Selecting & Prioritizing Pipeline Replacements Using Pipeline Risk Model

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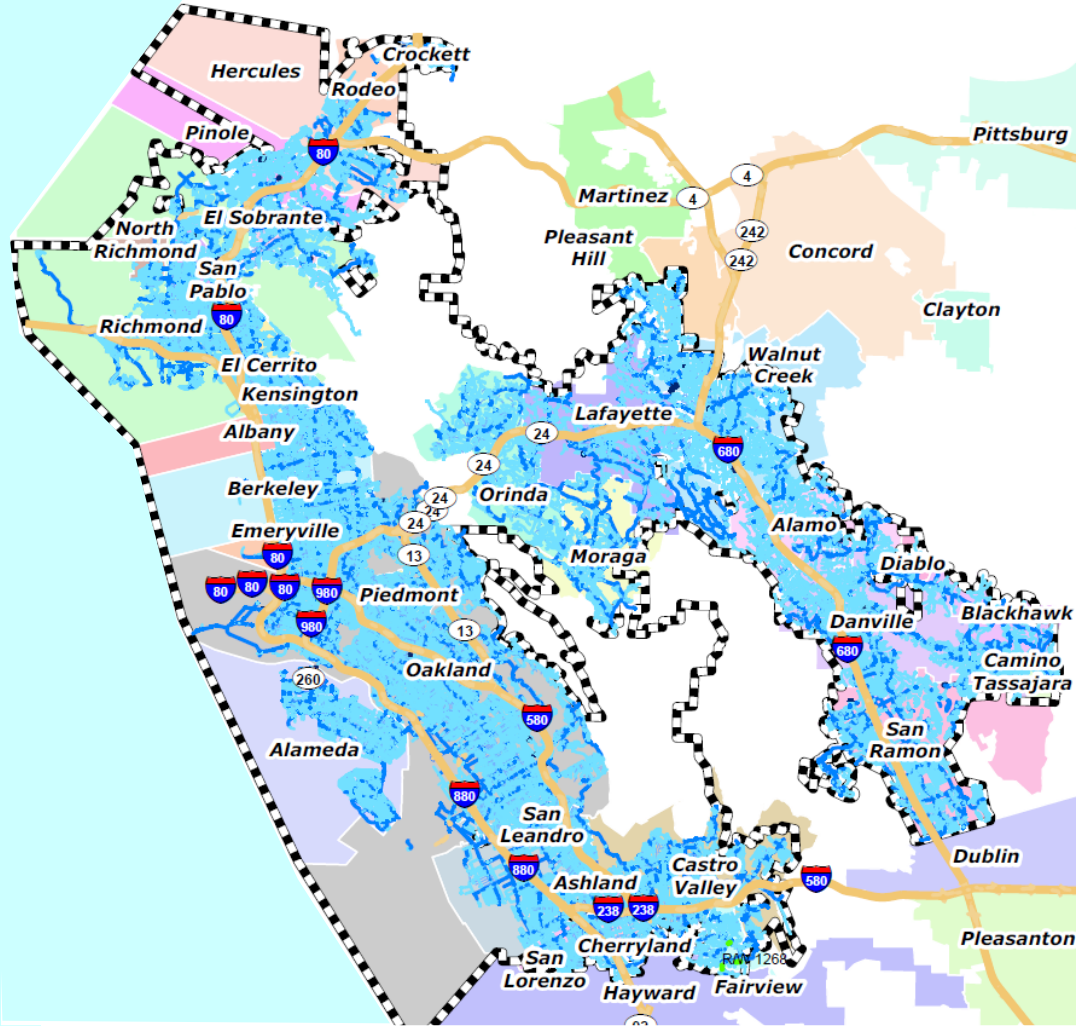
ESRI USER CONFERENCE

EBMUD Pipeline Inventory

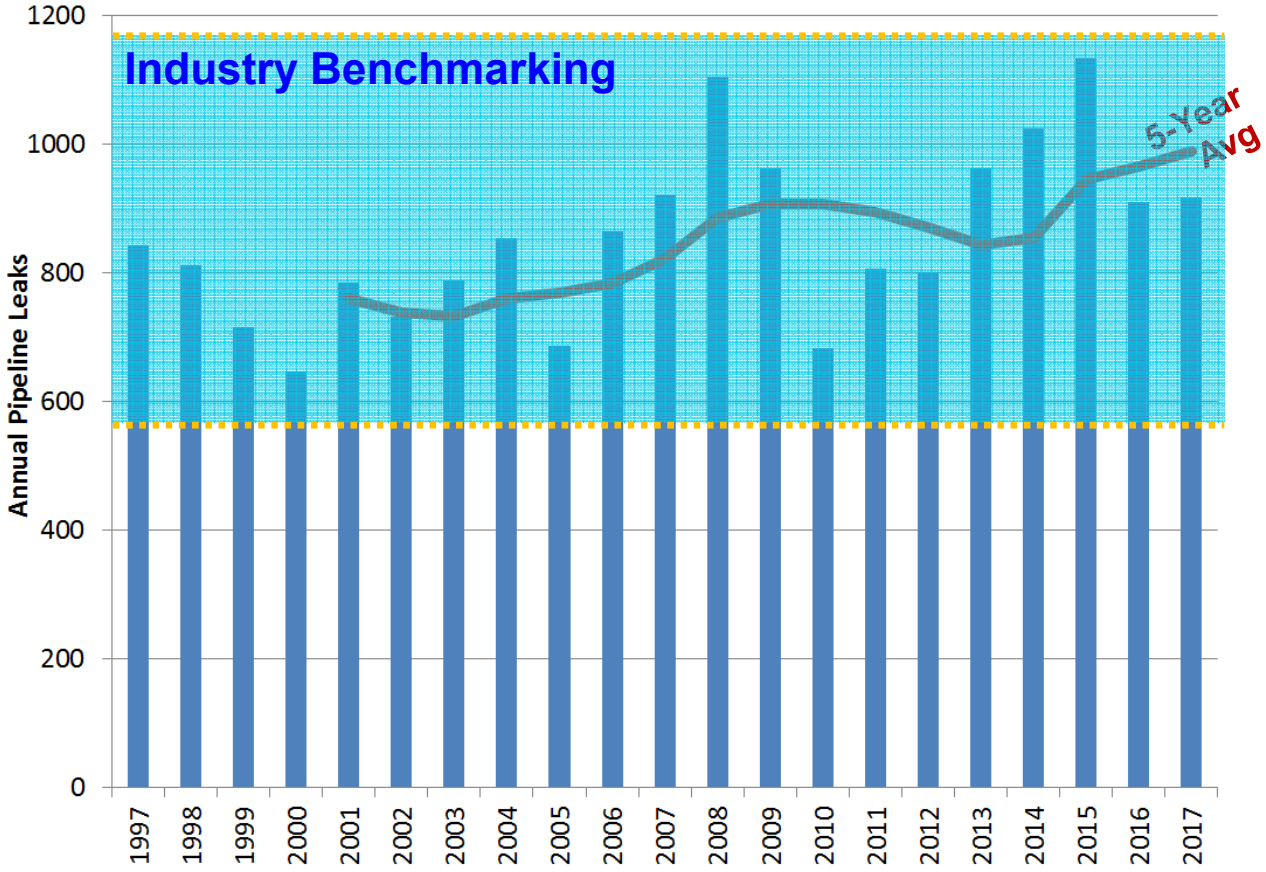
- Serves 1.4 million customers in over 20 cities
- 4,200 miles of Pipeline
  - 400 mi Transmission Pipe (>20”)
  - 3,800 mi Distribution Pipe (≤ 20”)

    ~25% in Fault Zone or Landslide Zone
- Average Age of Pipe = 57 years
- Oldest Pipe = 142 years



Leaks & Pipeline Replacement Program

- Average 989 leaks/year
- Replacing 15 miles/year with 10 District Crews



How do we make sure we are replacing the *right* pipe?

Pipeline Risk Model

Innovyze InfoMaster®

"LOF" "COF"

RISK = (Likelihood of Failure) x (Consequence of Failure)

The probability a pipeline will leak.

The resulting magnitude of consequence if the pipe does leak.

Likelihood of Failure Criteria

LOF Scoring:

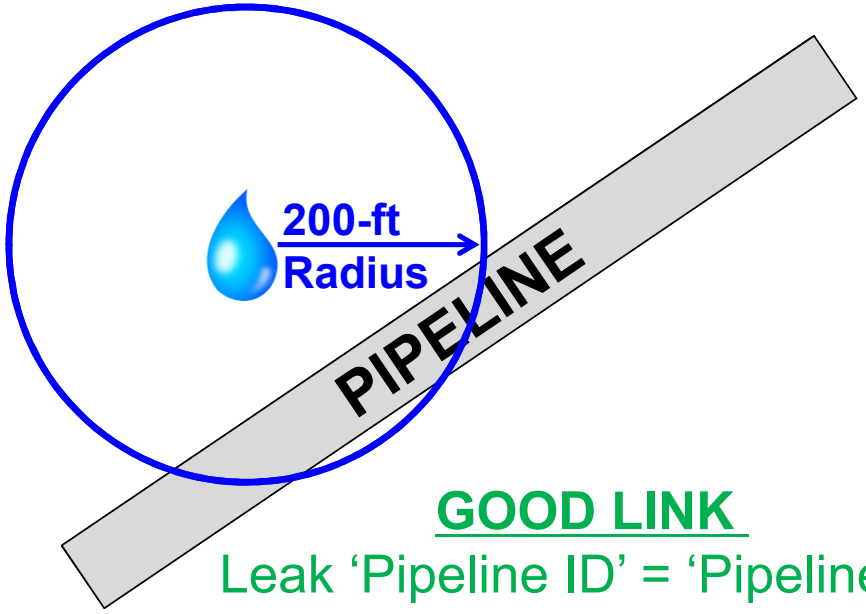
90% based on Leak History
10% based on Pipe Age

Many published industry reports have concluded that leak history is the greatest indicator of future leaks.

If all else is equal, better to replace older pipe to get better life cycle costs.

$$LOF\ Score = \sum_{i}^{n} [(LOF\ Weight)_i * (LOF\ Rank)_i]$$

x-y coordinates = Leak Address



GOOD LINK

Leak 'Pipeline ID' = 'Pipeline ID' within 200-foot radius

Likelihood of Failure Scores

Score	% of Network	Simplified Description
LOF **1**	**69%**	New pipe or old pipe that has never leaked *(53% is over 50 years old)*
LOF **2**	**15%**	Pipe that has leaked once
LOF **3**	**7%**	Pipe that has leaked 2-3 times
LOF **4**	**7%**	Pipe that has leaked >3 leaks/1,000 feet *(old cost benefit ratio calculation)*
LOF **5**	**2%**	The leakiest 2% of distribution system

Consequence of Failure

Diameter
Consumption
Critical Customers
Ease of Access
Creek Crossing
Highway Crossing
Railroad Crossing
Major Road Crossing

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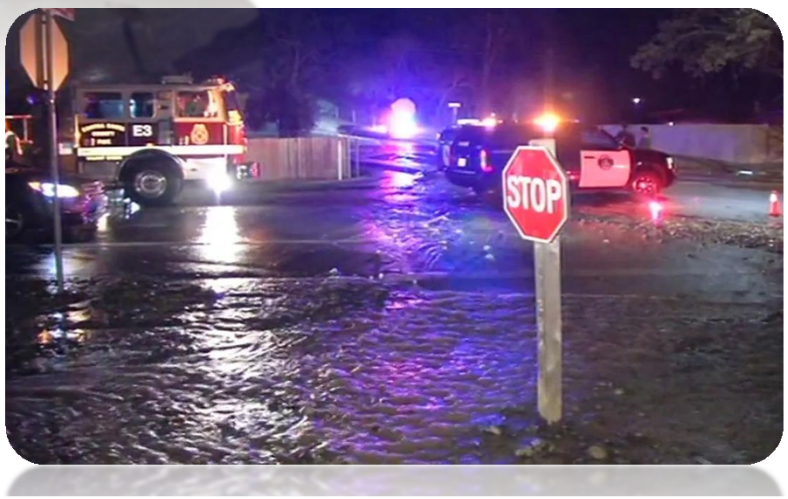


Risk Matrix & Model Results

Likelihood of Failure Scores

Consequence of Failure Scores

	1	2	3	4	5
1	A (1,449 mi)	B (275 mi)	C (163 mi)	D (168 mi)	F (53 mi)
2	A (500 mi)	B (111 mi)	C (49 mi)	D (42 mi)	F (13 mi)
3	A (299 mi)	B (89 mi)	C (35 mi)	D (21 mi)	F (10 miles)
4	B (185 mi)	C (64 mi)	D (14 mi)	F (10 mi)	F (2 mi)
5	B (190 mi)	C (44 mi)	D (9 mi)	F (6 mi)	F (2 mi)

Focus on these pipes

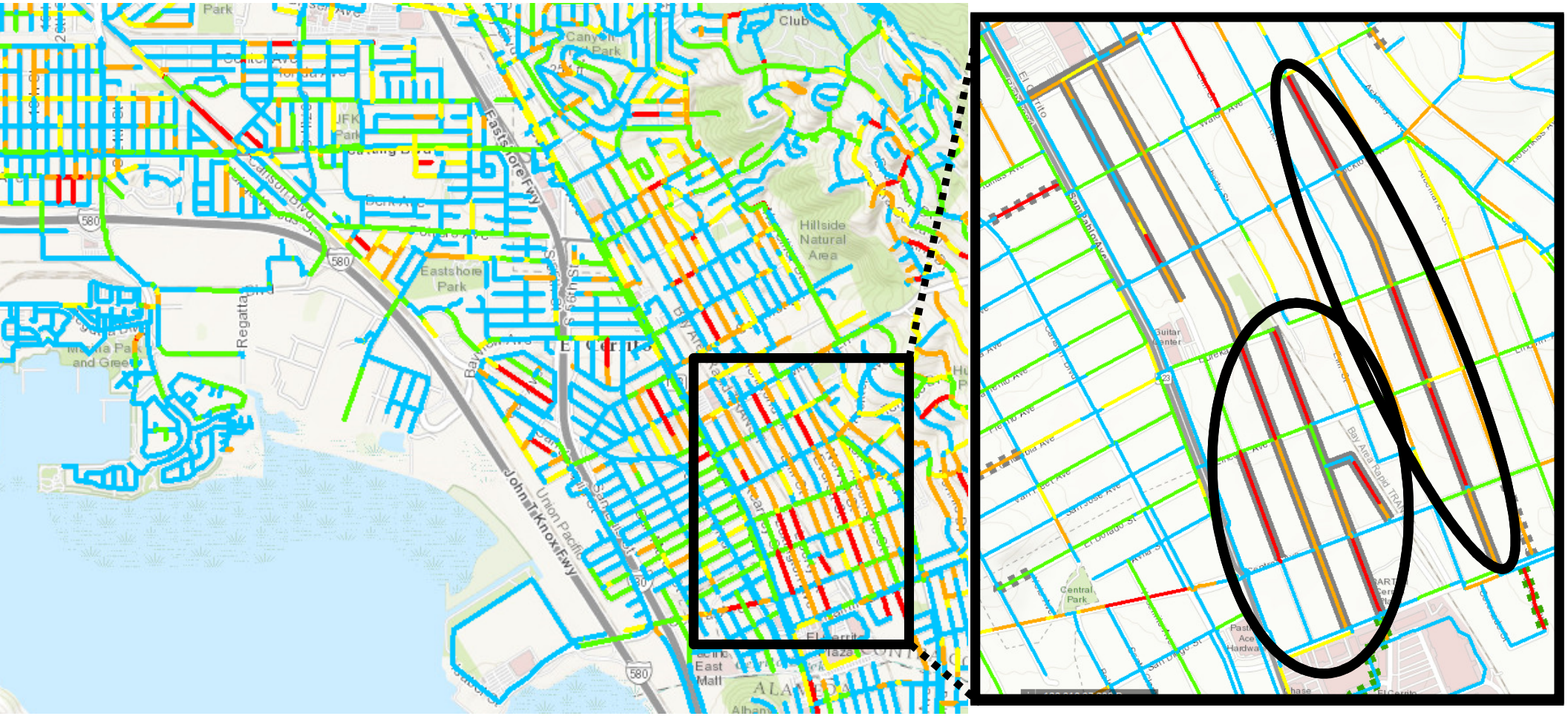
Risk Grades

	A Pipe	59%	2,248 mi
	B Pipe	22%	850 mi
	C Pipe	9%	355 mi
	D Pipe	7%	264 mi
	F Pipe	3%	96 mi

View Results Geographically on

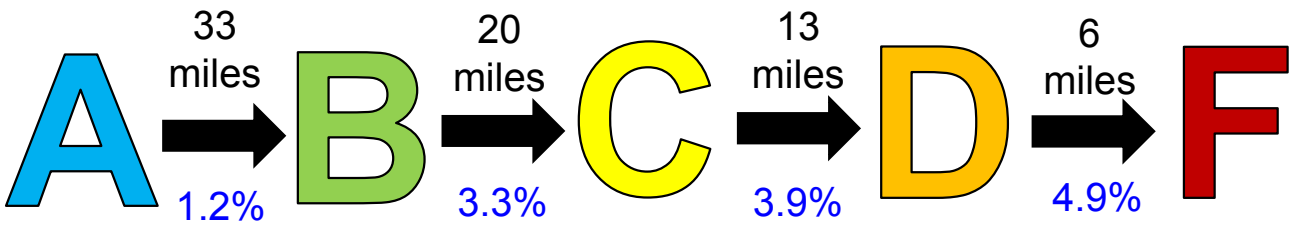
esri ArcGIS Online

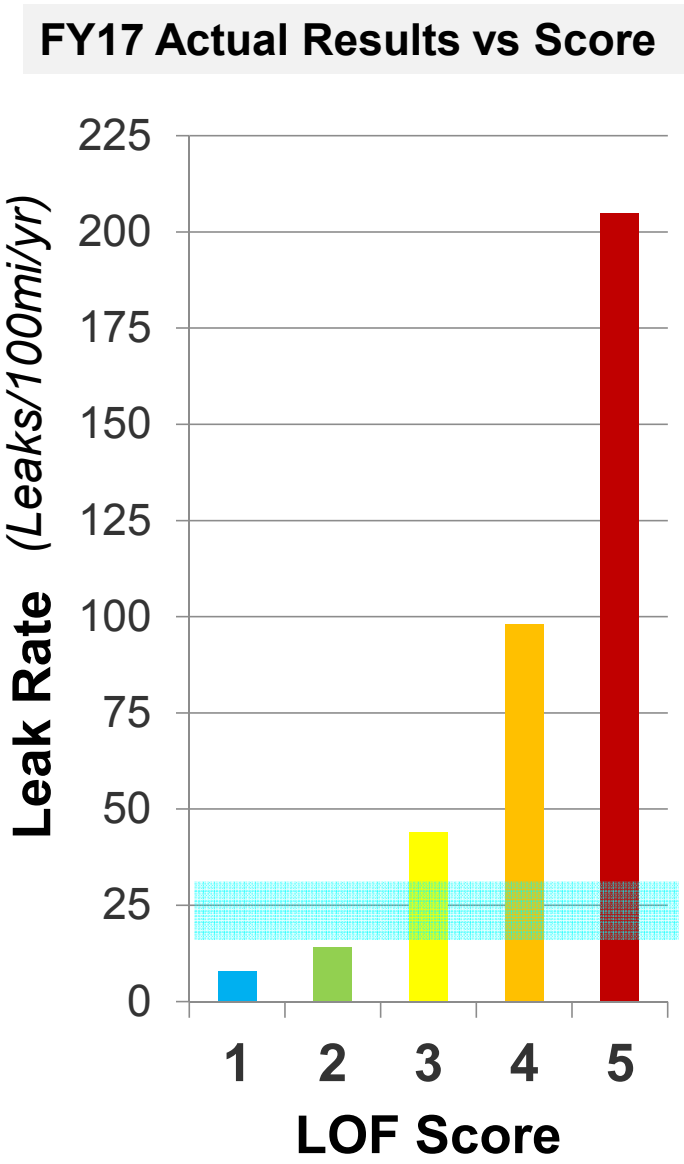
Selecting Projects in ArcGIS Online



Model Verification

- **LOF 5** pipe is *23x* more likely to leak than an **LOF 1** pipe
- ~1/2 the leaks occur on **LOF 4** & **LOF 5** pipelines (9% of network)
- Can estimate pipe life expectancy:





Benefits of Using Risk Model

- Automates assessment of all 3,800 miles of distribution pipe
- Identifies “right” pipes for replacement
- Provides transparency on replacement decisions
- Provides ability to forecast leak rates & replacement rate needs

What will leak rate be in X years

if we replace X miles of F pipe per year?

Questions?