

Risk Management and Project Prioritization in an Integrated GIS Environment

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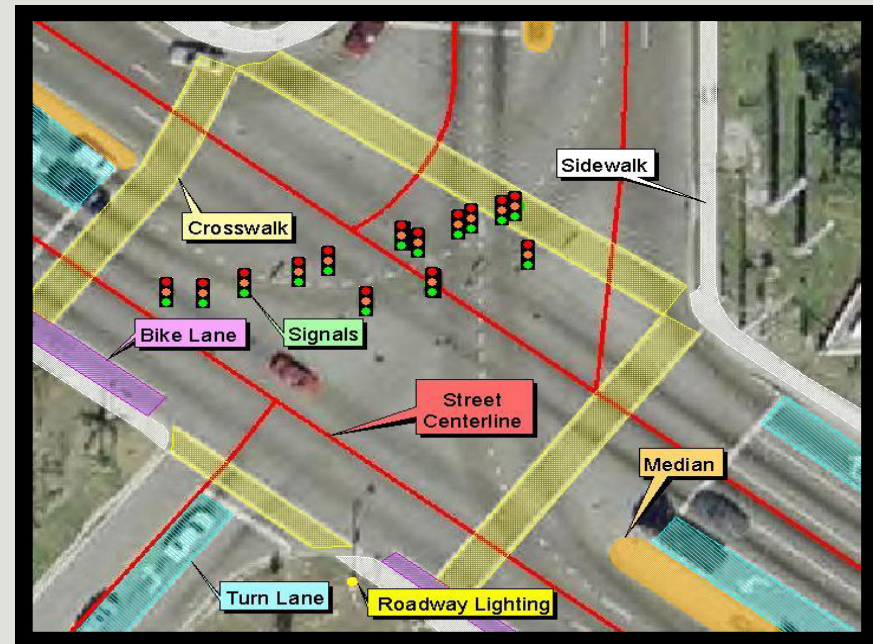
JULY 12TH, 2016



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



Asset Management Goals

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

Asset Management Goals

- Citizen Response/Customer Satisfaction
- Fiscal Responsibility/Infrastructure Sustainability
- Public Safety
- Federal Requirements



Federal Requirements – Map-21

Performance Based Asset Management Plan:

- Asset management objectives pursuant to achieving a long-term state of good repair over the life of its assets at a minimum cost
- Defined **Measures and Targets** designed to achieve and sustain a desired state of good repair over the lifecycle of the assets at minimum practical cost
- Results from a **Performance Gap Analysis**
- Results from the **Life-Cycle Cost Analysis**
- Results from the **Risk Assessment Analysis**
- Discussion of short and long term **Investment Strategies**

Significance of Federal Requirements?

- The elements for a National/State/Local geospatial base for linear/point asset management is beginning to form.
- Coordination between Local and State Governments is highly encouraged from the Federal Level
- Compliance with Map-21 will affect Federal Funding at the State/Local level.
- **FHWA Recognizes that GIS is critical Tool for Managing Assets**

Performance-Based Asset Management

- Forecast capital budget needs
- Create & manage capital projects
- Analyze different tactics using “what-if” scenarios

Plan Management

Forecasts

Projects

Reporting

Citizen Request Portal

Request Management

Service Requests

- Document & track requests for action
- External or internal

Work Orders

Personnel

Work Management

Equipment

- Create & track work orders
- Manage time & expenses for labor & equipment
- Manage quantity, expenses & location for inventory



Risk

- Track condition, depreciation & value
- Analyze & prioritize consequences of failure

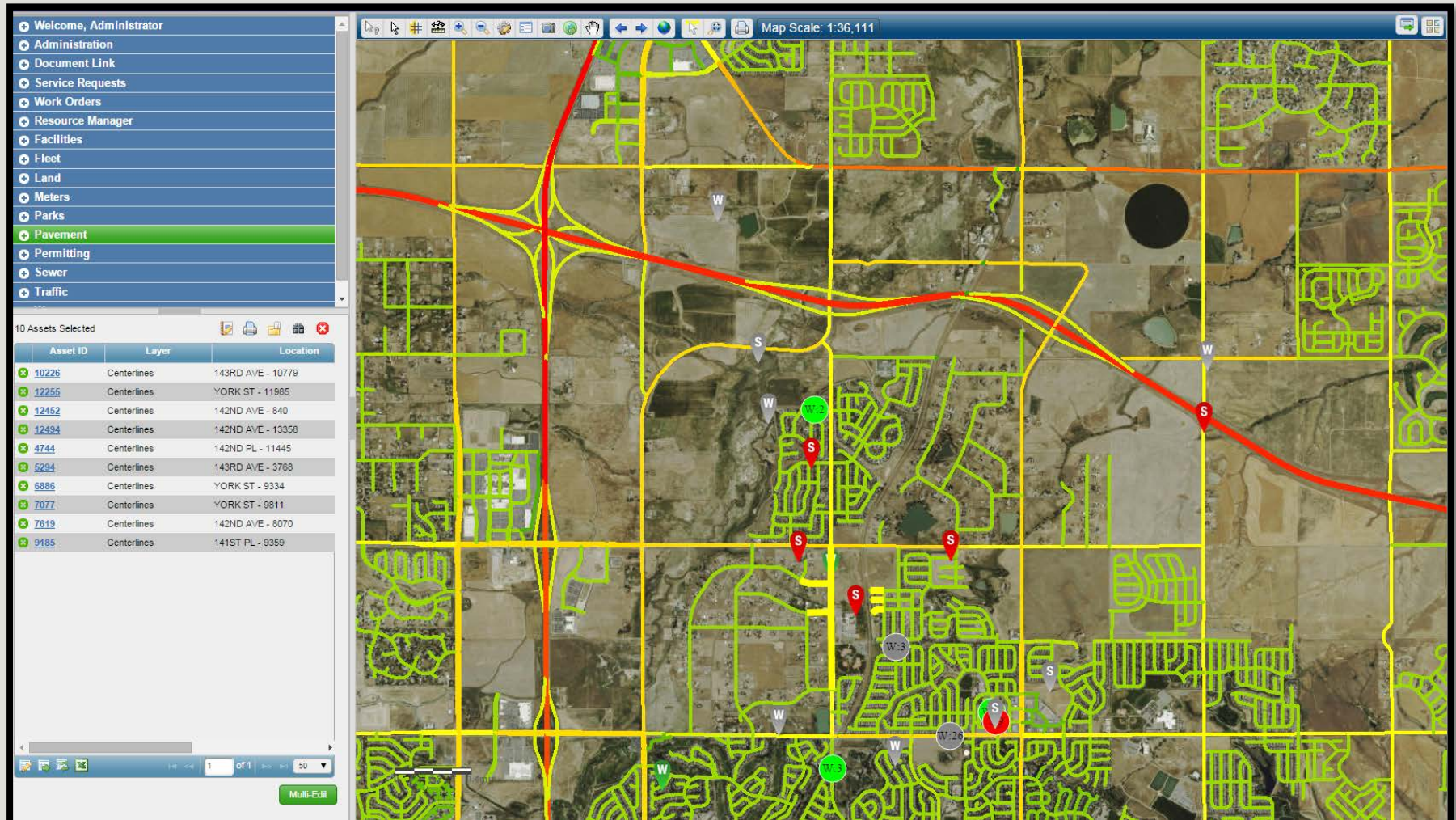
Risk-Based Asset Management

Valuation

Condition

Inventory

Map-Centric Asset and Risk Inventory



Risk Analysis and Matricies

- Risk can be defined as the Likelihood (Probability) of Asset Failure and the Consequences of Failure to system operation or Customer Safety
- Failure Modes and Probabilities aid in development of a Risk Matrix
- Risk Matrix supports the prioritization of assets actions; maintenance, repair, rehabilitation or replacement
- Risk determines **WHEN and WHERE** to spend limited maintenance and Capital Improvement dollars

Probability of Failure: Examples

- Age of asset (e.g. % life left)
- Condition of asset
- Capacity of asset
- Performance of asset (e.g. efficiency)

Configure Life Expectancies

The screenshot shows the 'Risk Settings Administrator' window. The main title is 'Risk Settings For: Sanitary Sewer (Asset Class)'. Below this, there are tabs for 'Failure Modes', 'Consequences', and 'Terms'. The 'Failure Modes' tab is active, showing 'Failure Mode Settings For: Sanitary Pipe (Asset Type)'. Within this tab, there are sub-tabs for 'Data Sources', 'Failure Probabilities', and 'Life Expectancies'. The 'Life Expectancies' sub-tab is selected, displaying a table with columns for 'MATERIAL', 'DIAMETER', and 'Years Life Expected'. The table contains 15 rows of data, with row 5 highlighted. To the left of the table, there are configuration options for 'Sub-Asset Type 1' (MATERIAL), 'Sub-Asset Type 2' (DIAMETER), and 'Install Year' (Install Year). There are also 'Synchronize' and 'Clear' buttons. A note at the bottom left states: 'NOTE: Life Expectancies set here are also used in the Valuation and Risk modules. Any changes made here will be reflected in Valuation and Risk.' At the bottom of the window, there are 'Copy From', 'Save', and 'Close' buttons.

	MATERIAL	DIAMETER	Years Life Expected
1	AC		75
2	AC	0	75
3	AC	10.00	75
4	AC	12.00	75
5	AC	14.00	75
6	AC	15.00	75
7	AC	16.00	75
8	AC	18.00	75
9	AC	20.00	75
10	AC	22.00	75
11	AC	24.00	75
12	AC	4.00	75
13	AC	6.00	75
14	AC	8.00	75
15	BR	30.00	100
▼	CAS	0	100

Sub-Asset Type 1: MATERIAL
Scale: 0

Sub-Asset Type 2: DIAMETER
Scale: 2

Install Year: Install Year

NOTE: Life Expectancies set here are also used in the Valuation and Risk modules. Any changes made here will be reflected in Valuation and Risk.

Apply highlighted entry to all rows

Copy From Save Close

Configure Failure Probabilities

Risk Settings Administrator

Risk Settings For: Sanitary Sewer (Asset Class)

Failure Mode Settings For: Sanitary Pipe (Asset Type)

Failure Modes

Valid values for % Life Left are between 0 and 100 Apply Graph

	Value	Prob of Failure	Level of Service Thresholds			
1	1	95	<input type="radio"/> Above	<input checked="" type="radio"/> Minimum	<input type="radio"/> Below	<input type="radio"/> Failure
2	6	85	<input type="radio"/> Above	<input checked="" type="radio"/> Minimum	<input type="radio"/> Below	<input type="radio"/> Failure
3	11	75	<input type="radio"/> Above	<input checked="" type="radio"/> Minimum	<input type="radio"/> Below	<input type="radio"/> Failure
4	16	62	<input type="radio"/> Above	<input checked="" type="radio"/> Minimum	<input type="radio"/> Below	<input type="radio"/> Failure
5	21	50	<input type="radio"/> Above	<input checked="" type="radio"/> Minimum	<input type="radio"/> Below	<input type="radio"/> Failure
6	26	38	<input type="radio"/> Above	<input checked="" type="radio"/> Minimum	<input type="radio"/> Below	<input type="radio"/> Failure
7	31	25	<input type="radio"/> Above	<input checked="" type="radio"/> Minimum	<input type="radio"/> Below	<input type="radio"/> Failure
8	36	20	<input type="radio"/> Above	<input checked="" type="radio"/> Minimum	<input type="radio"/> Below	<input type="radio"/> Failure
9	41	15	<input type="radio"/> Above	<input checked="" type="radio"/> Minimum	<input type="radio"/> Below	<input type="radio"/> Failure
10	46	12	<input type="radio"/> Above	<input checked="" type="radio"/> Minimum	<input type="radio"/> Below	<input type="radio"/> Failure
11	51	10	<input type="radio"/> Above	<input checked="" type="radio"/> Minimum	<input type="radio"/> Below	<input type="radio"/> Failure
12	56	8	<input type="radio"/> Above	<input checked="" type="radio"/> Minimum	<input type="radio"/> Below	<input type="radio"/> Failure
13	61	5	<input type="radio"/> Above	<input checked="" type="radio"/> Minimum	<input type="radio"/> Below	<input type="radio"/> Failure

Copy From Save Close

Consequences of Failure: Examples

- High cost to repair
- Loss of service
- Loss of life or injury
- Adverse health impact
- Property damage
- Loss of revenue
- Environmental damage
- Regulatory impact
- Disruption to community

Configure Consequences

Risk Settings For: Sanitary Sewer (Asset Class)

Failure Modes | **Consequences** | Terms

Consequence Settings For: Sanitary Pipe (Asset Type)

Consequences | Ratings

	Consequence Name	Weight	Use for Criticality	% Life Left	Capacity	Condition	Effeciency	I/I	Sulfide	Test
1	Environmental Impact	10	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2	Health and Safety	12	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
3	High Cost to Operate	8	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
4	High Cost to Repair	8	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
5	Loss of Service	10	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
6	Property Damage	10	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
7	Public Relations	8	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
8	Regulatory Impact	10	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
9	Disruption to Community	10	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Risk Assessment

Asset updated successfully [Icons]

Attributes	Documents	Service Calls	Work Orders
Projects	Data Link	Facility	Edgesoft
Condition	Risk	Valuation	Budgets

Consequences		Failure Probabilities	
Asset Class: Streets			
Asset Type: Pavement			
Location: POZEBLVD			
Risk Factor (1-10):	3.80	[Save]	
Consequence Factor (1-10):	10.00	[Cancel]	
Failure Probability:	38%	[Details...]	
Criticality Factor:	7.67		

Failure Mode	Value	Units	Failure Probability
Age	71		27 %
Distresses	69		29 %
Drainage	80		19 %
Striping/Marking	60		38 %

Scale: 1:4,513 Base Map: World_Imagery

Risk Manager

Filter is OFF - Current list contains 1 out of 29825 Assets

Form View | Reports

Layer: **Centerlines** Asset Class: **Streets**

Location: **POZEBLVD** Risk Calculation Details for **Pavement: 16065** Asset Type: **Pavement**

Created: 07/27/2015 By: Administrator Modified: 07/27/2015 By: Administrator


Probability of Failure Ratings				Failure Modes and Failure Probabilities					
Consequence	Rating	Weight	Score	Age	Distresses	Drainage	Striping/Marking	High Scores	
				27%	29%	19%	38%		
Public Perception*	Low	0.333	5.00	1.36	1.46	0.95	1.90	1.90	
Vehicle Damage*	Moderate	0.333	8.00	2.17	2.33	1.52	3.04	3.04	
Safety*	High	0.333	10.00	2.71	2.92	1.90	3.80	3.80	
Criticality Factor: 7.67				Consequence Factor: 10.00				38%	3.80

Consequences that contribute to the Criticality Factor are marked with an *

Risk Factor: 3.80	Overall Confidence: 100%
Consequence Factor: 10.00	Consequence Factor Confidence: 100%
Failure Probability: 38%	Failure Probability Confidence: 100%
Criticality Factor: 7.67	

[Save] [Print...] [Close]

Rec 1 of 1



Risk Assessment

Risk Manager

Filter is OFF - Current list contains 10179 out of 29824 Assets

Form View | Table View | **Filter** | Reports | Calculations

Asset Class: Streets GIS Facility

Summary Filter | Statement Filter

Asset Type: All All Assets Selected Assets When a value is picked: Add to Selection Set Replace Selection Set

Overall Factors	0.00 - 0.99	1.00 - 1.99	2.00 - 2.99	3.00 - 3.99	4.00 - 4.99	5.00 - 5.99	6.00 - 6.99	7.00 - 7.99	8.00 - 8.99	9.00 - 9.99	10.00	Not Rated	Total Rated	Total Assets
Risk Factor		8491	1509	124	1	1		39	1	1		12	10167	10179
Criticality Factor						8615	1	2	500		1049	12	10167	10179
Consequence Factor						8615			2		1550	12	10167	10179
Failure Probabilities	0.0% - 9.9%	10.0% - 19.9%	20.0% - 29.9%	30.0% - 39.9%	40.0% - 49.9%	50.0% - 59.9%	60.0% - 69.9%	70.0% - 79.9%	80.0% - 89.9%	90.0% - 99.9%	100 %	Not Rated	Total Rated	Total Assets
Overall Failure Probability			9998	2	1	2		162	1	1		12	10167	10179
Age			10006					161	1	1		1	10169	10170
Distresses	1	3	2	1	1	2						10160	10	10170
Drainage	2		2	2	2							10162	8	10170
Striping/Marking	6	1				1		1	1			10160	10	10170
Consequence Scores	0.0 - 0.99	1.0 - 1.99	2.0 - 2.99	3.0 - 3.99	4.0 - 4.99	5.0 - 5.99	6.0 - 6.99	7.0 - 7.99	8.0 - 8.99	9.0 - 9.99	10	Not Rated	Total Rated	Total Assets
Public Perception						8617			1		1549	3	10167	10170
Safety						8617			501		1049	3	10167	10170
Vehicle Damage						8615			502		1050	3	10167	10170

10179 asset(s) found matching search criteria,

Risk Filtering

The screenshot shows the 'Risk Manager' application window with the 'Filter' tab selected. The 'Asset Class' is set to 'Sanitary Sewer'. The interface is divided into four steps for configuring a filter statement.

Step 1: Select a filter statement:

Find All asset types ...

1. with a Risk Factor between value 1 and value 2
2. with a Consequence Factor between value 1 and value 2
3. with a Criticality Factor between value 1 and value 2
4. with a Failure Probability between value 1 and value 2
5. where Probability of Failure is Threshold Level
6. with a Consequence Rating between Rating 1 and Rating 2
7. with a Failure Mode value between value 1 and value 2
8. with a Failure Mode Probability between value 1 and value 2
9. where the Most or Least influential Consequence is Consequence
10. where the Most or Least influential Failure Mode is Failure Mode
11. where Consequence is most likely to occur due to Failure Mode
12. with a Confidence Type between value 1 and value 2

Step 2: Complete the filter statement (Note: enter value of 'nr' or 'NR' to search for assets that are 'not rated'):

Find: Sanitary Pipe, Sanitary Manhole, Sewer Pump Station, Sewer - Other

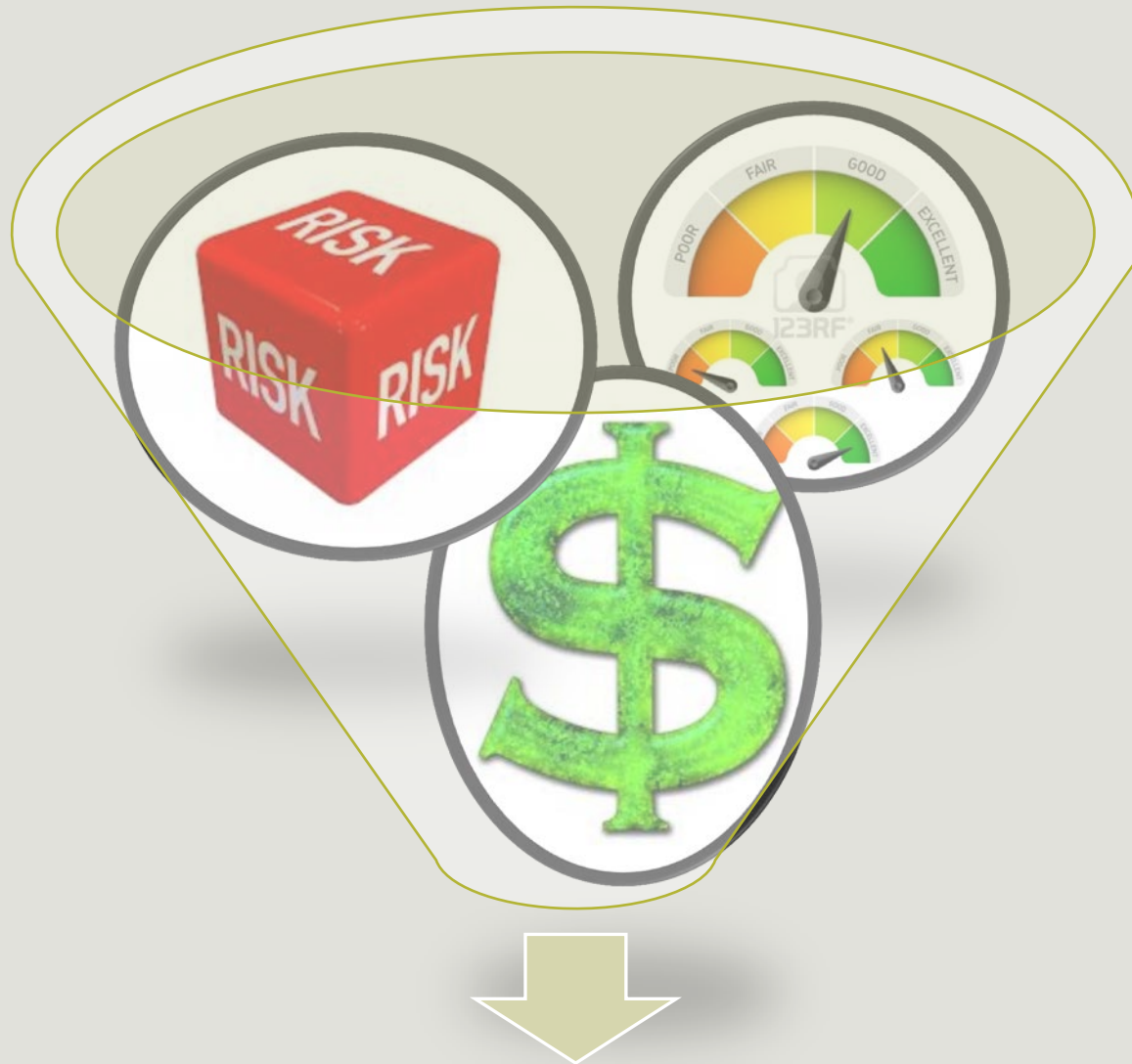
with a: % Life Left, Capacity, Condition, Efficiency, I/I, Sulfide

Failure Probability between: 90 % and 100 %

Step 3: Select from: All Assets Selected Assets

Step 4: Results will: Replace List Append List Filter List

Buttons at the bottom: Apply Filter, Clear Filter, Add To Selection, Clear Selection, Close

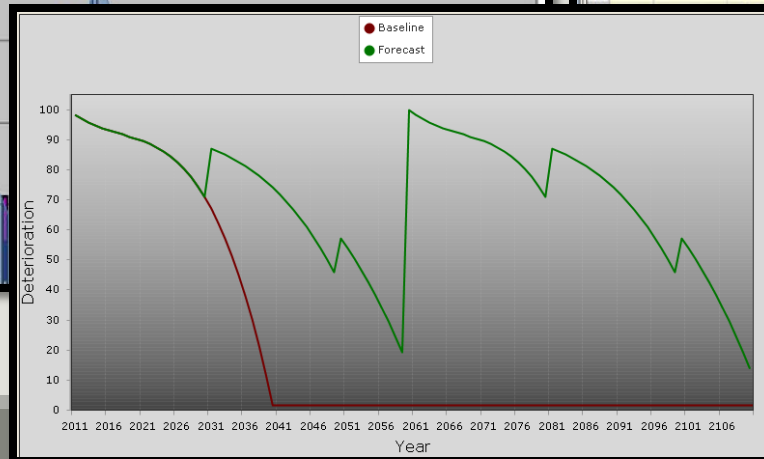
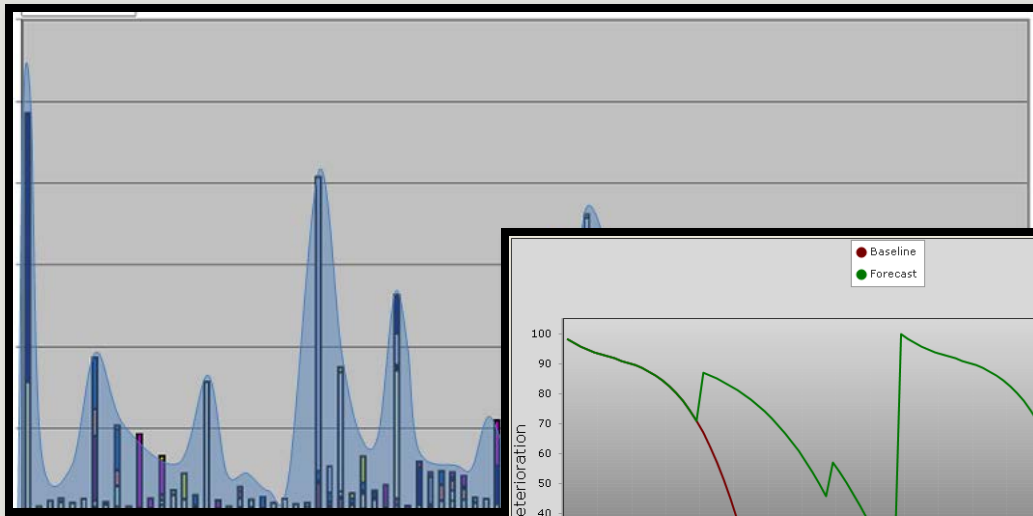


Budget Forecasting / Projects

Risk Utilized to Prioritize Budget Forecasts

Cost effective life-cycle planning

GIS-based strategic asset management tools to prioritize WHERE and WHEN work needs to be programmed and a powerful budget forecasting tool to forecast near and long term budgetary needs using decay curves, risk and condition data. Combined, these tools offer life cycle management capabilities that help agencies provide the consistent level of service that customers expect.



Budget Scenario Manager - Windows Internet Explorer

Filter is OFF - Current list contains 17 out of 17 Scenarios

Form View Table View Filter Reports

Scenario Name: [Blank] Scenario Type: Automatic Analysis Period: 100 Years (2110) Created By: [Blank] Modified By: [Blank]

Asset Class(es): Water Asset Type(s): Water Tanks

Notes Summary Job Details Audit Budget Documents

Scenario Time Span (years): 2011 - 2110 Current list contains 41 out of 41 Jobs

Year	Asset Type	Asset ID	Failure Type	Failure Probability	Job	D-Curve Before	D-Curve After	% Life Used Before	% Life Used After
10	2036	Water Tanks	2	Deterioration	Tank Coating	41.61	56.87	84.99	76.78
11	2036	Water Tanks	3	Deterioration	Tank Coating	41.61	56.87	84.99	76.78
12	2045	Water Tanks	1	Deterioration	Tank Coating	41.61	56.87	84.99	76.78
13	2046	Water Tanks	2	Deterioration	Replacement	13.83	100.00	93.80	0.00
14	2048	Water Tanks	3	Deterioration	Replacement	13.83	100.00	93.80	0.00
15	2049	Water Tanks	8	Deterioration	Tank Coating	41.61	56.87	84.99	76.78
16	2050	Water Tanks	5	Deterioration	Tank Coating	41.61	56.87	84.99	76.78
				Deterioration	Tank Coating	41.61	56.87	84.99	76.78
				Deterioration	Tank Coating	41.61	56.87	84.99	76.78
				Deterioration	Replacement	13.83	100.00	93.80	0.00
				Deterioration	Replacement	13.83	100.00	93.80	0.00

Assets [Apply Filter] [Add To Selection] [Clear Selection]

New New Copy Print... Close Rec [6] of 17 [17] of 17

Local intranet | Protected Mode: Off

Budget Forecasting Tools

- Budget Forecasting enables “What-if” scenario analysis
- Determines how assets will perform over time based on “What-if” funding scenarios
- Asset selection is based on Short-Term (**Risk-Based**) or Long-Term (D-Curve) criteria
- Budget Forecasting supports an agency in implementing the most optimal level of funding for Assets

Budget Forecasting

Budget Scenario Manager

Filter is OFF - Current list contains 1 out of 1 Scenarios

Form View | Table View | Filter | Reports

Scenario Name: **10 YR Sewer** | Scenario Type: **Automatic** | Analysis Period: **10 Years (2019)** | Created By: [Kenneth Spalding](#) 07/22/2010
 Modified By: [Kenneth Spalding](#) 08/09/2010

Asset Class(es): **Sewer**
 Asset Type(s): **Pipe**

Notes | **Summary** | Job Details | Audit

Scenario Time Span (years): **2010 - 2019**

Year	Baseline			Forecast			Budget	
	Avg Deterioration	Avg Age	Avg % Life Used	Avg Deterioration	Avg Age	Avg % Life Used	Budget Cap	Budget Required
2010	77.84	59.0	62.02 %	77.84	59.0	62.02 %	\$200,000	\$0
2011	73.90	60.0	63.13 %	73.90	60.0	63.13 %	\$206,000	\$0
2012	72.80	61.0	64.24 %	72.80	61.0	64.24 %	\$212,180	\$0
2013	71.65	62.0	65.35 %	71.65	62.0	65.35 %	\$218,545	\$0
2014	70.45	63.0	66.46 %	70.45	63.0	66.46 %	\$225,102	\$0
2015	69.18	64.0	67.57 %	69.62	63.0	66.64 %	\$231,855	\$228,166
2016	67.86	65.0	68.67 %	68.76	63.0	66.73 %	\$238,810	\$235,329
2017	66.47	66.0	69.78 %	67.87	63.0	66.81 %	\$245,975	\$243,238
2018	65.02	67.0	70.89 %	66.92	63.0	66.94 %	\$253,354	\$242,081
2019	63.52	68.0	72.00 %	66.08	63.0	66.97 %	\$260,955	\$246,251
Total							\$2,292,775	\$1,195,064

Save | Edit | Delete | New Rec | 1 of 1

Sewer Collection System Improvements

Step 5 | **Step 6** | Step 7 | Run

Average Deterioration Curve target for each Asset Type

(Set to 100 to ignore target levels) Refresh

Click to see if any assets fall below the minimum value allowed. It will be processed as budget cap allows. It is possible that the

Next>> | Save | Close

N: 278605 - E: 1196875 | Local intranet | 100%



questions?

