtenance VNB110	Portable Water	Appurtenance	BO	32C
19	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB132	Appurtenance VNB132	Portable Water	Appurtenance	BO	32C
20	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB133	Appurtenance VNB133	Portable Water	Appurtenance	MAR	32C
21	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB145	Appurtenance VNB145	Portable Water	Appurtenance	BO	32C
22	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB146	Appurtenance VNB146	Portable Water	Appurtenance	MAR	32C
23	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB149	Appurtenance VNB149	Portable Water	Appurtenance	MAR	32C
24	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB151	Appurtenance VNB151	Portable Water	Appurtenance	MAR	32C
25	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB209	Appurtenance VNB209	Portable Water	Appurtenance	MAR	33A
26	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB212	Appurtenance VNB212	Portable Water	Appurtenance	MAR	33A
27	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB219	Appurtenance VNB219	Portable Water	Appurtenance	BO	33A
28	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB220	Appurtenance VNB220	Portable Water	Appurtenance	BO	33A
29	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB225	Appurtenance VNB225	Portable Water	Appurtenance	MAR	33A
30	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB232	Appurtenance VNB232	Portable Water	Appurtenance	AVA	32C
31	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB233	Appurtenance VNB233	Portable Water	Appurtenance	MAR	32C
32	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB236	Appurtenance VNB236	Portable Water	Appurtenance	MAR	32C
33	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB240	Appurtenance VNB240	Portable Water	Appurtenance	MAR	32C
34	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB245	Appurtenance VNB245	Portable Water	Appurtenance	MAR	33A
35	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB246	Appurtenance VNB246	Portable Water	Appurtenance	BO	33A
36	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB257	Appurtenance VNB257	Portable Water	Appurtenance	MAR	33A
37	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB259	Appurtenance VNB259	Portable Water	Appurtenance	MAR	33A
38	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB265	Appurtenance VNB265	Portable Water	Appurtenance	MAR	33A
39	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB267	Appurtenance VNB267	Portable Water	Appurtenance	MAR	33A
40	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB269	Appurtenance VNB269	Portable Water	Appurtenance	MAR	33A
41	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB271	Appurtenance VNB271	Portable Water	Appurtenance	MAR	33A
42	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB276	Appurtenance VNB276	Portable Water	Appurtenance	MAR	33A
43	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB286	Appurtenance VNB286	Portable Water	Appurtenance	BO	33C
44	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB289	Appurtenance VNB289	Portable Water	Appurtenance	MAR	33C
45	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB294	Appurtenance VNB294	Portable Water	Appurtenance	MAR	33C
46	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB295	Appurtenance VNB295	Portable Water	Appurtenance	BO	33C
47	City of Carlsbad	Portable Water System	Distribution	Appurtenance		VNB293	Appurtenance VNB293	Portable Water	Appurtenance	MAR	33C

# SCADA linked to CMMS

## Optimization Drivers

Customers

Rapid response

Regulatory

Increasing requirements

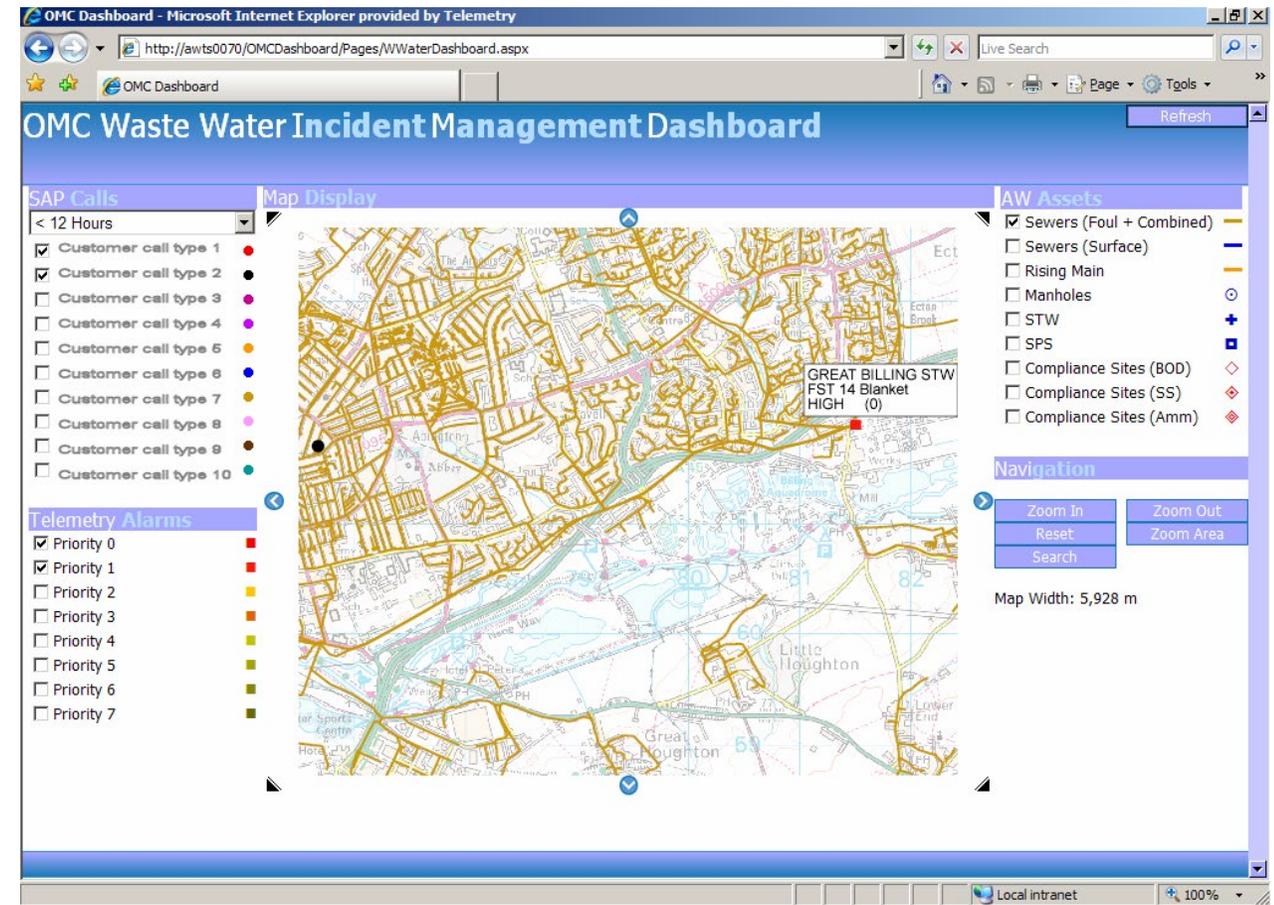
Water quality

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)

An aerial photograph of a coastline during sunset. The sky is a mix of soft pinks, oranges, and yellows. The ocean waves are visible breaking onto a sandy beach. To the right, a grassy hillside slopes down towards the water. The text "Open Discussion" is centered in a blue, sans-serif font.

# Open Discussion