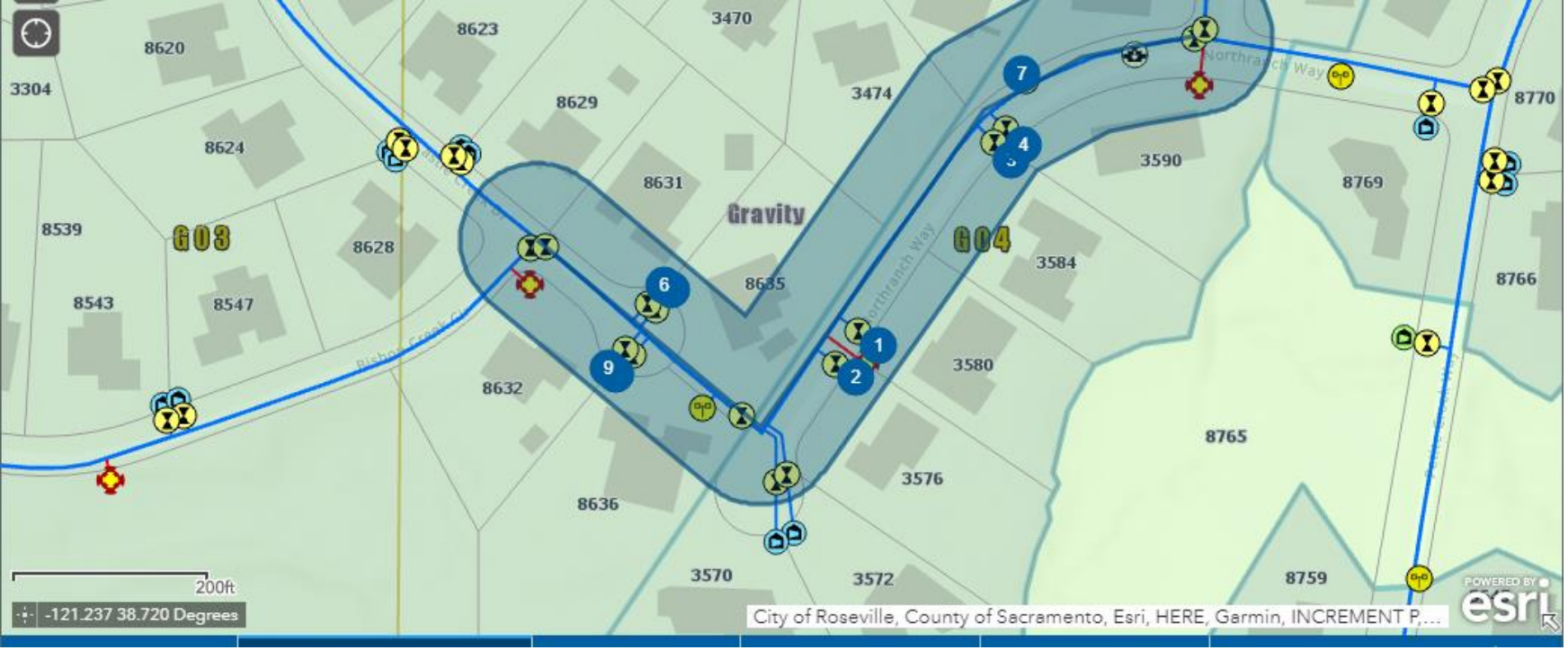
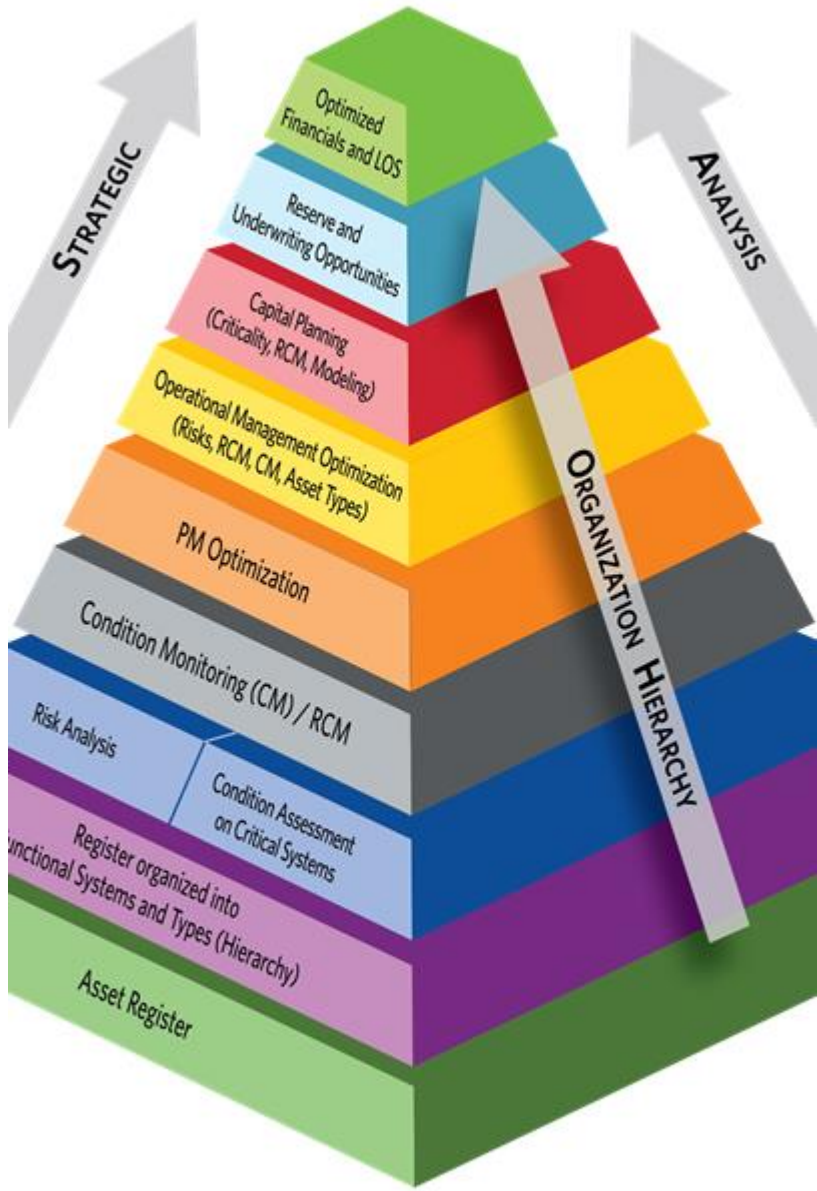


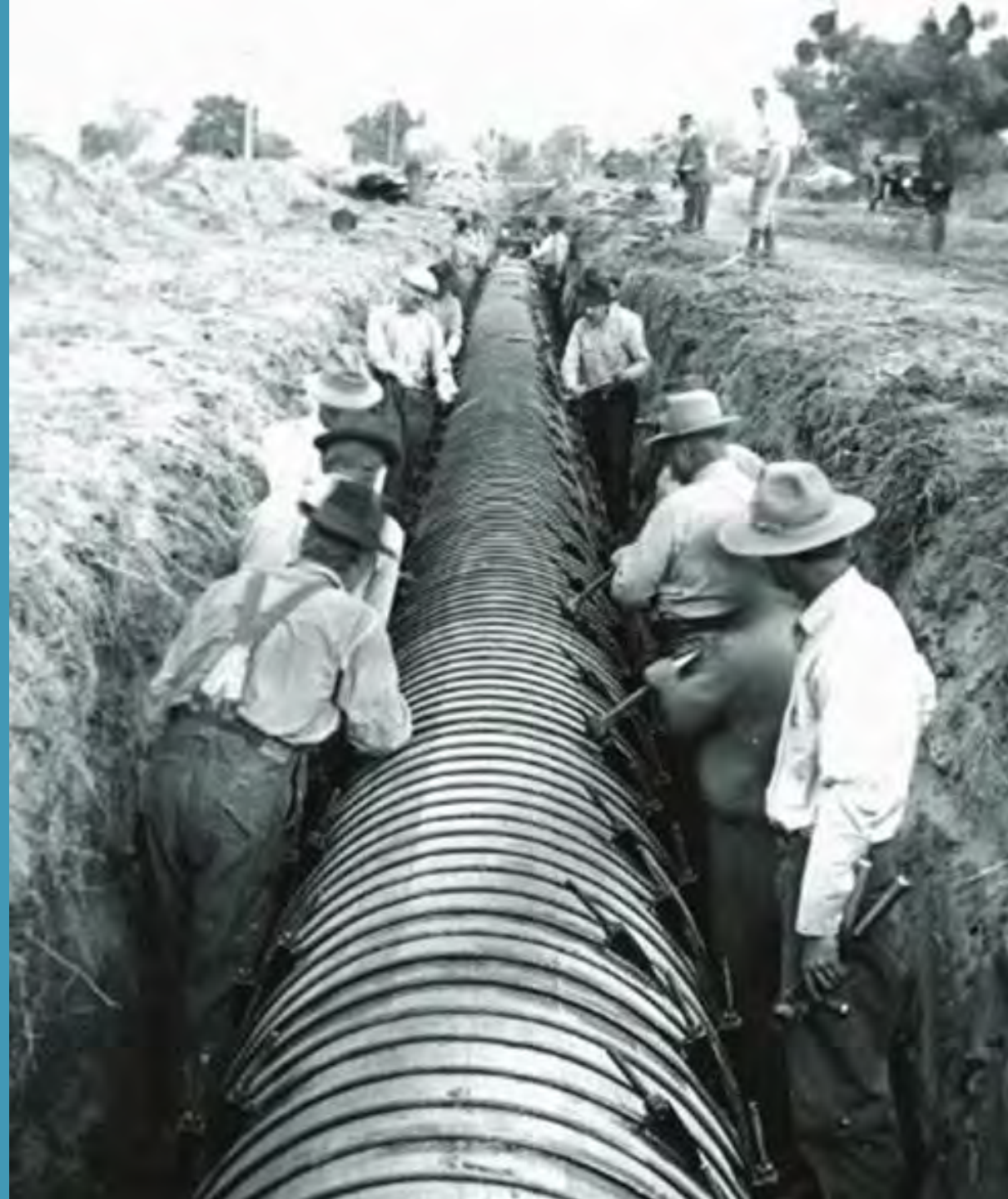


Leveraging Financial Capital Through Data-Driven Asset Management and GIS Applications

February 21, 2024

Agenda

- Tee Up: Data Driven Approach
- Asset Management
  - Allan Scott
- Pause for questions
- Geographic Information Systems
  - Randy Olden
- Wrap Up and Questions



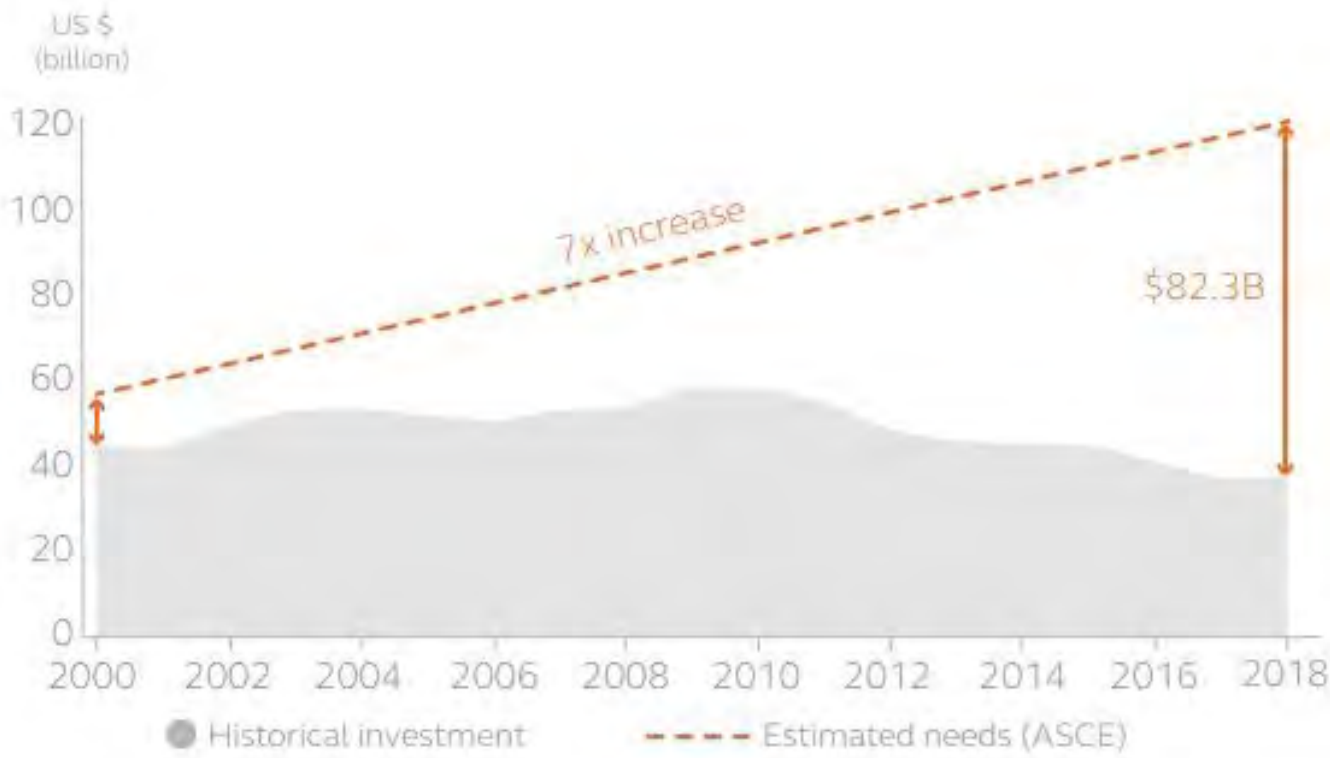
AWWA State of Water Industry

- 26% of utilities are struggling to cover cost of service
- 32% will struggle to cover full cost of service in the future
- No 1. Concern: renewal and replacement of aging infrastructure
- No 2. Concern: financing for improvements
- Honorary mention: workforce turnover/retirements

Mountain County Agencies

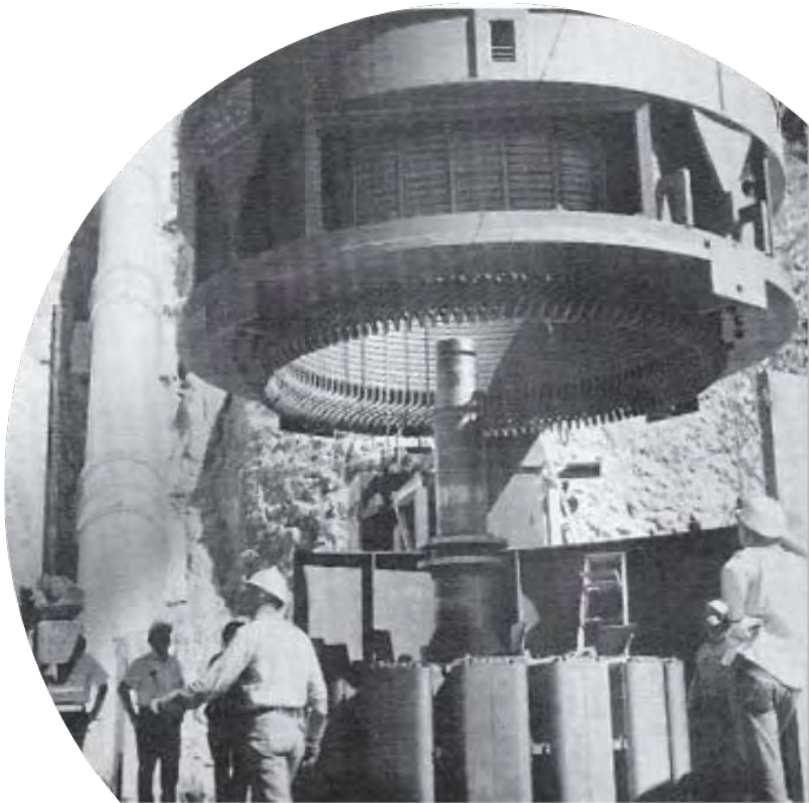
- Very challenging infrastructure to repair and replace!

Water and wastewater capital needs versus historical investment



Sources: American Society of Civil Engineers, U.S. Congressional Budget Office, Bluefield Research

Total gap projected to grow to **$434 billion** by 2029



ASCE AMERICAN SOCIETY® OF CIVIL ENGINEERS

Traditional Approach

Focus on Capital Expenditures for repair and replacement

Often lacks Operational Expenditure or Total Expenditure over the asset’s lifecycle

Creates reactive and preventative maintenance approach

- static, time-based
- standard industry assumptions
- mean time to failure

Data Driven Approach

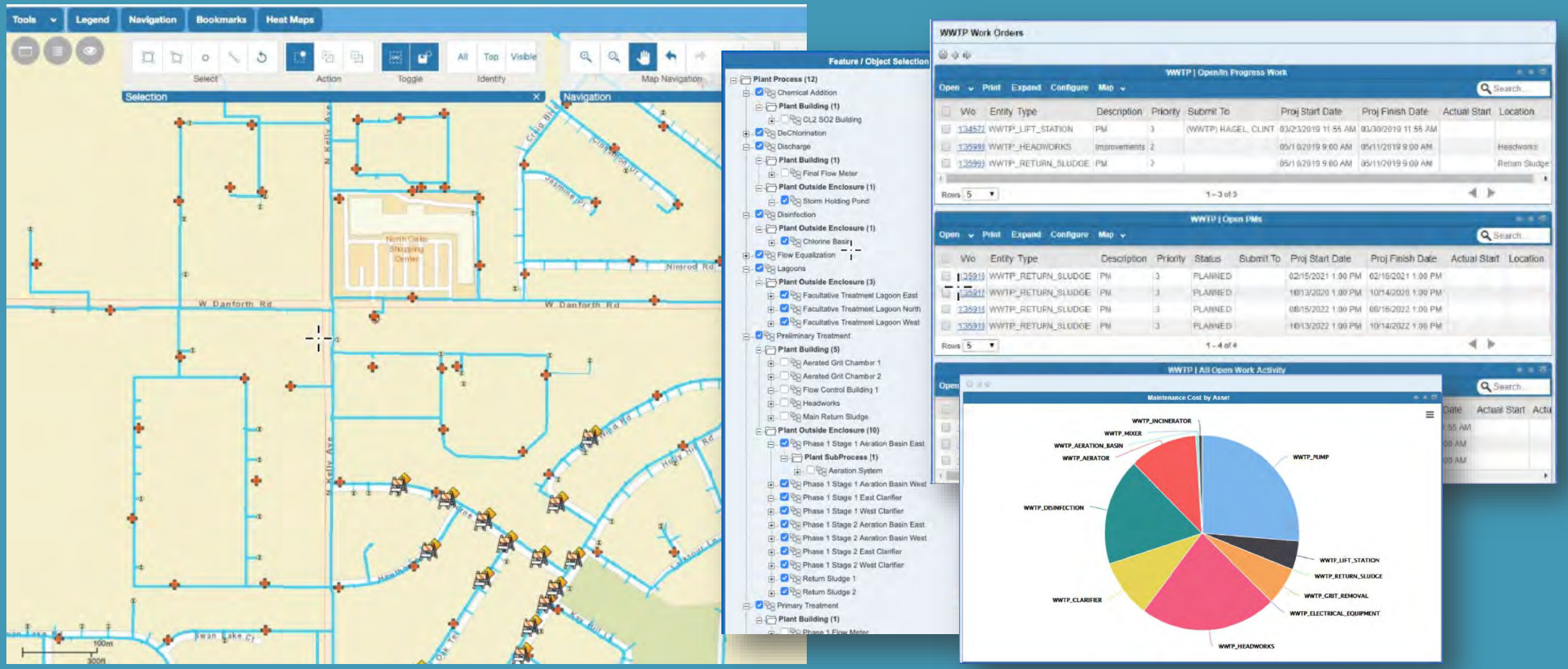
Maximize Value over asset Operating Life

- Emphasizes integration, bringing data from multiple sources to inform maintenance and replacement decisions
- Prioritize risks before infrastructure fails
- Optimize spending decisions, reducing infrastructure funding gap
- Digital asset planning approach have allowed utilities to reduce capital expenditures up to 20%, and save significant O&M energy costs

Data Driven Approach and Institutional Knowledge

- Estimated 10.6% of water sector workers will retire or transfer each year
- Some expecting half of their workforce to retire in 5 to 10 years
- Recognizes and captures the substantial value that utility workers create for their organizations and customers
- Provides an avenue to improve onboarding, increases knowledge transfer, video training for new hires

Data Driven Approach is Scalable

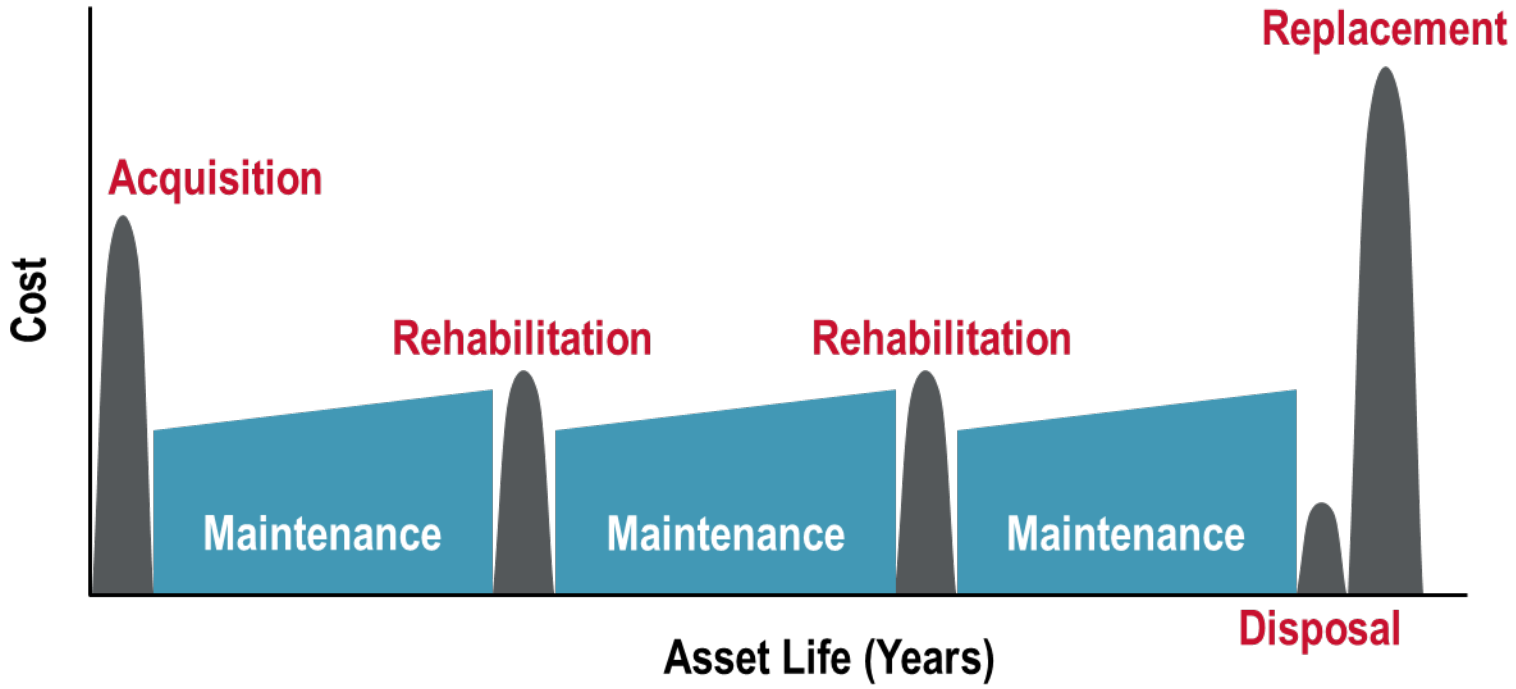


Asset Management

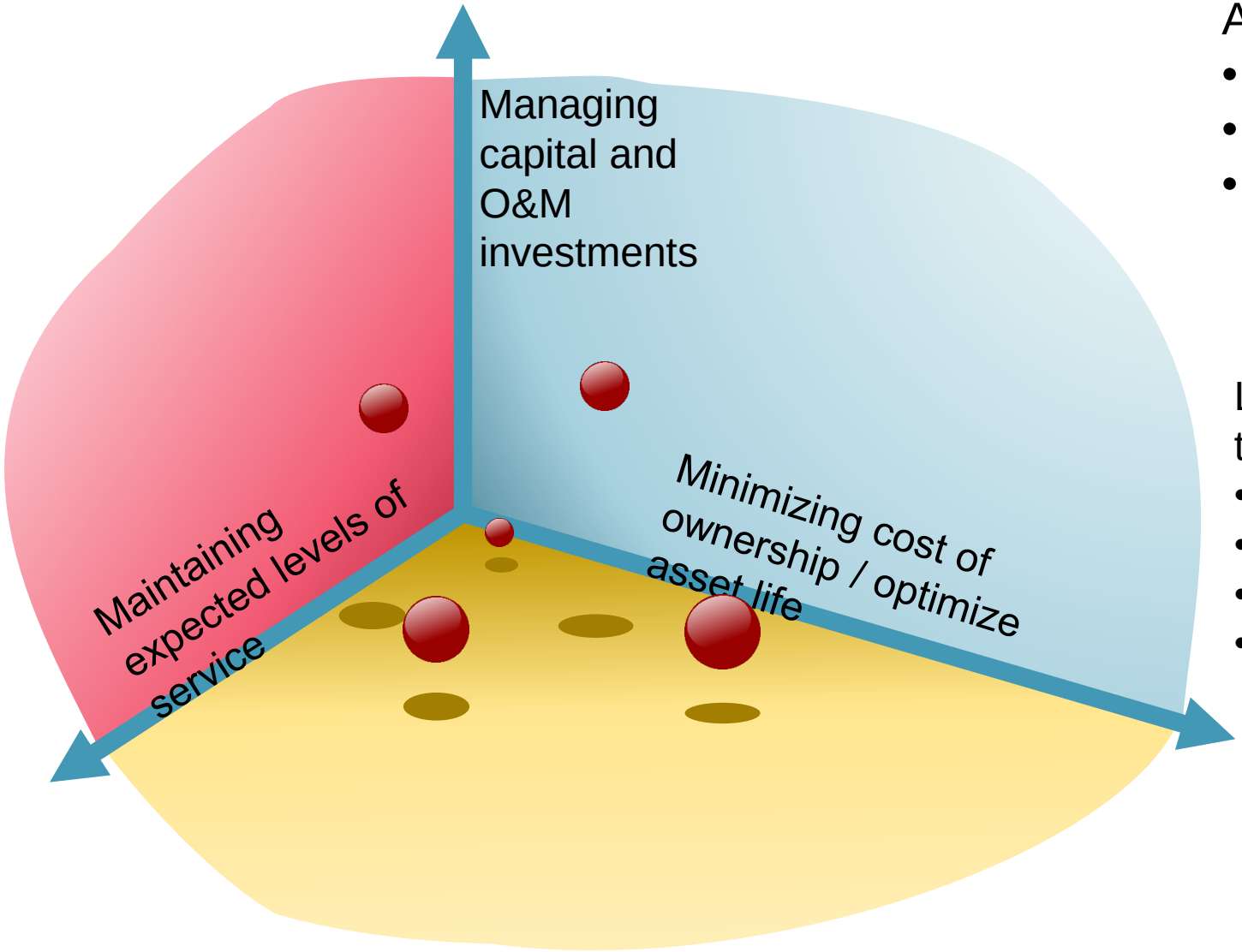
Allan Scott

What is asset management?

Goal of asset investment planning is to minimize lifecycle costs and realize value from the assets



What is Asset Management?



AM balances out:

- Investments,
- Cost of ownership
- Maintaining defined levels of service

Level of Service – measure of the quality of service provided:

- Minimal water outages
- Minimal sewer overflows
- Treatment capacity
- Pavement condition

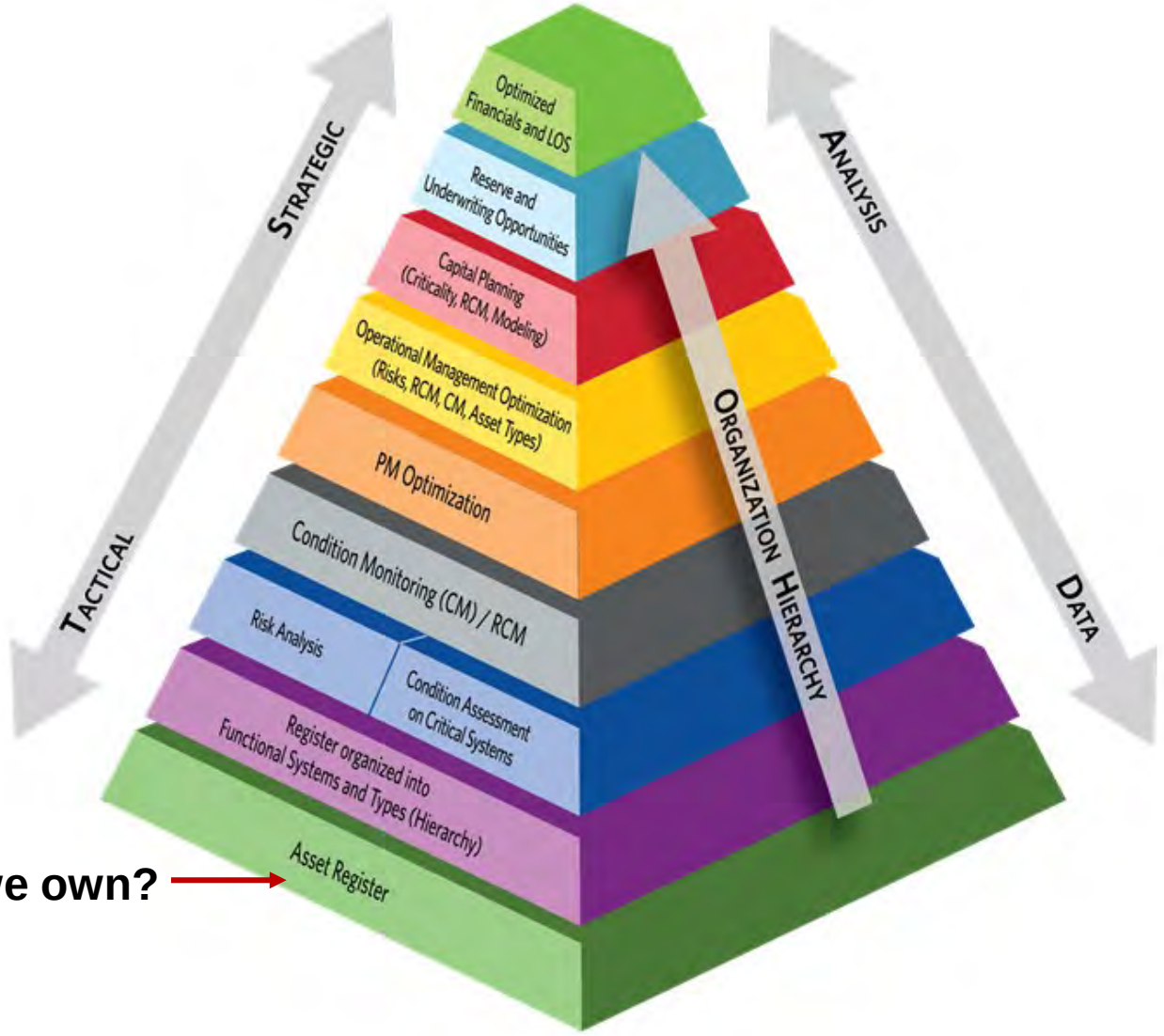
Most utilities have thousands of assets of various ages, condition, importance, and cost

Asset Management provides a framework to organize utility decision-making

- Make decisions based on measurable data
- Manage risk – ties to expected service levels
- Alignment from corporate to field level
- Repeatable processes/sustainable programs

Most utilities are doing some form of asset management whether they know it or not

Intuitive ⟷ Quantitative

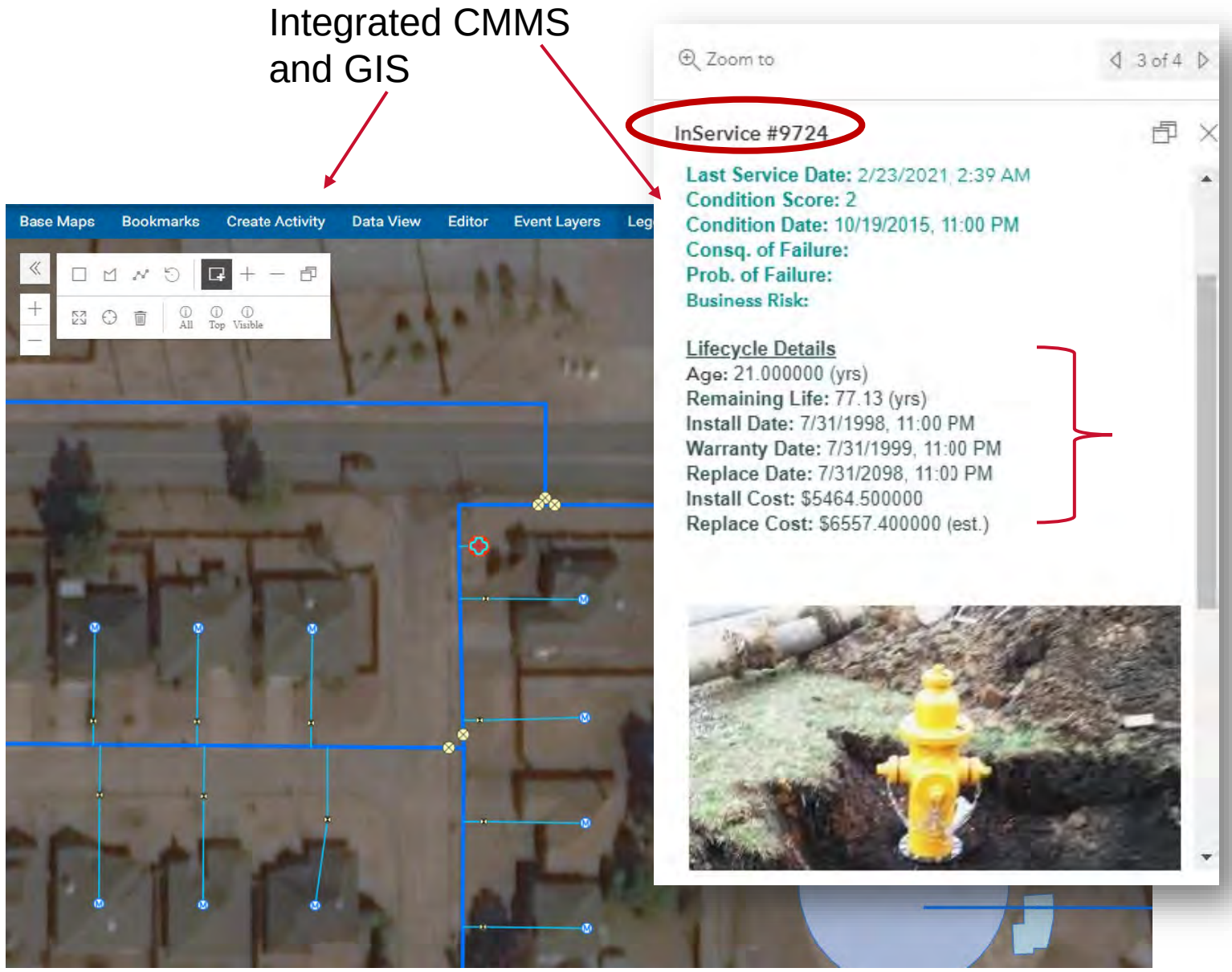


What do we own? →

Credit:
Uberlytics LLC, 2017

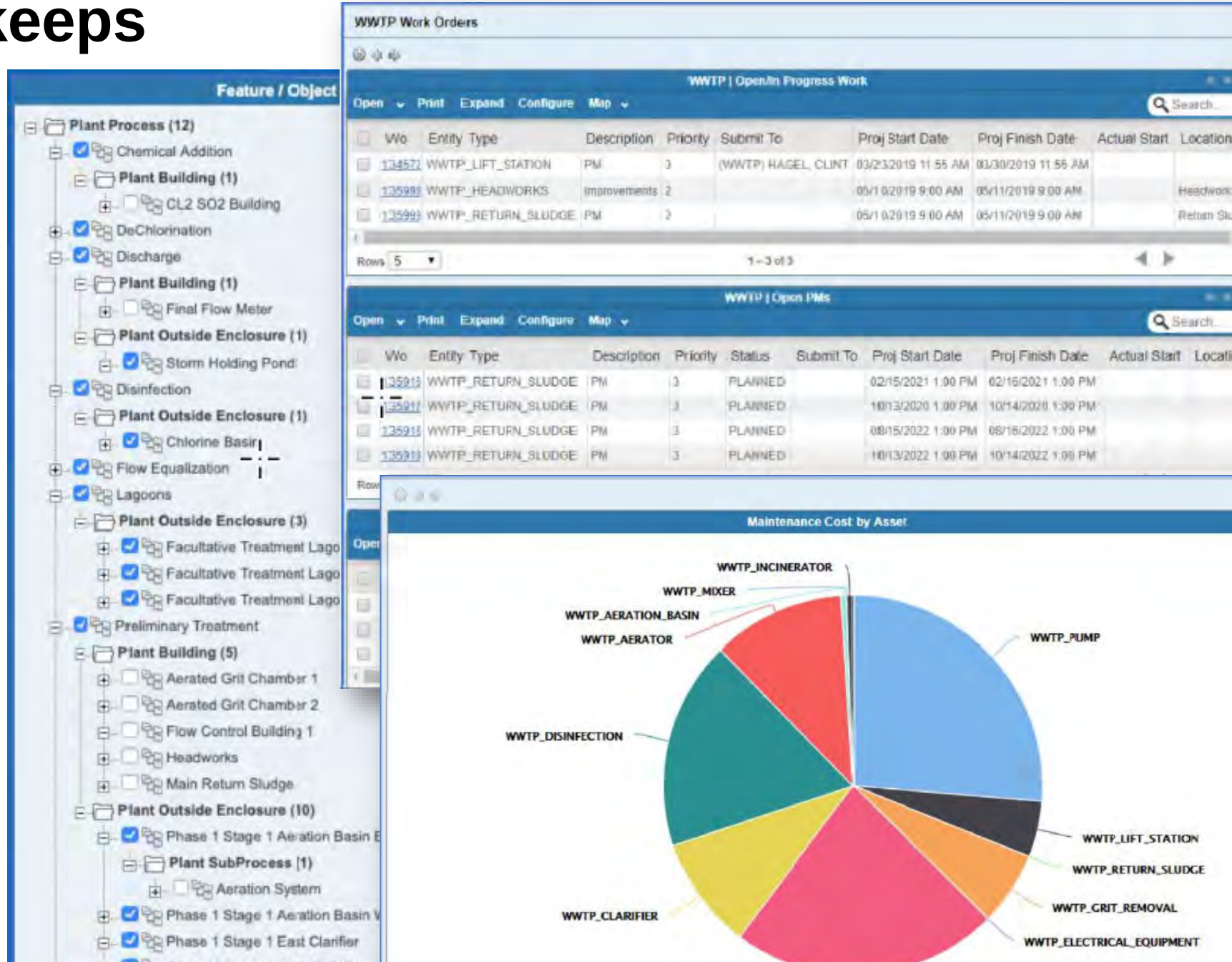
Asset Registry Key Concepts

- Designate one authoritative source for all managed data
- One standard naming convention
- Only manage data used for analysis and decision-making
- Organize data in a hierarchy or spatially (e.g. map books)
- Build in quality control procedures
- Leverage data investment using mobile technology



Asset Hierarchy keeps data organized

- Good for buildings and facilities
- Organized by system/process
- Easy to find equipment
- Supports analysis and reporting
  - Reviewing open work orders
  - Comparing maintenance costs per system



Asset Management provides a framework to organize utility decision-making

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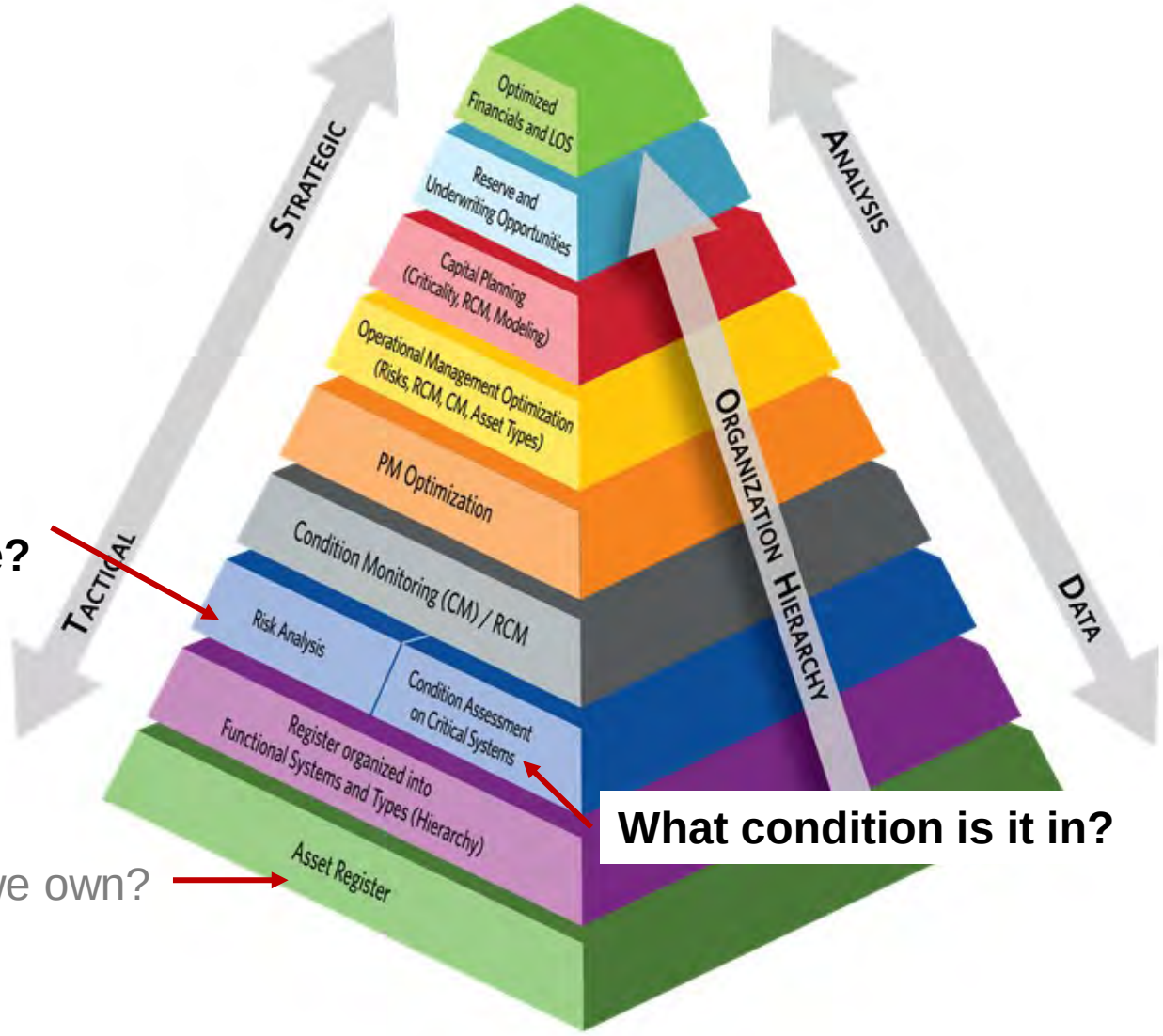
Which assets are critical to performance?



What condition is it in?

What do we own?

Credit:
Uberlytics LLC, 2017

Risk-based planning drives prioritization and condition assessment approach

= Likelihood x Consequence

What is the likelihood the asset will fail?

- Condition
- Location
- Performance
- Maintenance history

What are the consequences of asset failure?

Consider costs from stakeholder perspective

- Health and safety
- Financial
- Regulatory compliance
- Service delivery

Risk-based planning drives prioritization and condition assessment approach

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What is
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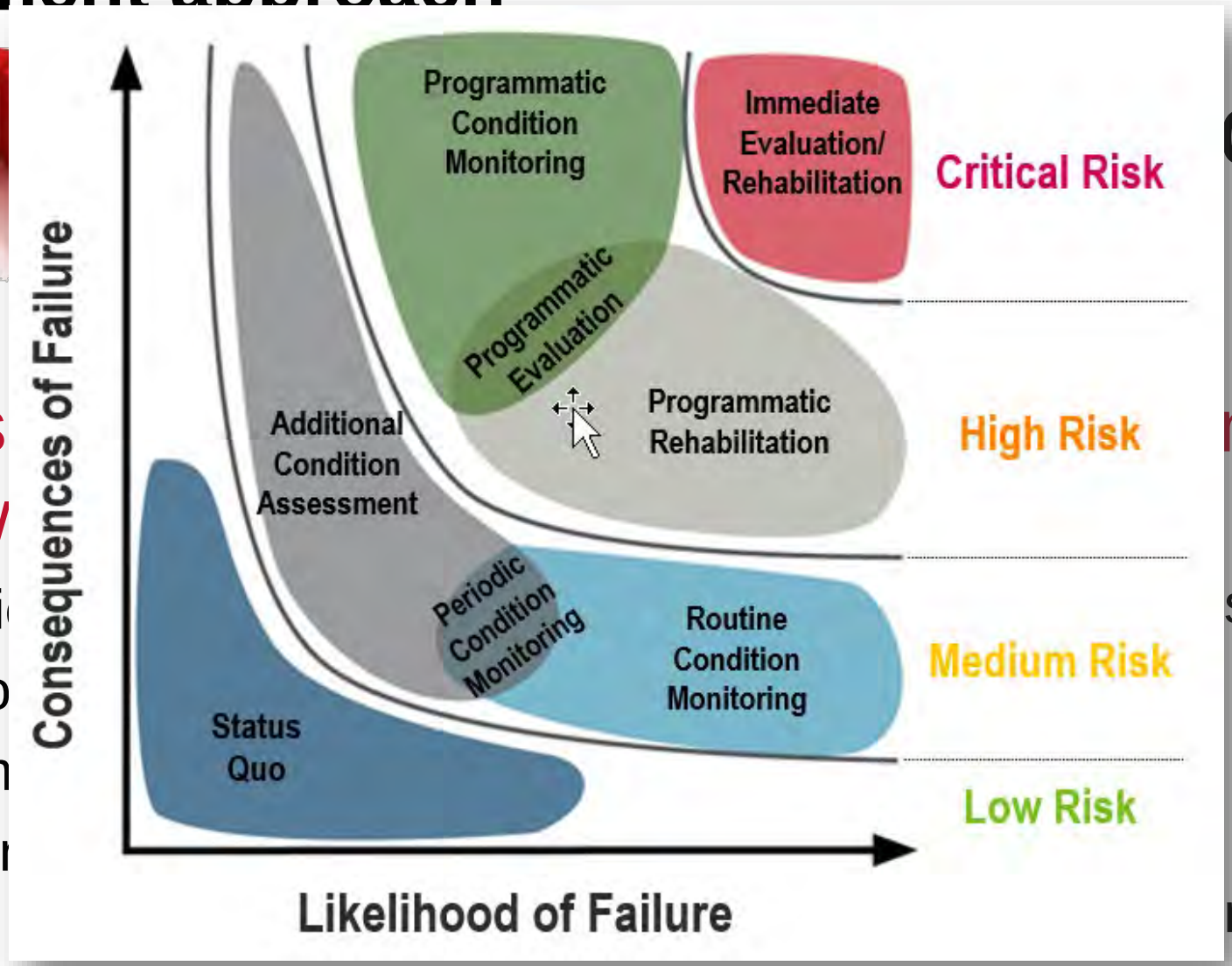
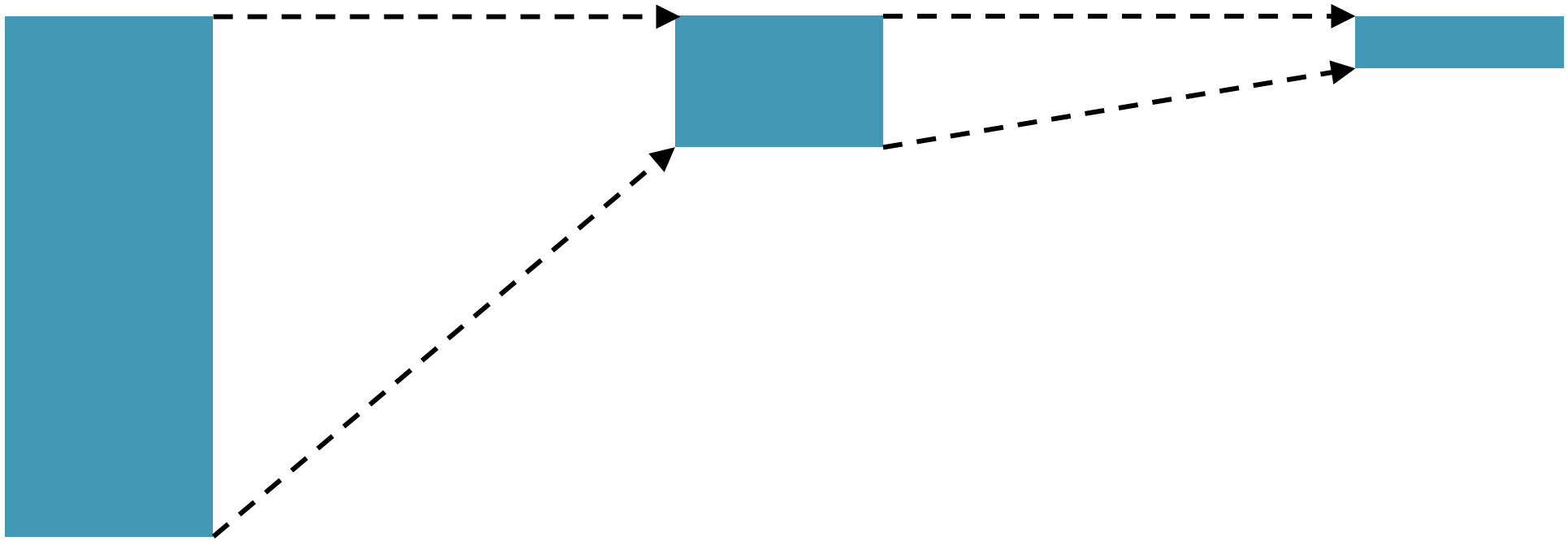
- Service delivery



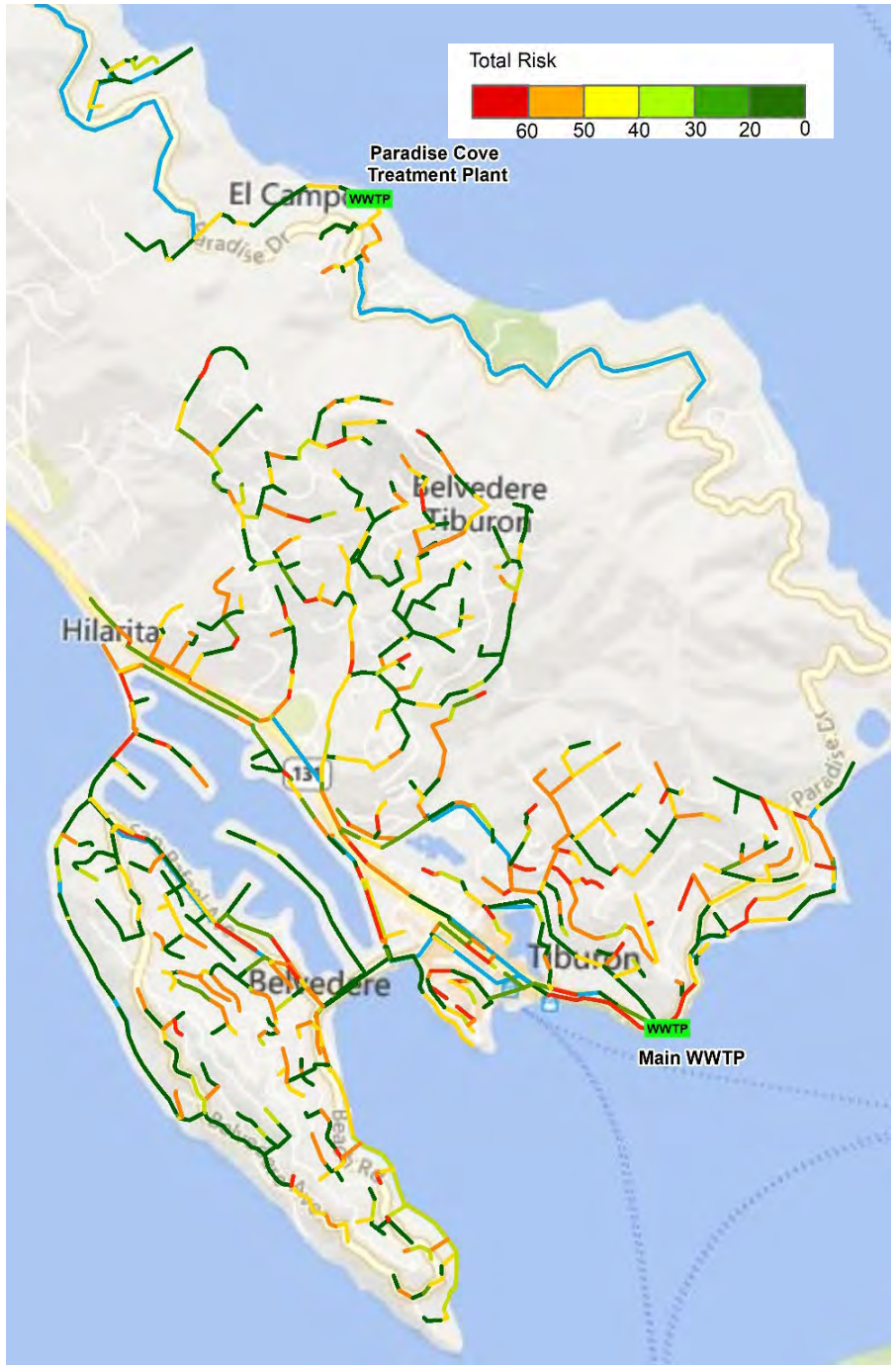
Condition Assessment Planning

Risk-based approach focuses your condition assessment efforts

Desktop Review / Rapid Field Assessment	Performance Evaluation ("At Risk" Assets)	Specialist Inspections (Critical / High Cost Assets)
All Assets	15%-25% of Assets	5%-10% of Assets



Increasing Level of Effort / Cost of Acquiring Information



Gravity Main Assessment
Risk Modeling

LoF (70%) + **CoF 30%** = **Risk Score**

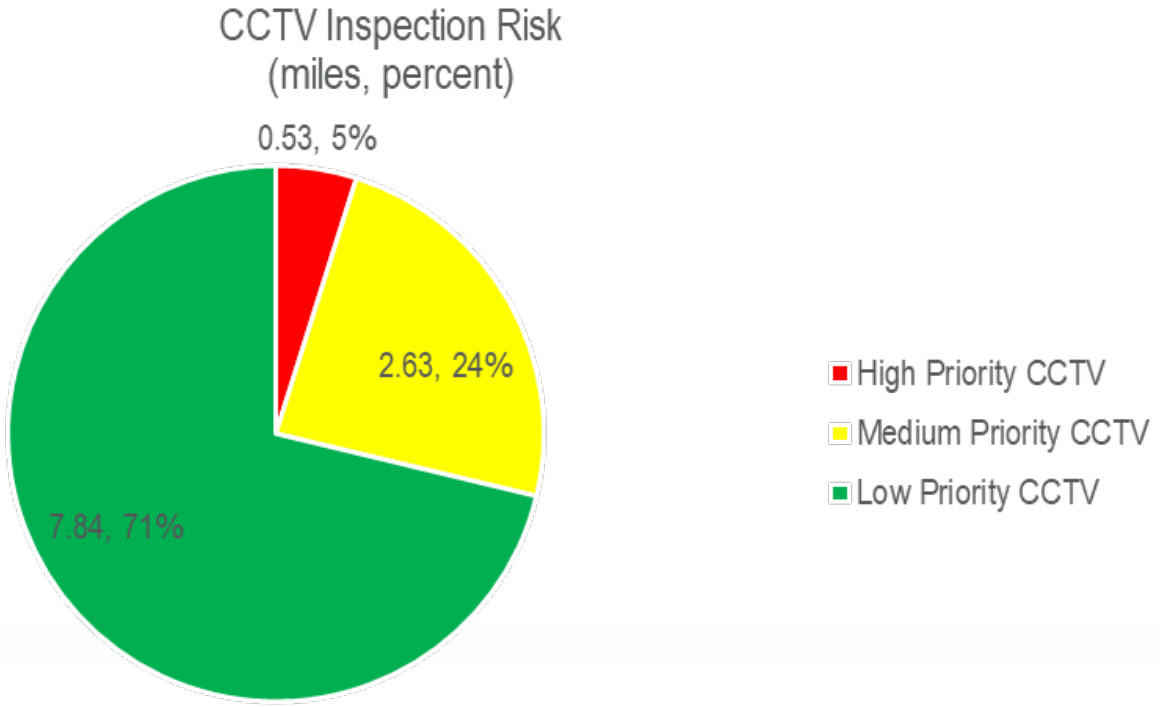
- CCTV (Peak Structural Score) [55%]
- Maintenance (Cleaning Frequency) [10%]
- Material (Pipe Material) [5%]

- Customer Service (Pipe Diameter) [10%]
- Public Exposure (Critical Facilities) [10%]
- Regulatory (SSO History) [10%]

- Likelihood of Failure (LoF)
  - How quickly will it fail?
- Consequence of Failure (CoF)
  - How bad is it if it does fail?

InfoAsset™ Planner

Gravity Main Assessment
Results



- For the next 5 years:
  - Rehab – 2.2 miles ($3M)
  - Inspection – 1-2 miles ($100K)

Asset Management provides a framework to organize utility decision-making

- Make decisions based on measurable data
- Manage risk – ties to expected service levels
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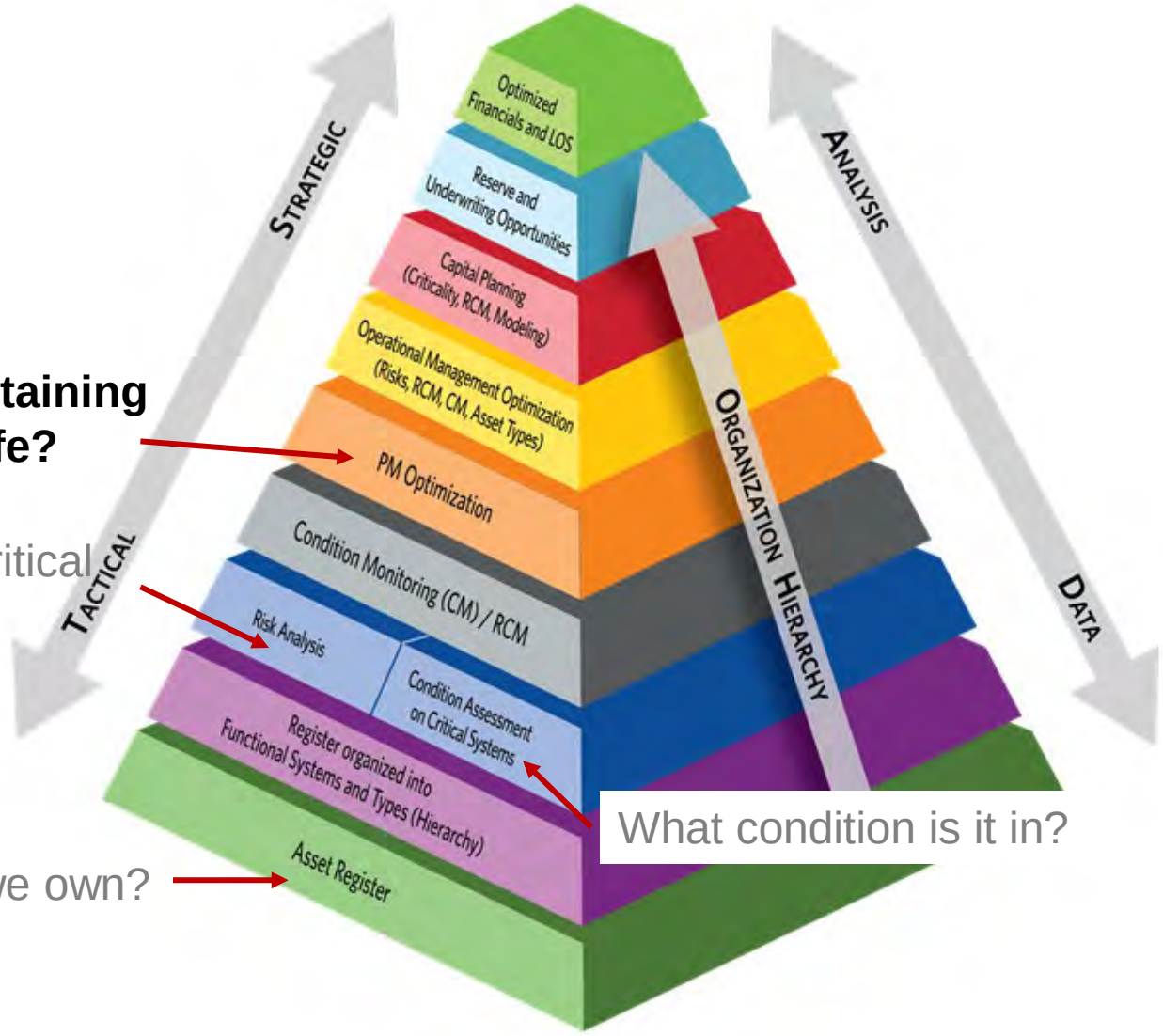
- Repeatable processes/sustainable programs

Am I properly maintaining for longest asset life?

Which assets are critical to performance?

What do we own?

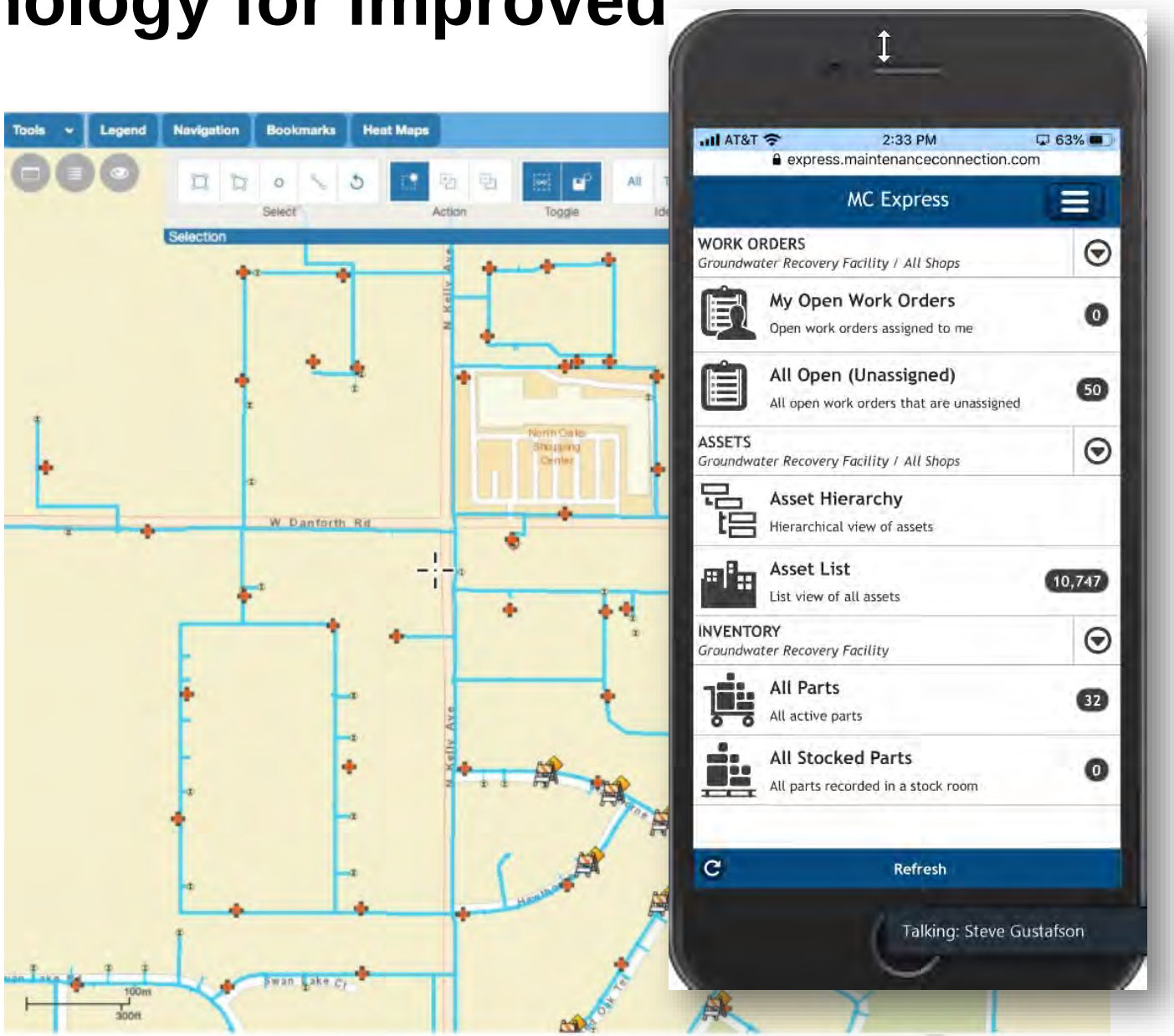


What condition is it in?

Credit:
Uberlytics LLC, 2017

Benefits of mobile technology for improved maintenance

- Low cost to implement
- Secure
- Provides field staff with key maintenance history, job plans, procedures
- Quickly and accurately record new work
- Collect key data for real-time analysis
- Capture institutional knowledge



Asset Management provides a framework to organize utility decision-making

- Make decisions based on measurable data
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- Alignment from corporate to field level
- Repeatable processes/sustainable programs

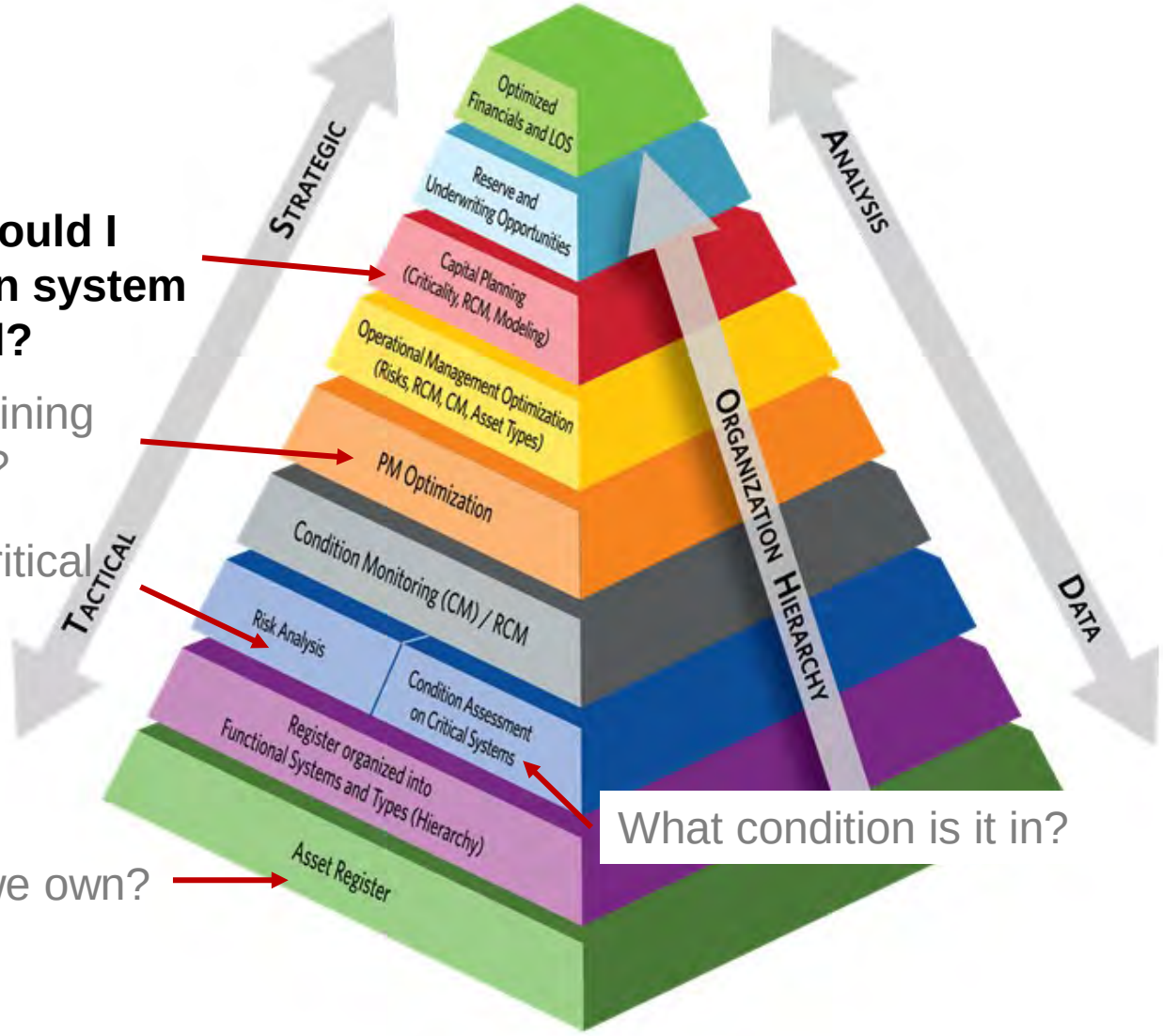
How should I invest in system renewal?

Am I properly maintaining for longest asset life?

Which assets are critical to performance?

What condition is it in?

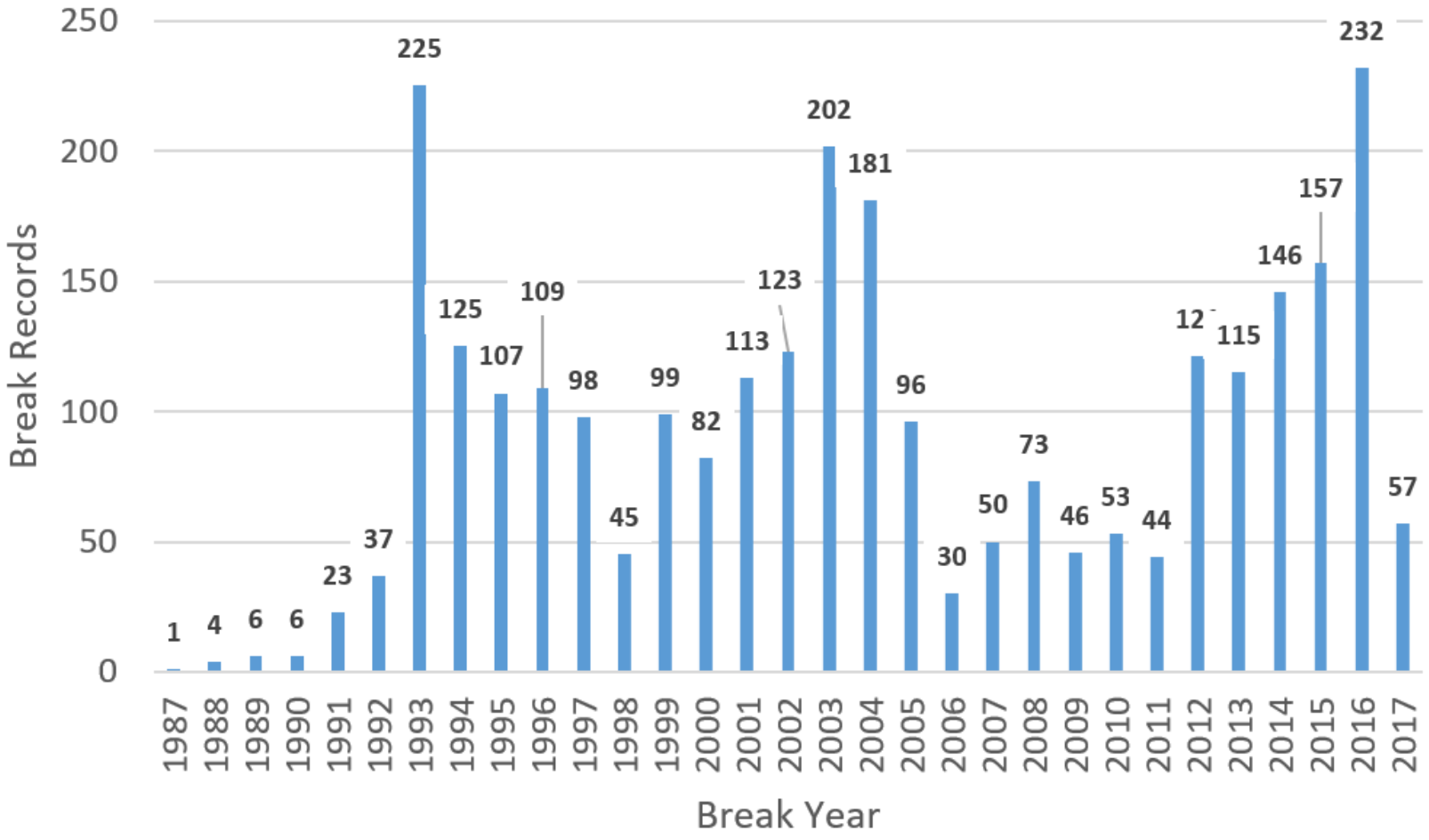
What do we own?



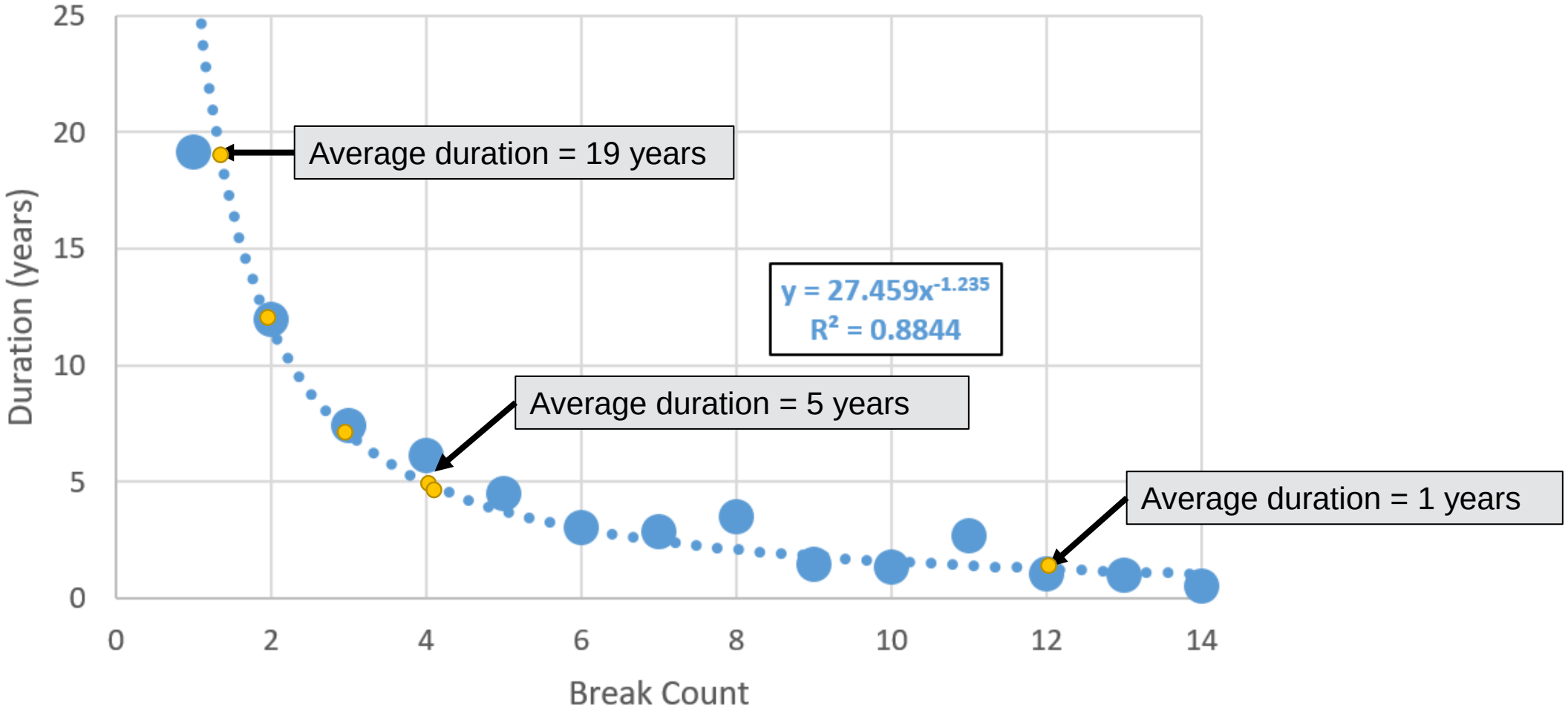
Credit:
Uberlytics LLC, 2017

Main break forecasting aligns capital investment and target level of service

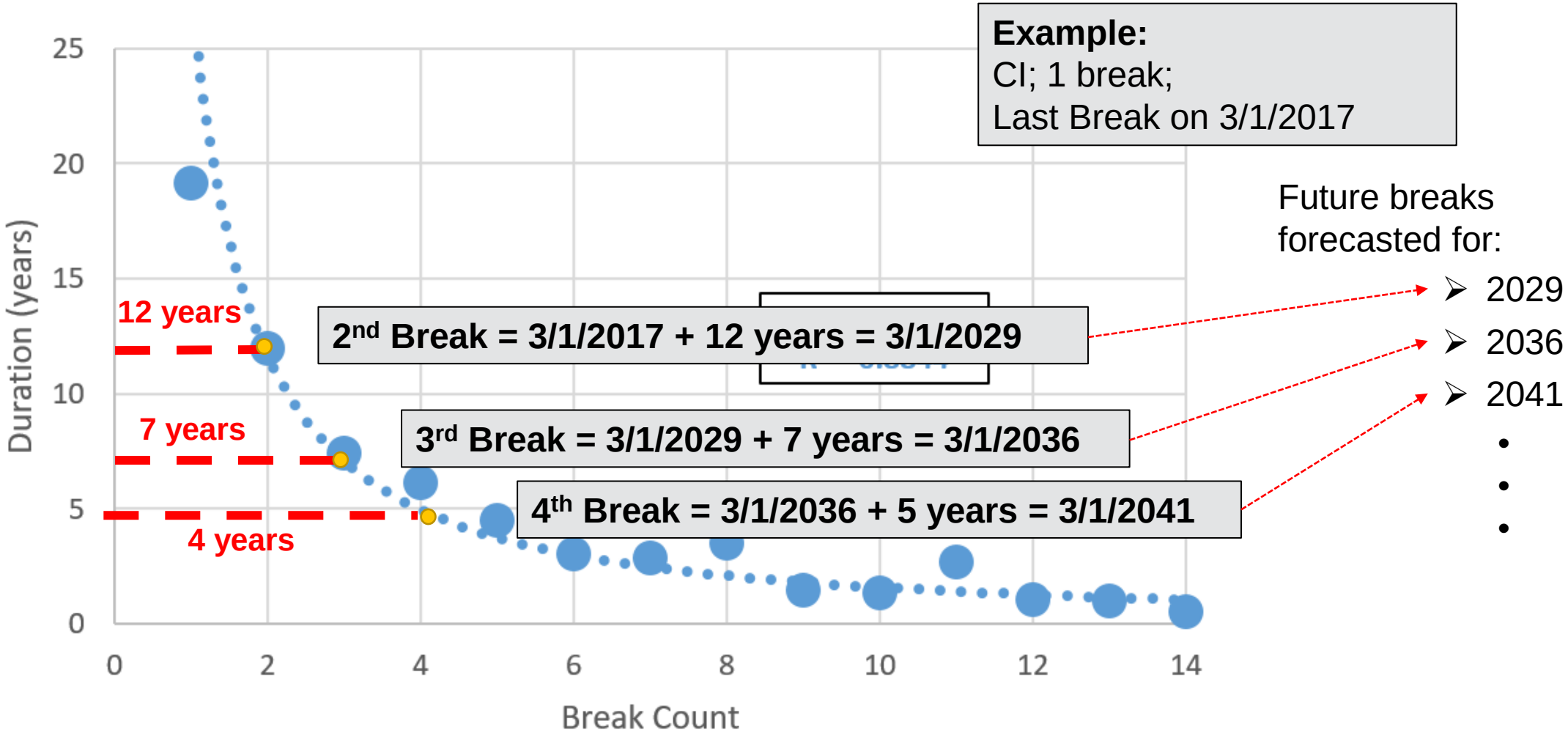
- Using break history to measure historical main break frequency
- Forecast future breaks based on historical patterns
- Model different investment scenarios to see how future break rates are affected



Project Break Forecasting Curve



Project Break Forecasting Curve



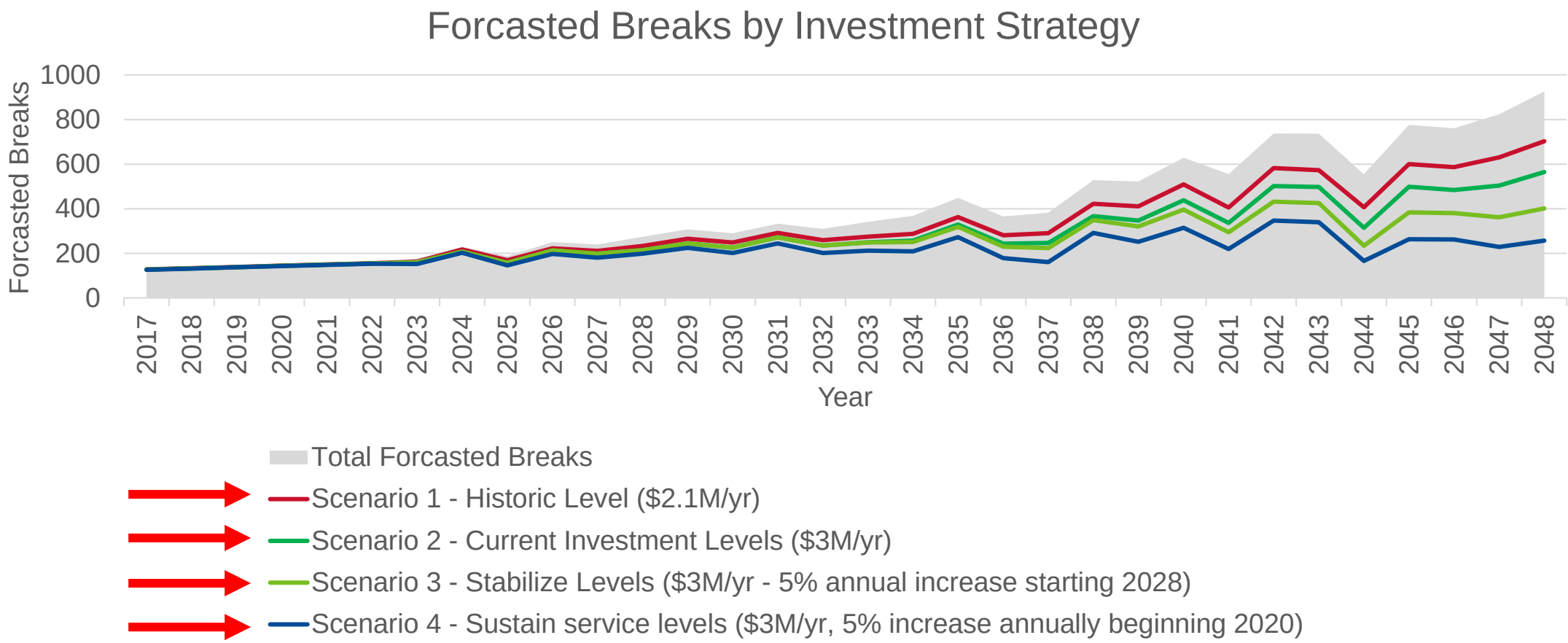
Summary of Scenarios

Settings/Service Levels	Investment Scenario			
	1	2	3	4
Initial renewal level (mi/yr)	1.5	2.15	2.15	2.15
Funding Increase Begins	2018	2018	2028	2020
Annual % Increase	0%	0%	5%	5%
Cumulative Investment (in millions)	$ 69	$ 99	$ 155	$ 219
Break Rate (# breaks/100 mi by 2050)	70	55	39	23
Year to Replace (by 2050)	567	396	135	92
Cumulative Breaks Avoided	3,352	4,411	5,061	6,254
Cumulative Customer Outages Avoided	64,820	68,880	74,230	93,430

Scenarios Modeled:

- Scenario 1 – Sustain Historic Investment Levels
- Scenario 2 - Sustain Existing Investment Levels
- Scenario 3 – Stabilize Service Levels* in about 30 years
- Scenario 4 – Sustain Existing Service Levels

Forecasted Breaks by Investment Strategy



Asset Management provides a framework to organize utility decision-making

- Make decisions based on measurable data
- Manage risk – ties to expected service levels
- Alignment from corporate to field level
- Repeatable processes/sustainable programs

What do my customers/ stakeholders expect?

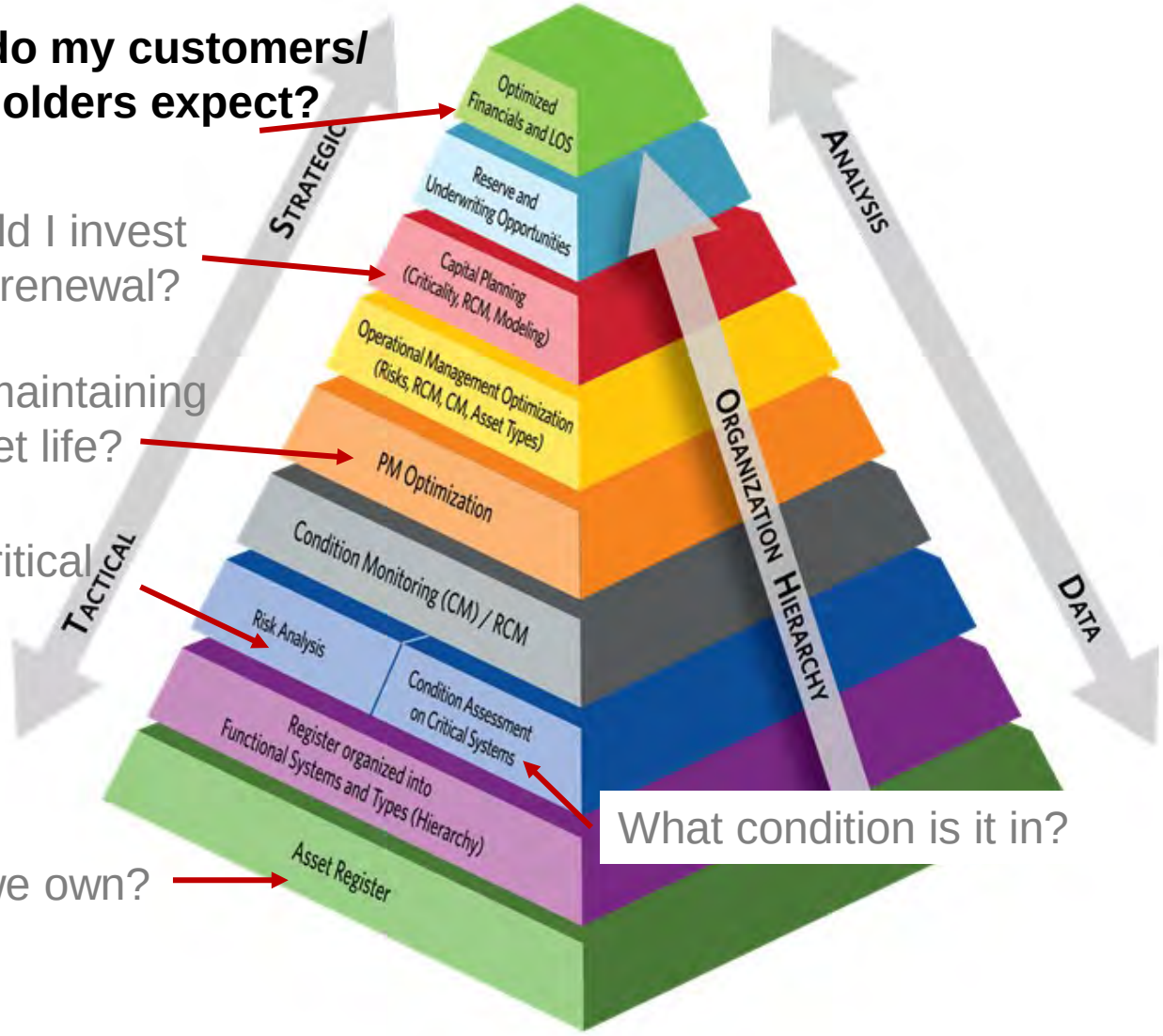
How should I invest in system renewal?

Am I properly maintaining for longest asset life?

Which assets are critical to performance?

What condition is it in?

What do we own?



Credit:
Uberlytics LLC, 2017

Project prioritization normalizes impacts of improvements

- Leverages on-going risk and condition assessments
- Assigns weightings to different service levels for different asset types
- Use existing risk data to create a normalized project score for each recommended improvement

- **Environmental Impacts** - How does failure impact waterways, environmentally sensitive areas?
- **Stakeholder/Customer Service** - How does failure impact customers, partner agencies, etc.?
- **Regulatory Compliance -** Will failure cause the District to violate regulatory requirements?
- **Health and Safety** - Injury to public, District staff, contractors, etc.
- **Financial Impact** - Will failure create significant financial impact to District or communities?
- **Ability to Restore Asset to Design Level of Service** (**LOS)** - How difficult will it be to restore expected level of service?
- **Location/Critical Facility Impact** - What is the impact of the failure on the community (e.g. open spaces vs. schools & hospitals)

Project prioritization normalizes impacts of improvements

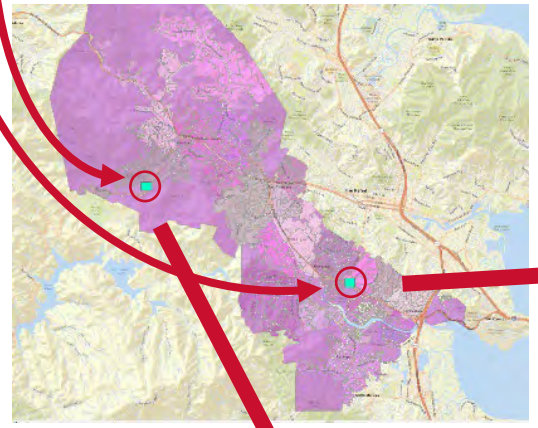
- Leverages on-going risk and condition assessments
- Assigns weightings to different service levels for different asset types
- Use existing risk data to create a normalized project score for each recommended improvement

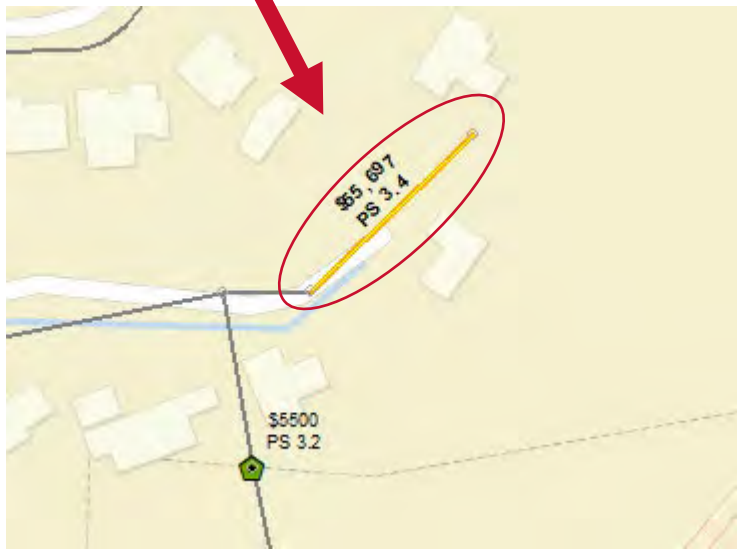
	Environmental	Stakeholder/Customer Service	Regulatory Compliance	Health and Safety	Financial Impact	Ability to Restore to Design LOS	Location/Critical Facility Impact	Overall Percentage
Gravity Mains	18%	18%	20%	10%	13%	13%	18%	**15%**
Manholes	18%	10%	10%	15%	13%	13%	18%	**14%**
Force Mains	28%	18%	15%	23%	28%	28%	25%	**23%**
Creek Crossings	28%	30%	30%	23%	20%	28%	10%	**24%**
Lift Stations	10%	25%	25%	30%	28%	20%	30%	**24%**
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Key:
Red numbers – highest for category
Red cells – highest for asset class

Project score prioritizes projects based on service levels

PIPE ID		Environmental	Stakeholder/ Customer Service	Location/Critical Facility Imact	Regulatory Compliance	Health and Safety	Ability to Restore to Design LOS	Finacial Impacts (No Criteria)	Risk	Project Prioritization Score
G341.010.G340.010.1	COF Scores	10	10	10	6	1	10	NA		
	PPS Weighting Factor	19%	20%	18%	21%	11%	13%	12%		
	Category Weighted Scores	**1.86**	**1.96**	**1.75**	**1.27**	**0.11**	**1.25**	**1.20**	**1**	**10.40**
F392.02D.F392.010.1	COF Scores	1	1	1	2	1	1	NA		
	PPS Weighting Factor	19%	20%	18%	21%	11%	13%	12%		
	Category Weighted Scores	**0.19**	**0.20**	**0.18**	**0.42**	**0.11**	**0.13**	**1.20**	**1**	**3.42**

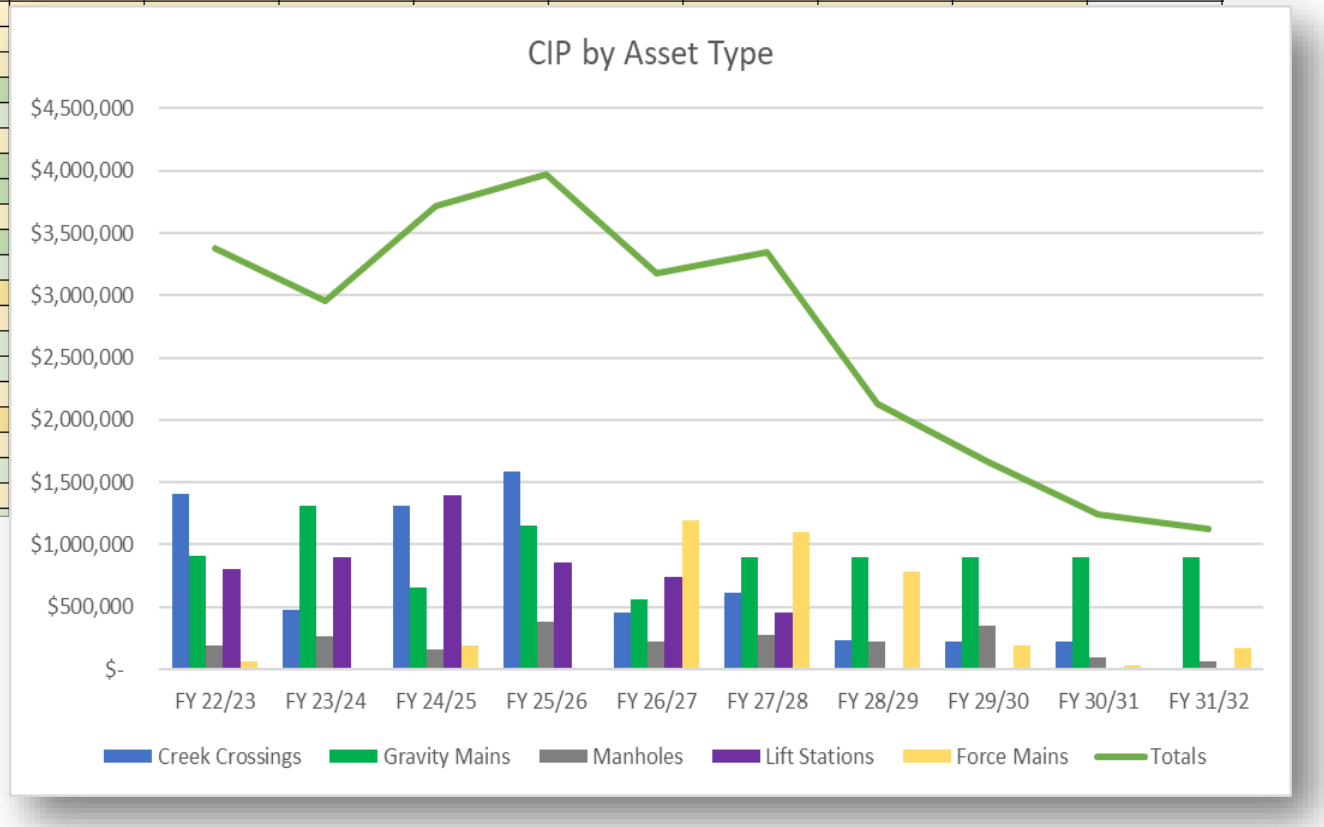




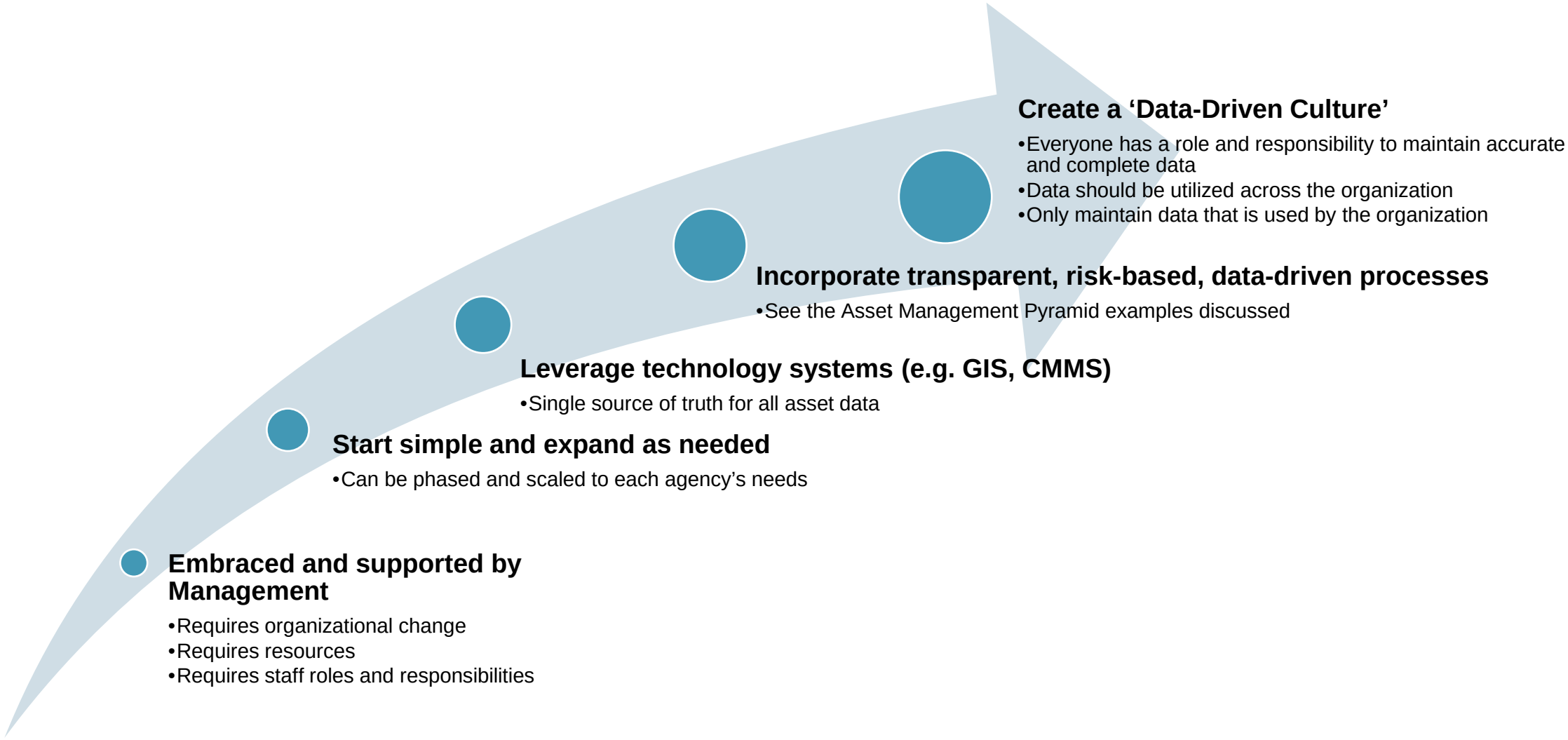
Data-driven Capital Improvement Plan

	A	B	I	J	K	O	P	Q	R	S	T	U	V	W	X	Y
1			Manhole	$ 2,218,400		$ 194,900	$ 263,000	$ 154,500	$ 382,600	$ 227,100	$ 276,200	$ 218,600	$ 345,000	$ 95,000	$ 61,500	High I&I Priority
2			Gravity Main	$ 9,079,830		$ 908,771	$ 1,307,028	$ 654,231	$ 1,150,183	$ 559,617	$ 900,000	$ 900,000	$ 900,000	$ 900,000	$ 900,000	High I&I Priority
3			Creek Crossing	$ 6,157,619		$ 1,313,146	$ 480,637	$ 1,306,979	$ 1,469,580	$ 438,985	$ 549,396	$ 202,675	$ 207,190	$ 189,031	$ -	Medium I&I Prio
4			Force Main	$ 3,840,000		$ -	$ 60,000	$ 166,667	$ 60,000	$ 1,370,000	$ 810,000	$ 750,000	$ 226,667	$ -	$ 396,667	Medium I&I Prio
5			Lift Stations	$ 5,251,600		$ 800,000	$ 900,000	$ 1,400,000	$ 858,600	$ 739,200	$ 453,800	$ -	$ -	$ -	$ -	
6			Total CIP	$ 26,447,448		$ 3,216,817	$ 3,010,665	$ 3,682,376	$ 3,920,963	$ 3,334,901	$ 2,989,396	$ 2,071,275	$ 1,678,857	$ 1,184,031	$ 1,358,167	Low
7						$ 3,222,851	$ 3,131,046	$ 3,044,163	$ 4,037,232	$ 4,020,609	$ 3,077,503	$ 2,128,415	$ 1,662,637	$ 1,244,584	$ 1,128,167	
8						Red	Green	Blue	purple	Brown	Grey	Black	Lt Blue	Lt Green		
9			Financial Plan	$ 27,980,000		$ 10,960,000	$ 4,060,000	$ 3,630,000	$ 3,930,000	$ 5,400,000						

10		Asset Type	Rehab Actio	Rehab Costs	Project Sco	FY 22/23	FY 23/24	FY 24/25	FY 25/26	FY 26/27	FY 27/28	FY 28/29	FY 29/30	FY 30/31	FY 31/32	Total
11	H100.010.H000.020.1	Creek Crossing	CIPP, Moderate	$ 284,971	11.97	$ 53,316		$ 231,655								$ 284,971
12	W501.010.W500.010.1	Creek Crossing	Moderate Stabi	$ 90,685	10.65			$ 90,685								$ 90,685
13	W601.050.W600.040.1	Creek Crossing	Spot Repair,	$ 8,781	10.60	$ 8,781										$ 8,781
14	G341.010.G340.010.1	Gravity Main	PIPE BURST	$ 96,864	10.40	$ 96,864										$ 96,864
15	**W516.080.W516.070.1**	Creek Crossing	Spot Repair, Ma	$ 71,464	10.05	$ 71,464										$ 71,464
16	W610.140.W610.130.1	Creek Crossing	Spot Repair,	$ 8,781	10.05	$ 8,781										
17	L220.030.L220.020.1	Creek Crossing	Moderate Stabi	$ 100,766	9.83											
18	W600.040.W600.030.1	Creek Crossing	CIPP,	$ 34,271	9.70	$ 34,271										
19	S107.050.S107.030.1	Creek Crossing	CIPP,	$ 30,037	9.66											
20	L411.025.L411.020.1	Creek Crossing	Moderate Stabi	$ 123,981	9.48											
21	W700.110.W700.100.1	Creek Crossing	CIPP, Major Sta	$ 241,159	9.47	$ 209,079										
22	S200.060.S200.050.1	Creek Crossing	CIPP,	$ 10,086	9.36		$ 10,086									
23	S602.030.S602.020.1	Creek Crossing	Moderate Stabi	$ 112,766	9.34		$ 8,573									
24	W602.030.W602.020.1	Creek Crossing	R/R per CDO,	$ 8,573	9.34	$ 8,573										
25	S610.080.S610.030.1	Creek Crossing	CIPP,	$ 21,605	9.31		$ 21,605									
26	L425.090.L425.080.1	Creek Crossing	Moderate Stabi	$ 232,718	9.27											
27	H001.030.H001.020.1	Creek Crossing	Moderate Stabi	$ 169,782	9.27											
28	W700.080.W700.060.1	Creek Crossing	CIPP, R/R per C	$ 72,771	9.24	$ 8,573										
29	F700.210	Manhole	Patch + Mr. Mar	$ 5,500	9.04	$ 5,500										
30	R400.140.R400.040.1	Creek Crossing	Minor Stabilizat	$ 67,092	8.84											
31	W516.010.W515.010.1	Creek Crossing	Major Stabilizat	$ 222,249	8.72	$ 222,249										
32	F380.010.F002.280.1	Creek Crossing	Moderate Stabi	$ 198,954	8.72											
33	W514.120.W514.110.1	Creek Crossing	Major Stabilizat	$ 170,038	8.72	$ 170,038										
34	R546.030.R546.020.1	Creek Crossing	Minor Stabilizat	$ 84,745	8.72											
35	W700.020.W700.010.1	Creek Crossing	CIPP,	$ 43,050	8.72											



Key Asset Management Success Factors



Embraced and supported by Management

- Requires organizational change
- Requires resources
- Requires staff roles and responsibilities

Start simple and expand as needed

- Can be phased and scaled to each agency's needs

Leverage technology systems (e.g. GIS, CMMS)

- Single source of truth for all asset data

Incorporate transparent, risk-based, data-driven processes

- See the Asset Management Pyramid examples discussed

Create a 'Data-Driven Culture'

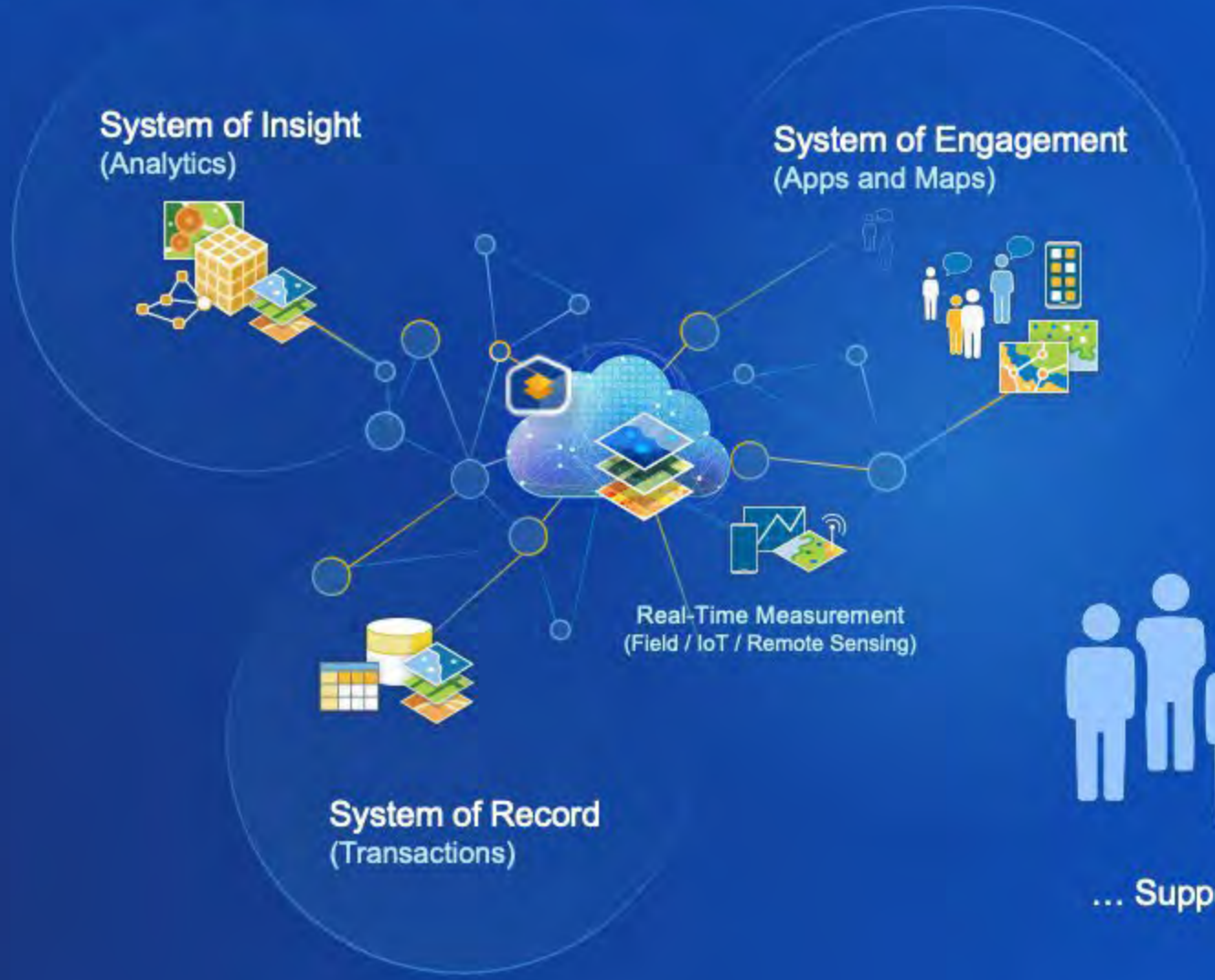
- Everyone has a role and responsibility to maintain accurate and complete data
- Data should be utilized across the organization
- Only maintain data that is used by the organization

Geographic Information Systems

Randy Olden

ArcGIS

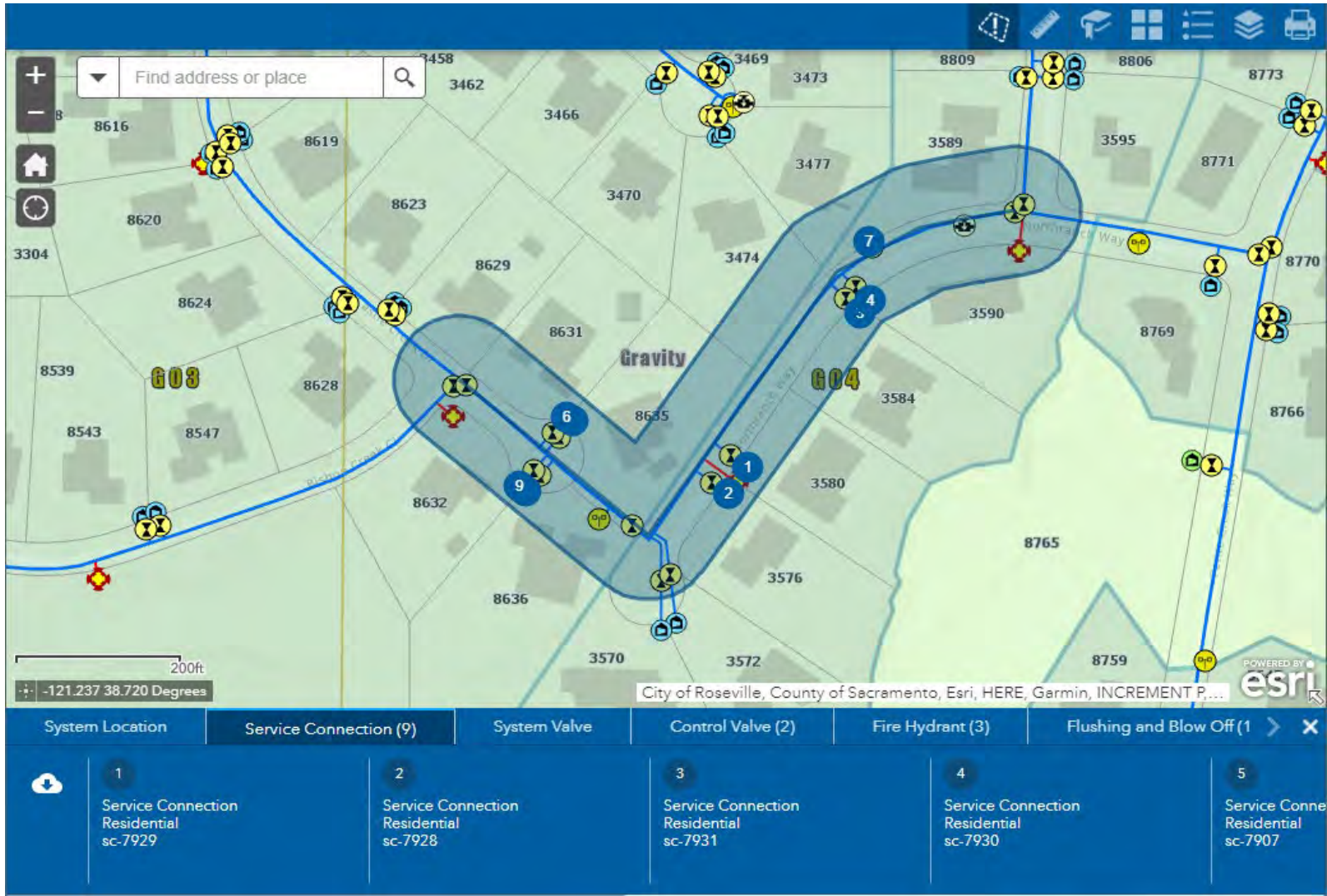
Three Fundamental Systems in One Platform



… Supporting the needs of the entire workforce

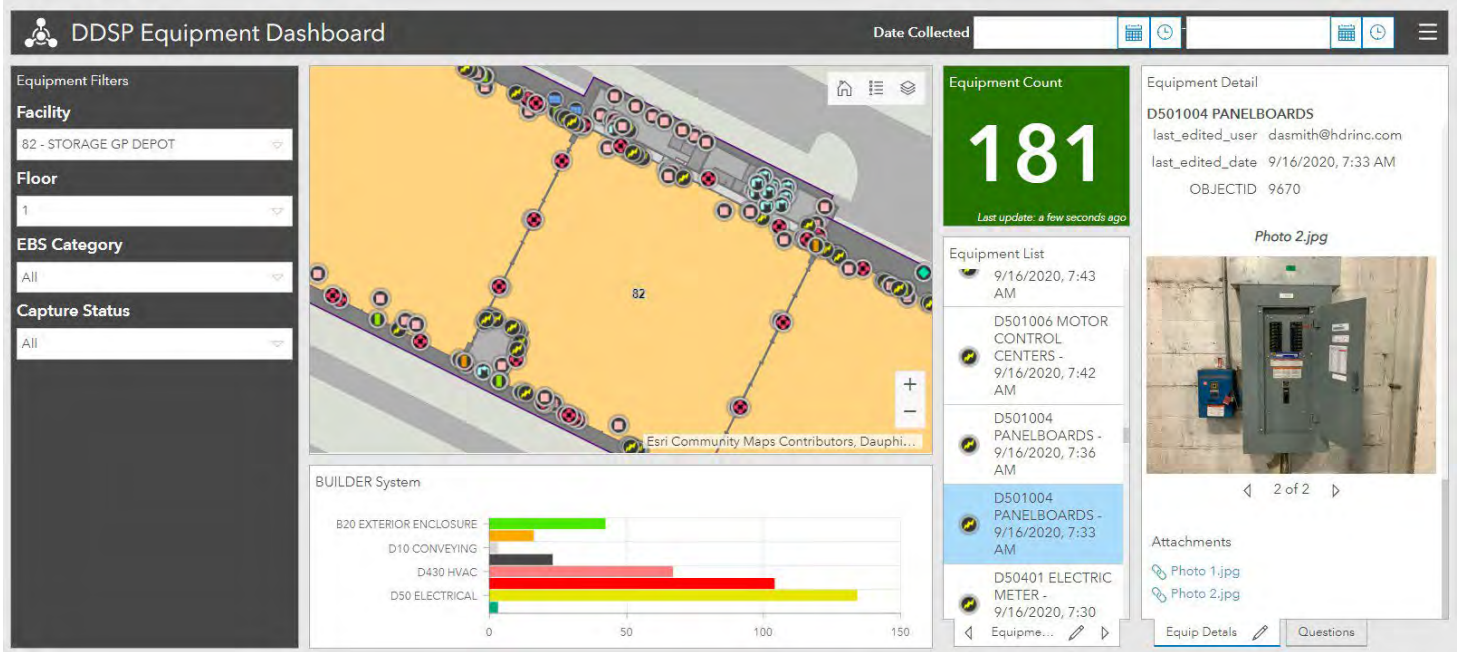
Potential Financial Capital Benefits

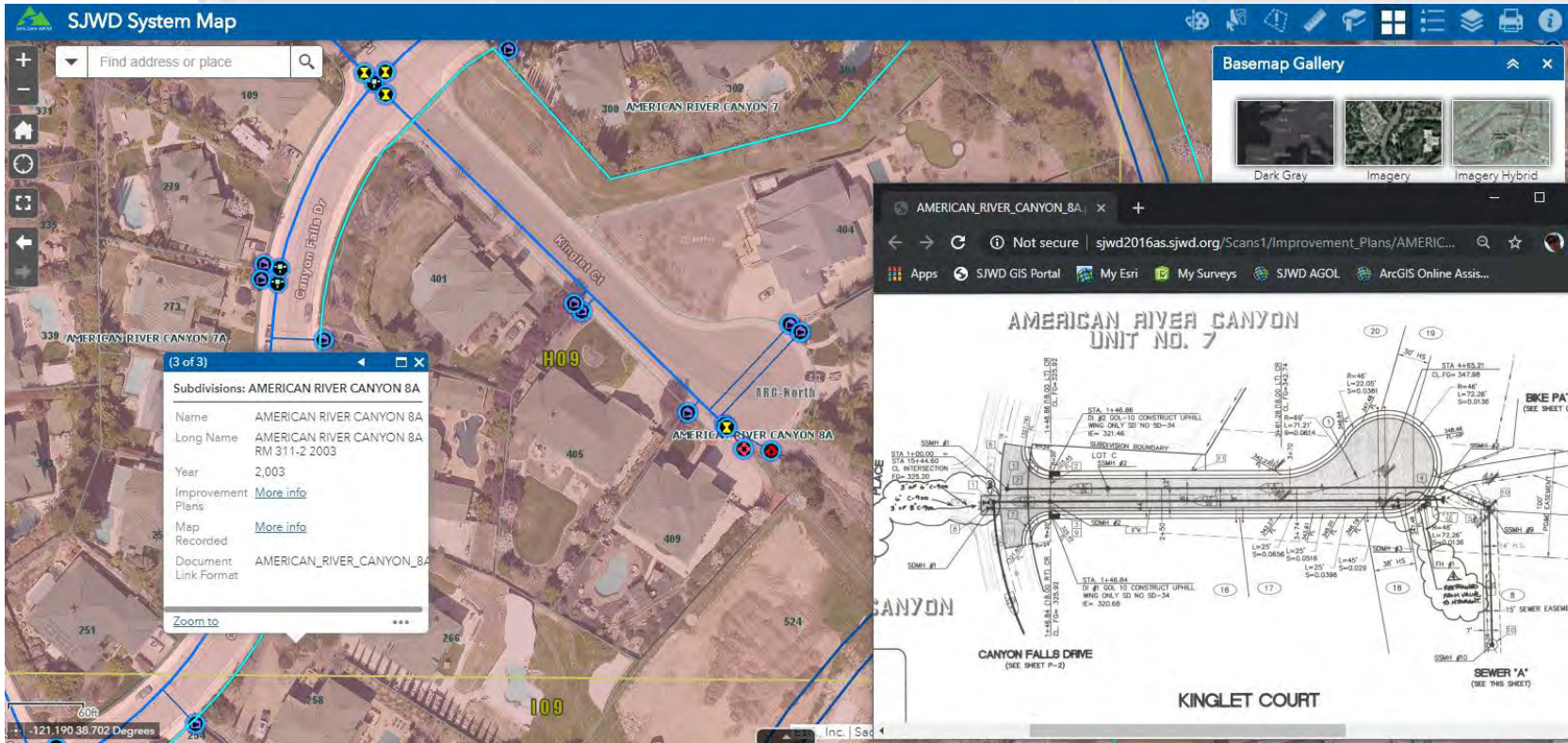
- Knowledge Capture
- Regulatory Reporting
- Planning
- Asset Management
- Constituent Engagement



Knowledge Capture

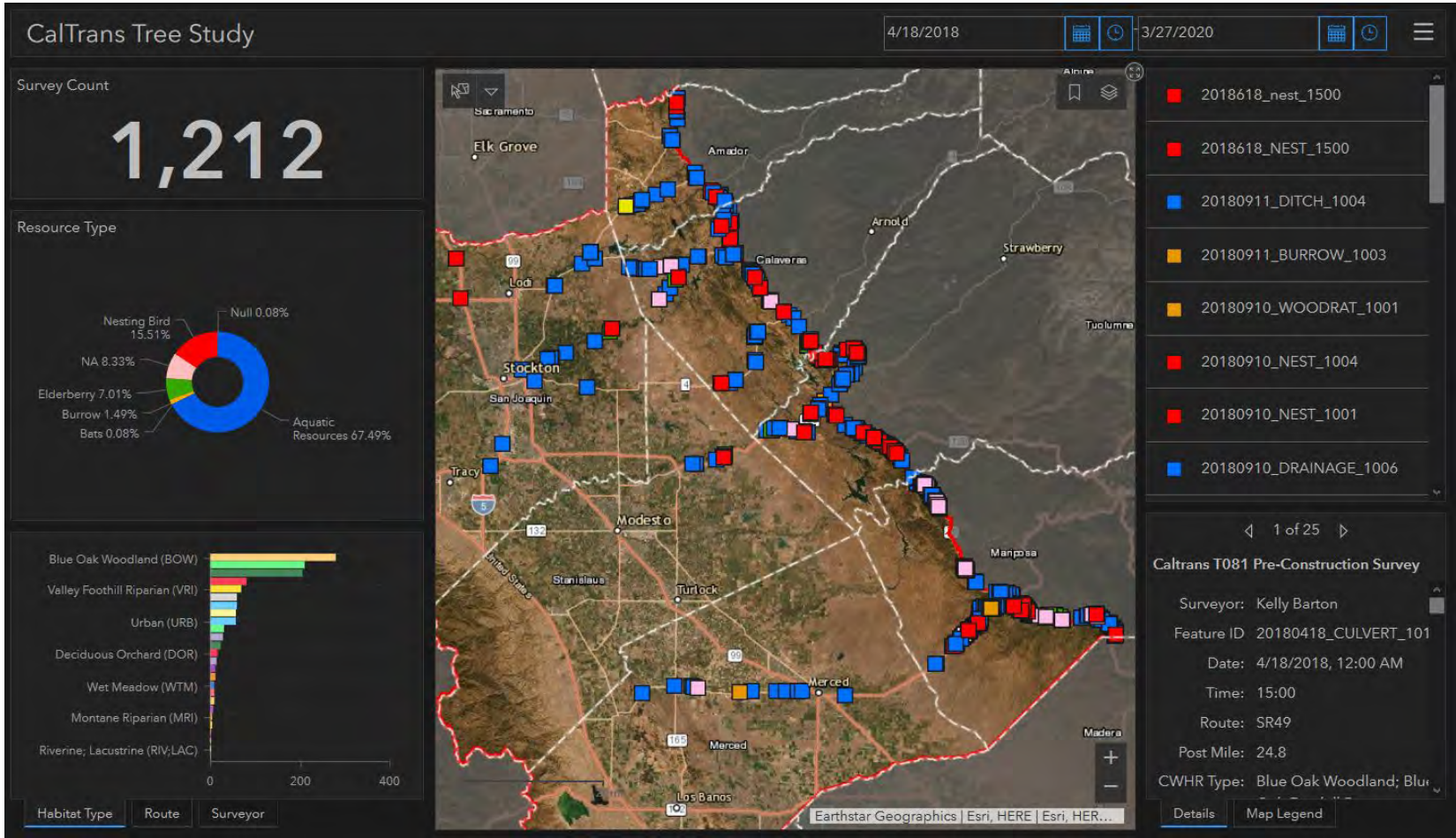
- Mobile data collection
  - Phone or tablet
  - Preconfigured forms
  - Live data feed
- Web app with links to
  - Drawings
  - Maintenance videos
  - Photos
  - CMMS integration





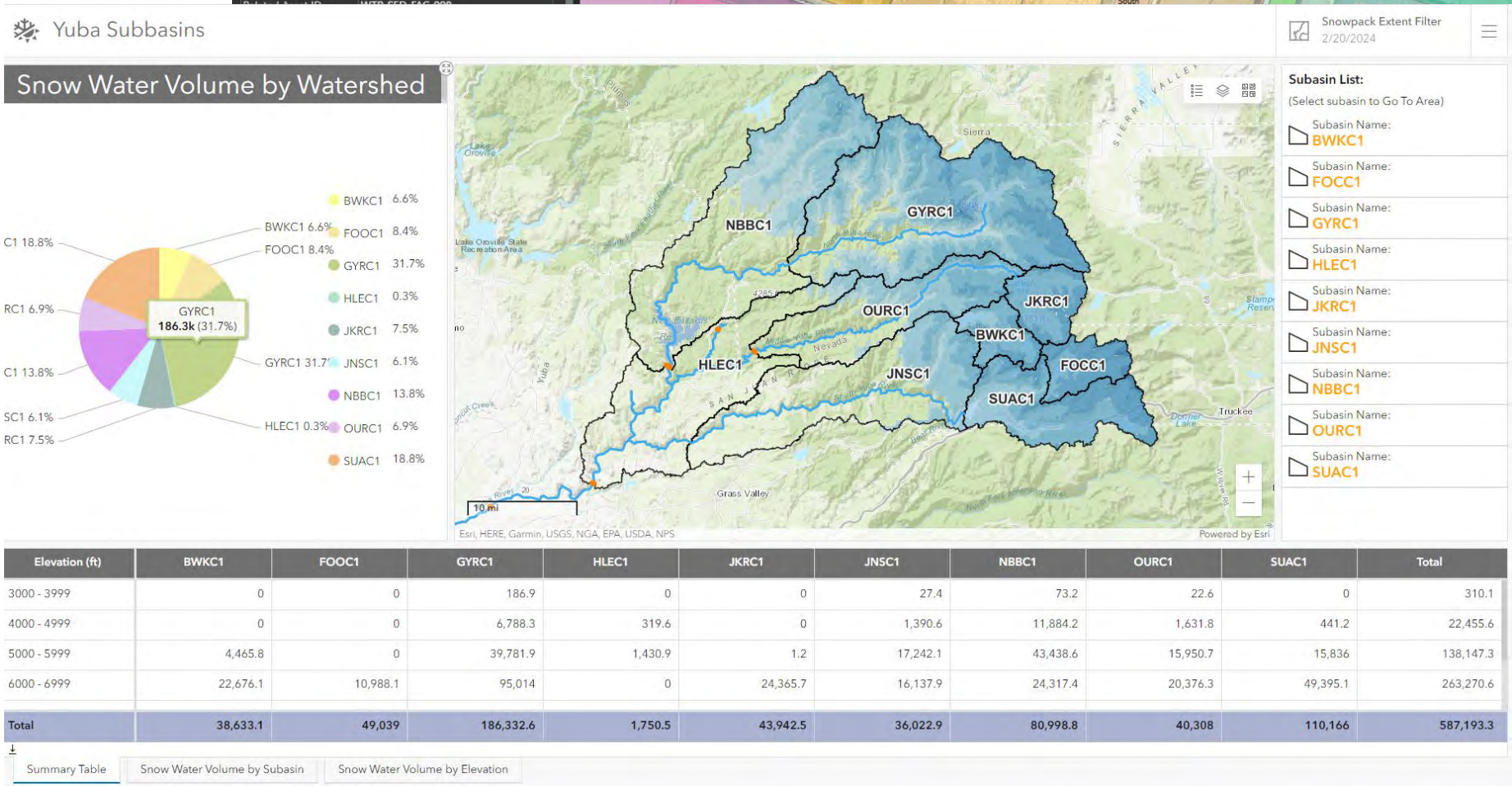
Regulatory Reporting

- Form Automation
- Dashboards
- Interactive Web Apps



Planning

- Digital Plan Documents
- Operations
- Equity Analysis

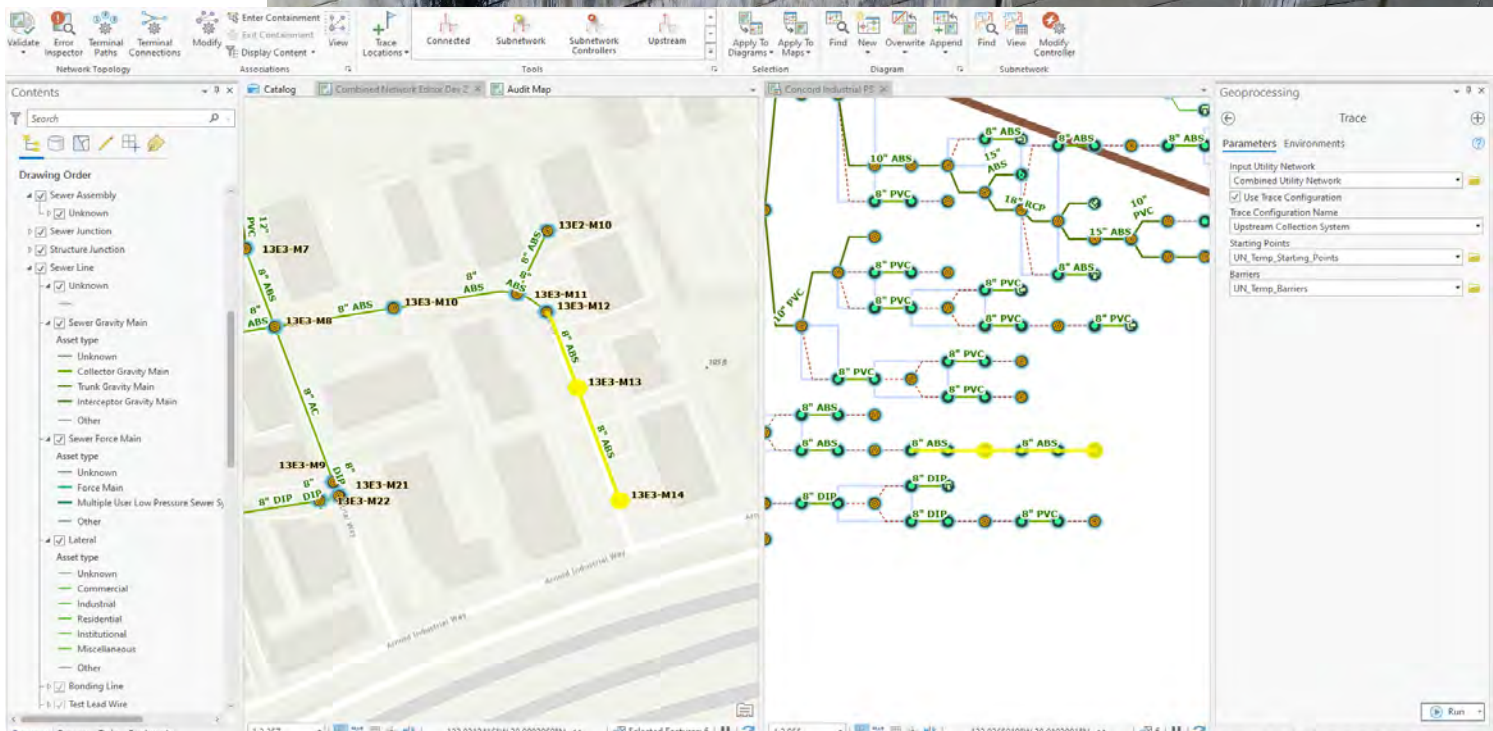


Elevation (ft)	BWKC1	FOOC1	GYRC1	HLEC1	JKRC1	JNSC1	NBBC1	OURC1	SUAC1	Total
3000 - 3999	0	0	186.9	0	0	27.4	73.2	22.6	0	310.1
4000 - 4999	0	0	6,788.3	319.6	0	1,390.6	11,884.2	1,631.8	441.2	22,455.6
5000 - 5999	4,465.8	0	39,781.9	1,430.9	1.2	17,242.1	43,438.6	15,950.7	15,836	138,147.3
6000 - 6999	22,676.1	10,988.1	95,014	0	24,365.7	16,137.9	24,317.4	20,376.3	49,395.1	263,270.6
Total	38,633.1	49,039	186,332.6	1,750.5	43,942.5	36,022.9	80,998.8	40,308	110,166	587,193.3

Summary Table | Snow Water Volume by Subasin | Snow Water Volume by Elevation

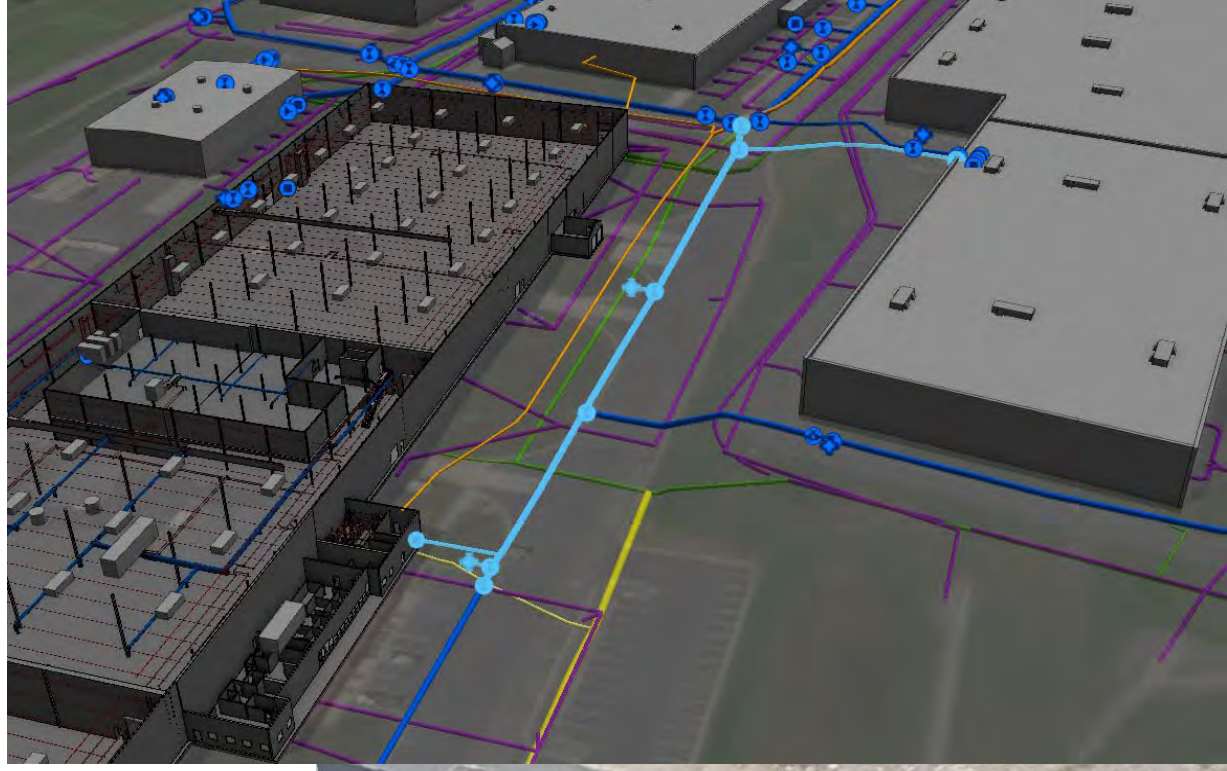
Asset Management

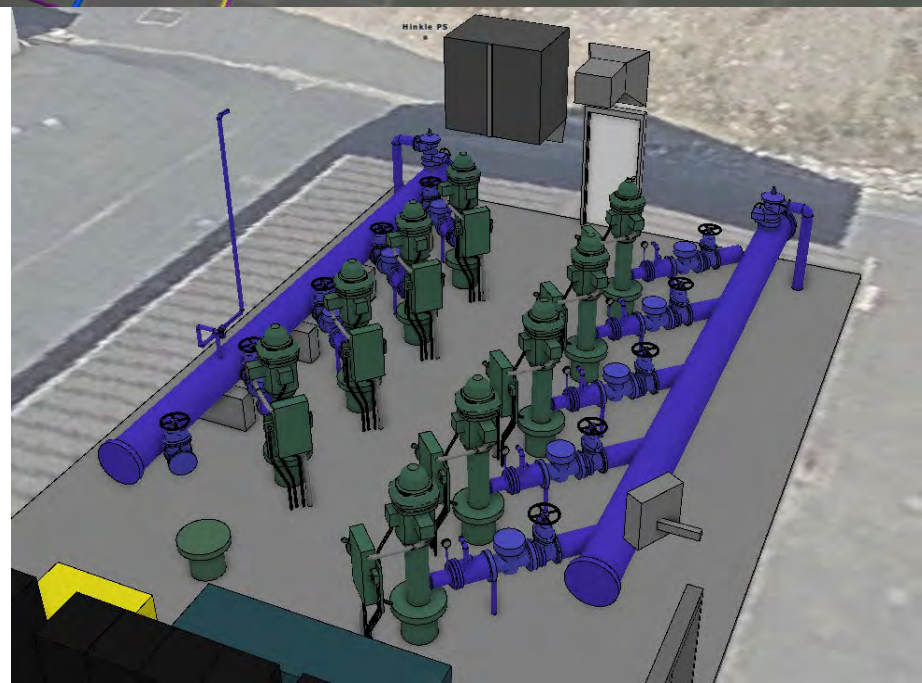
- Digital Twin
- Utility Network
- Integration with ERP or CMMS
- Mobile Workflows
- GeoAI



Digital Twin

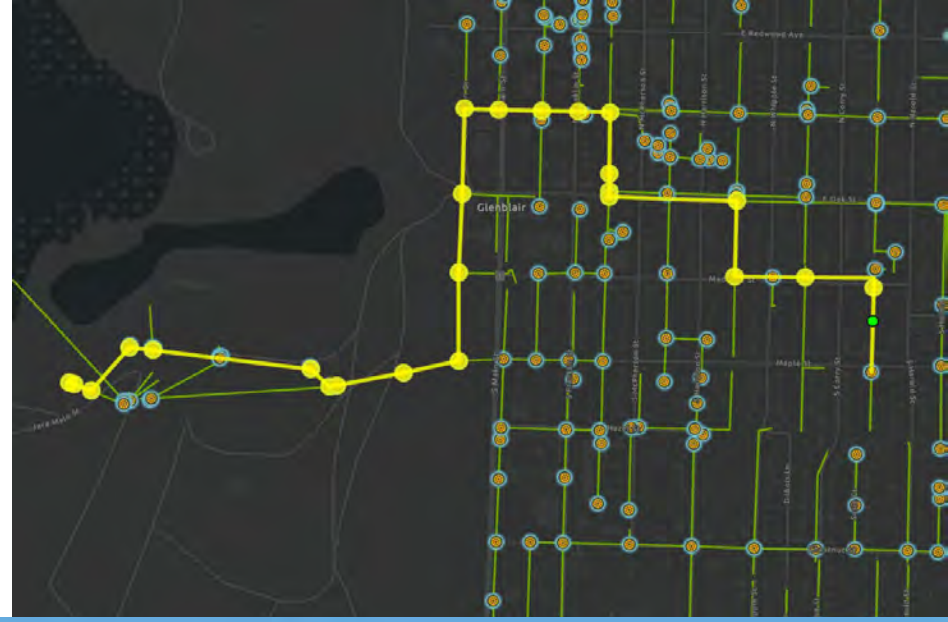
- 3D Representation of Infrastructure
- Smart Data
- Integration of enterprise systems
- Realtime sensors
- Automation

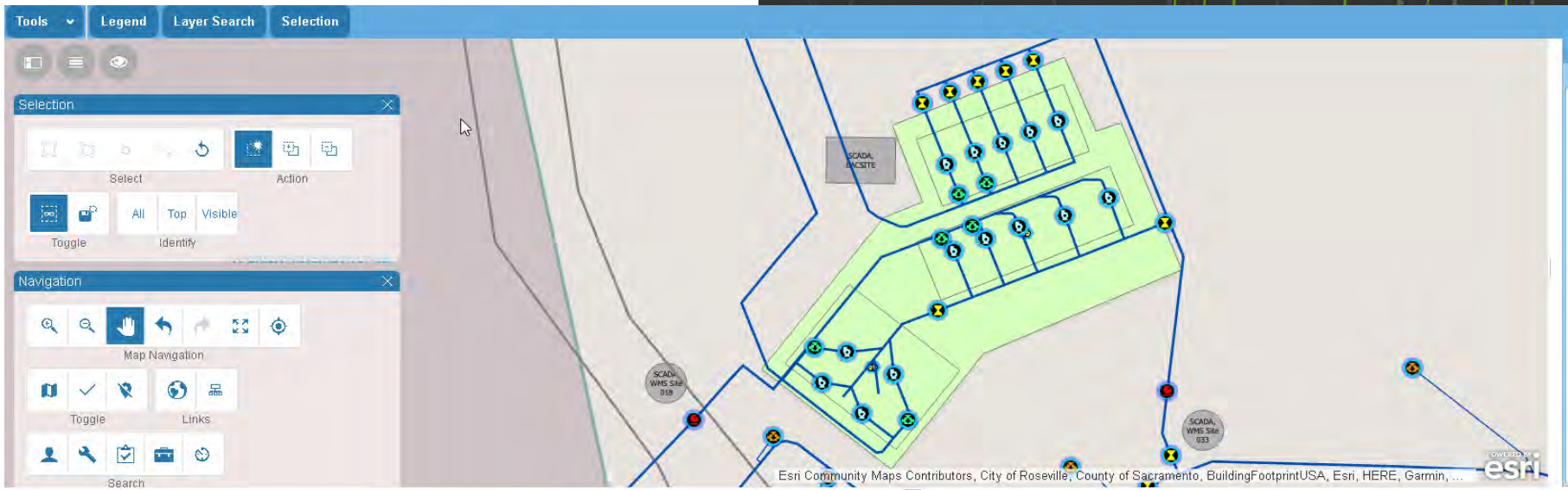




Utility Network

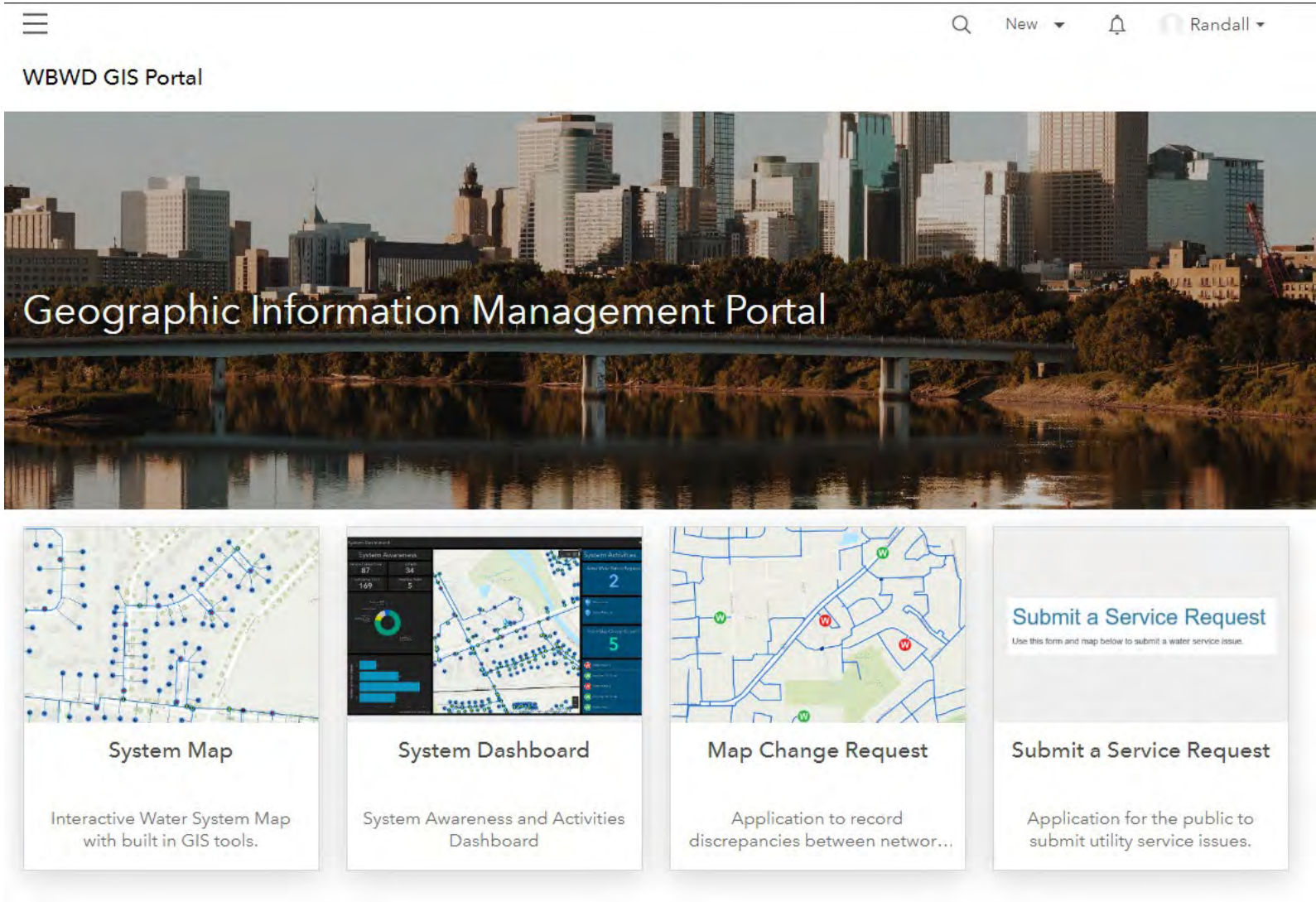
- Smart data model
- Industry best practices
- Scalable
- Web-based
- Network trace
- Model vertical assets





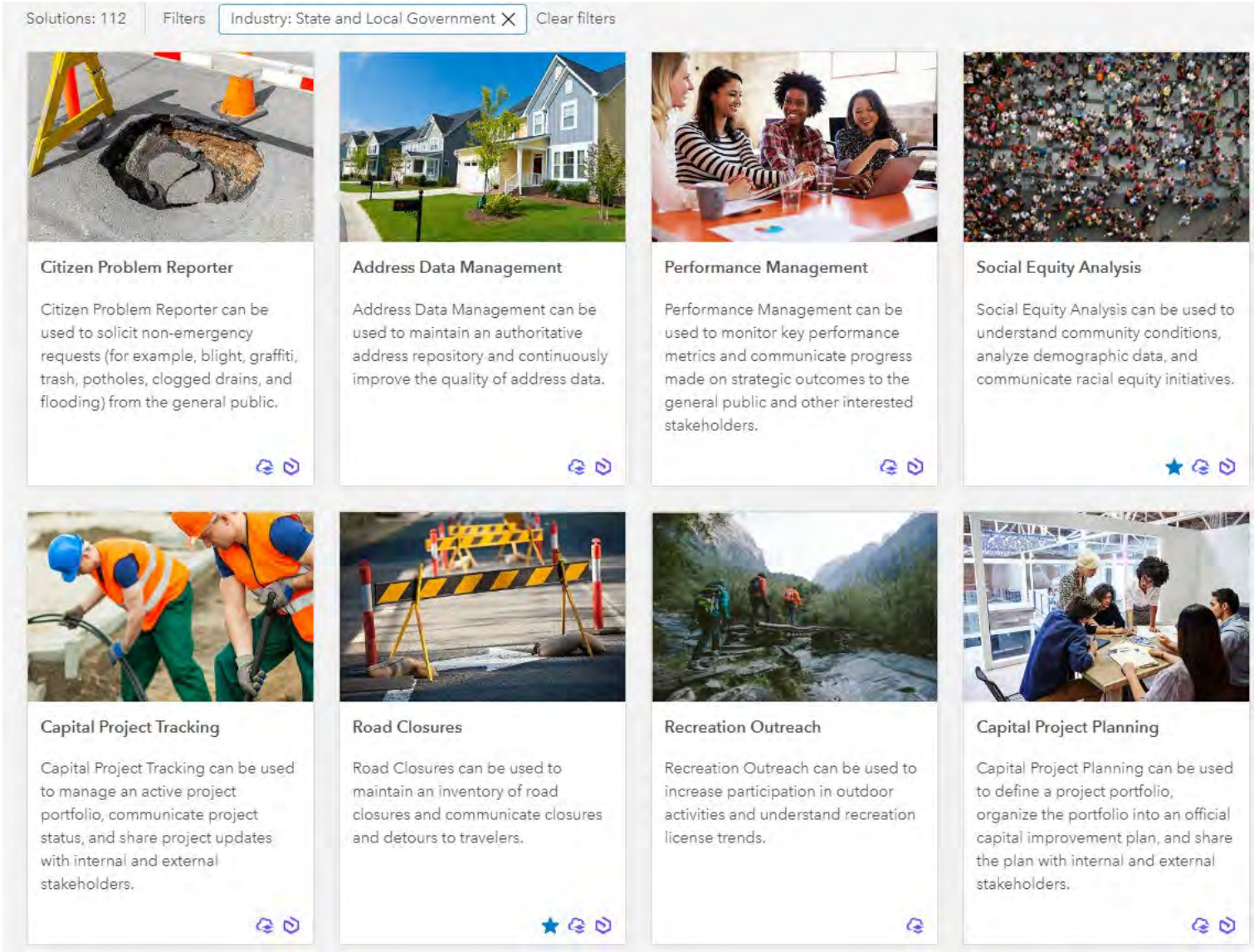
Constituent Engagement

- Configurable Web Apps
  - Storymaps
  - Hubs
  - Data Sharing
  - Community feedback
- ArcGIS Solutions
  - LCRR
  - Outreach
  - Service Request



Software Availability

- Utilize Existing GIS License
- Available Licensing Options from Esri
  - Small Utility EA
  - Small Utility Cloud EA



Discussion

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Thank you!

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