City of Silverton

Wastewater Collection System

Initial Risk Assessment

Presented to:

ORWEF Water Environment School 2017
Wednesday 29th, March 2017

Presented by:

Barry Buchanan, P.E.
Buchanan And Associates

BUCHANAN and ASSOCIATES
INFRASTRUCTURE PLANNING ... INFRAP

2735 Alvarado Terrace S, Salem OR 97302
phone: 360 901 1564 e-mail Barry@BuchananAndAssocaites.com

BUCHANAN and ASSOCIATES
INFRASTRUCTURE PLANNING ... INFRAP

agenda

8:00

Intro Overview
Likelihood

8:35

Break

8:45

Consequence
Risk

9:20

Break

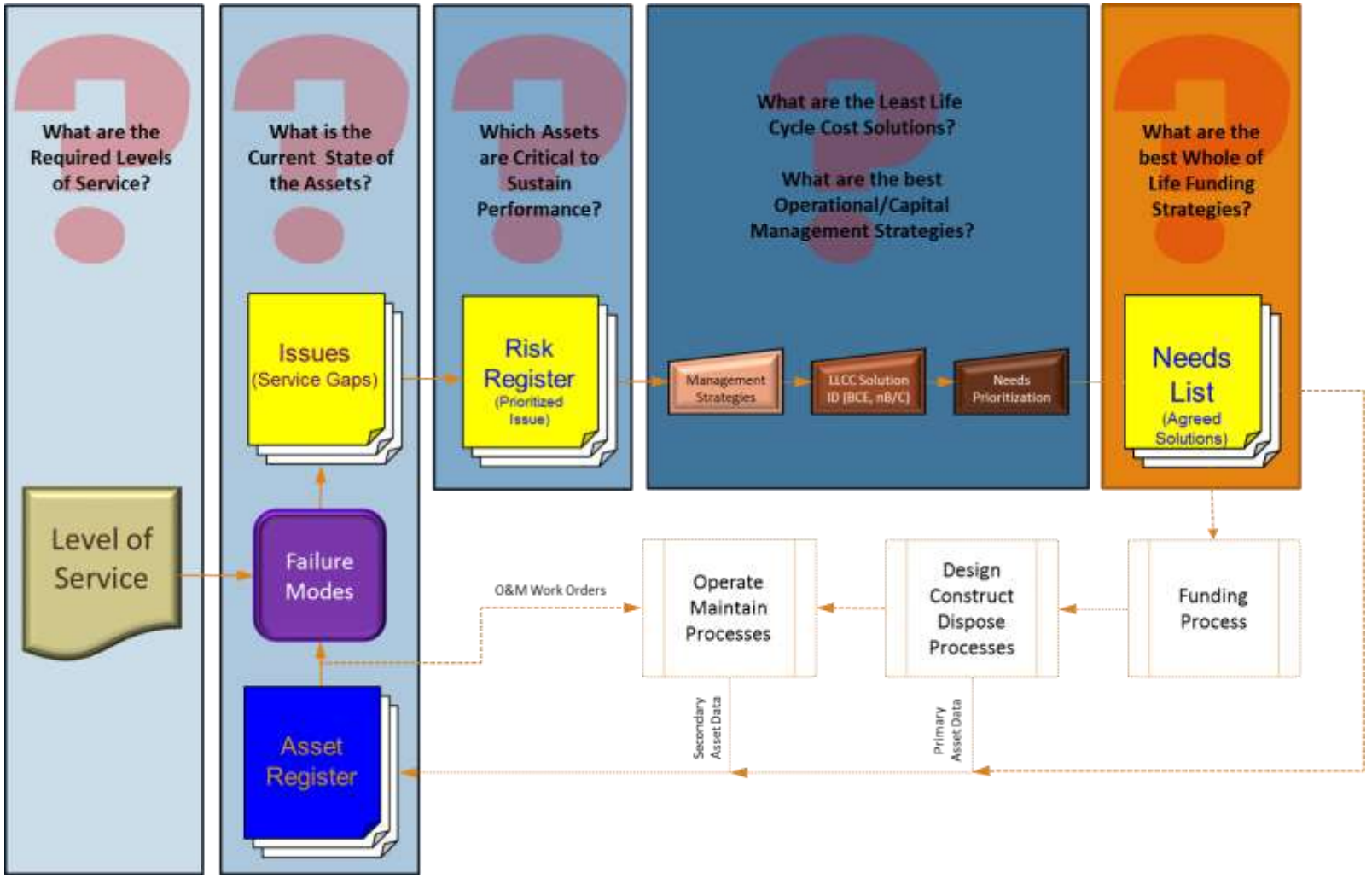
9:30

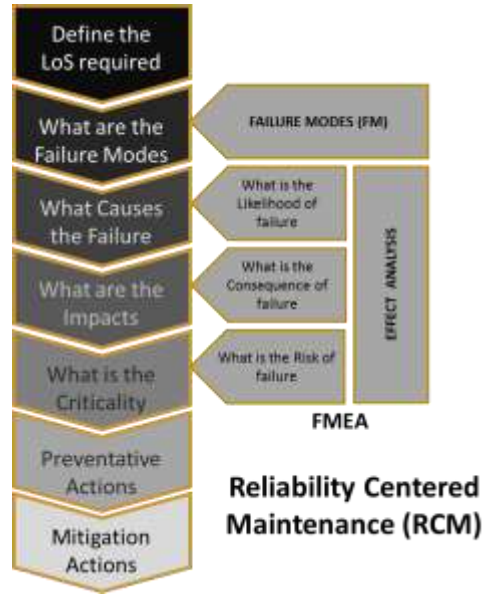
The Analysis
Discussion

10:05

http://bavoter.azurewebsites.net/

The Basic AM questions to produce an Needs List





plan & acquire assets (or not)

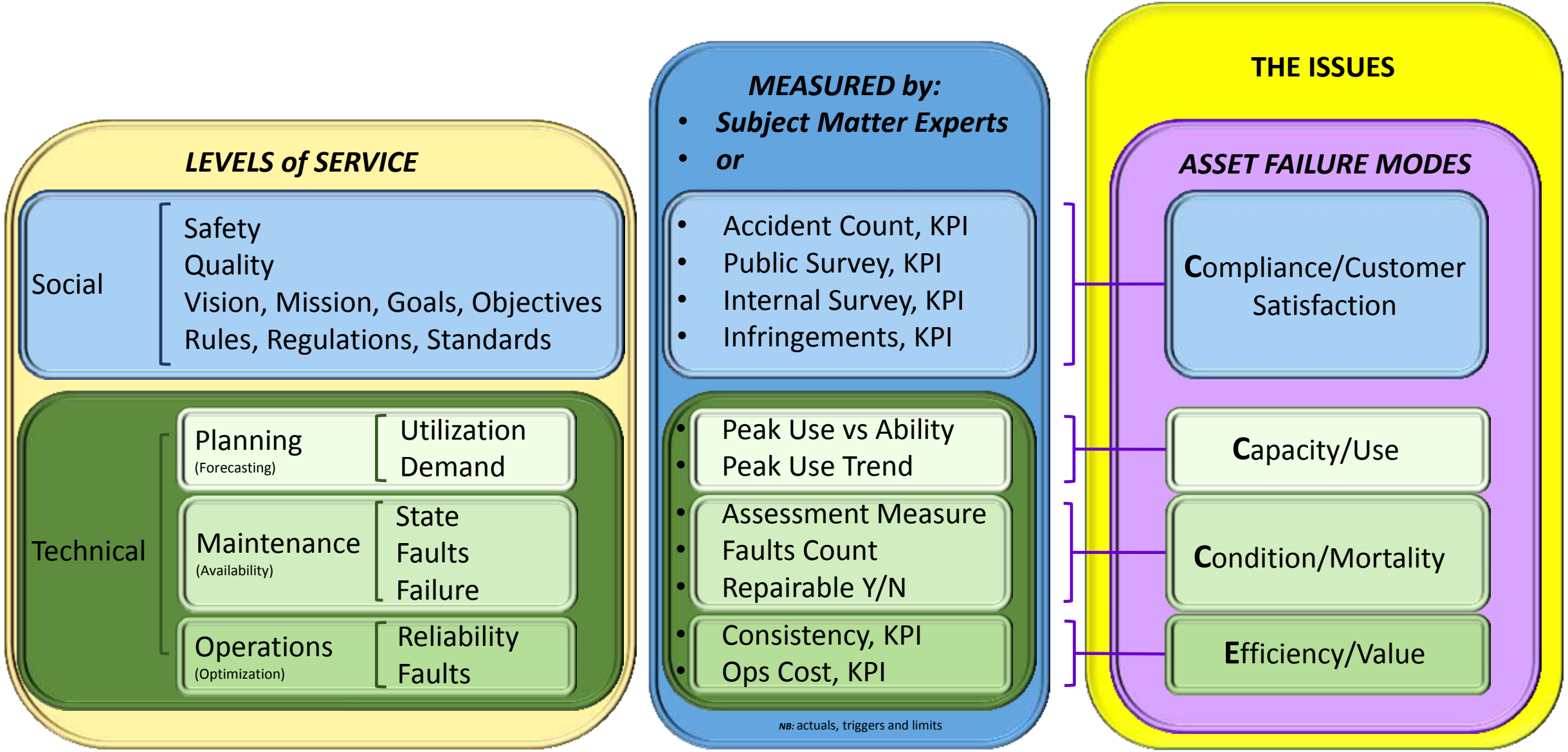
BUCHANAN and ASSOCIATES
INFRASTRUCTURE PLANNING ... INFRAP

***RISK* =**

Likelihood x Consequence

a risk approach

Qu 4,5,6


LEVELS of SERVICE
Social
Safety
Quality
Vision, Mission, Goals, Objectives
Rules, Regulations, Standards
Technical
Planning
(Forecasting)
Utilization
Demand
Maintenance
(Availability)
State
Faults
Failure
Operations
(Optimization)
Reliability
Faults
MEASURED by:
Subject Matter Experts
or
Accident Count, KPI
Public Survey, KPI
Internal Survey, KPI
Infringements, KPI
Peak Use vs Ability
Peak Use Trend
Assessment Measure
Faults Count
Repairable Y/N
Consistency, KPI
Ops Cost, KPI
NB: actuals, triggers and limits
THE ISSUES
ASSET FAILURE MODES
Compliance/Customer Satisfaction
Capacity/Use
Condition/Mortality
Efficiency/Value

failure modes

NOTE: Traditional Master Plan Focused on blue, based on *likelihood*
Traditional Facility Plan Focused on gold, based on *likelihood*
Asset Management Plan Focuses on ALL, based on ***RISK***

The Prime Modes of Failure

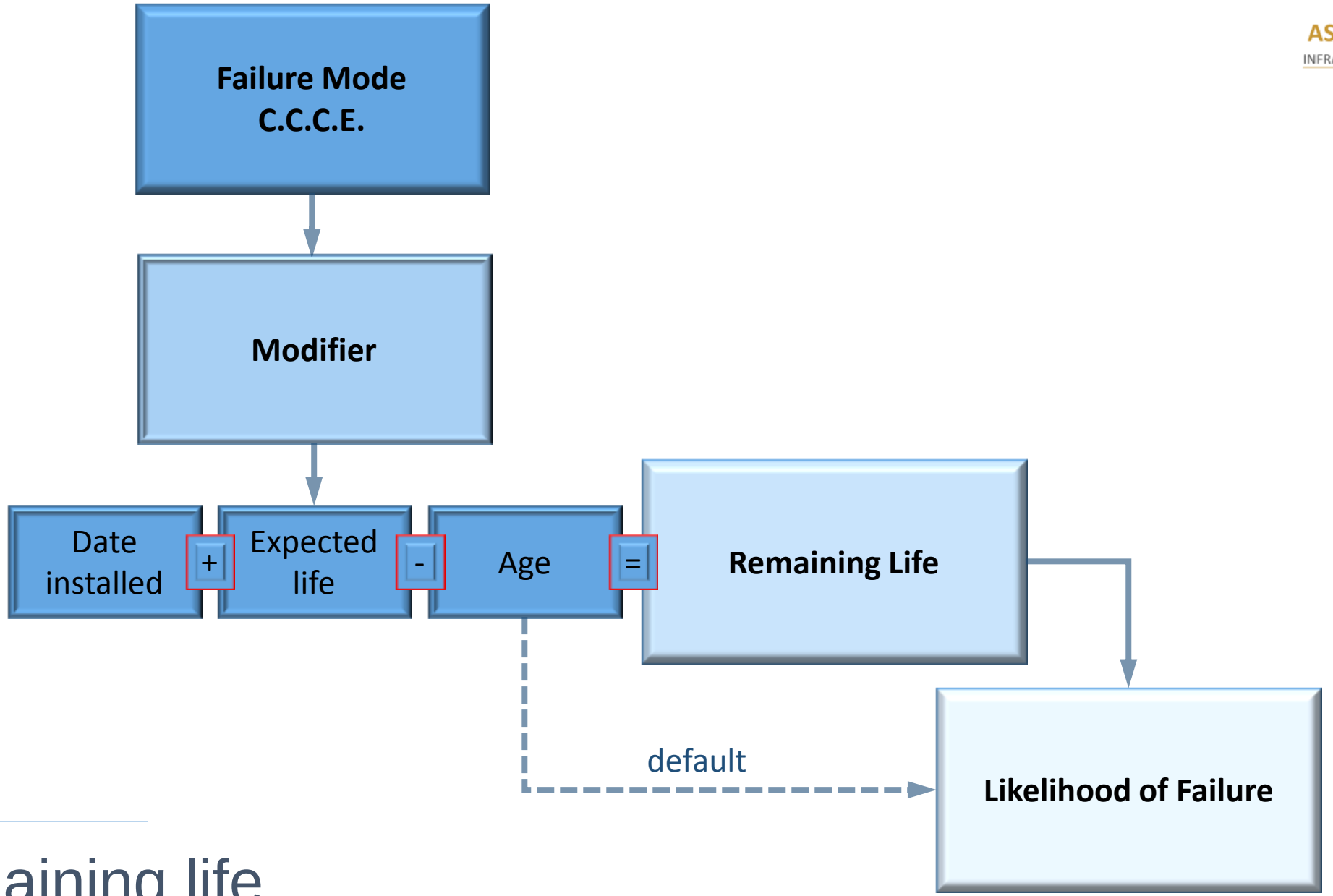
Capacity	– Capability vs Demand
Compliance	– Regulatory
	– Customer Satisfaction
Condition	– Physical Failure
Efficiency	– O&M Cost

Causes of Physical Failure

- ***Age***
- ***Physical deterioration***
- ***Weather***
  - Drought
  - Rain/Flood
  - Lightening Strike
  - Snow
  - Wind
- ***Fuel***
  - Power outage
  - Petroleum shortage
  - Diesel shortage
  - Gas shortage
- ***Solar interference***
- ***Earth Movement***
  - Earthquake
  - Settlement
  - Liquefaction
  - Landslide
- ***Fire***
- ***Damage***
  - Malicious
  - Accidental
- ***Others***

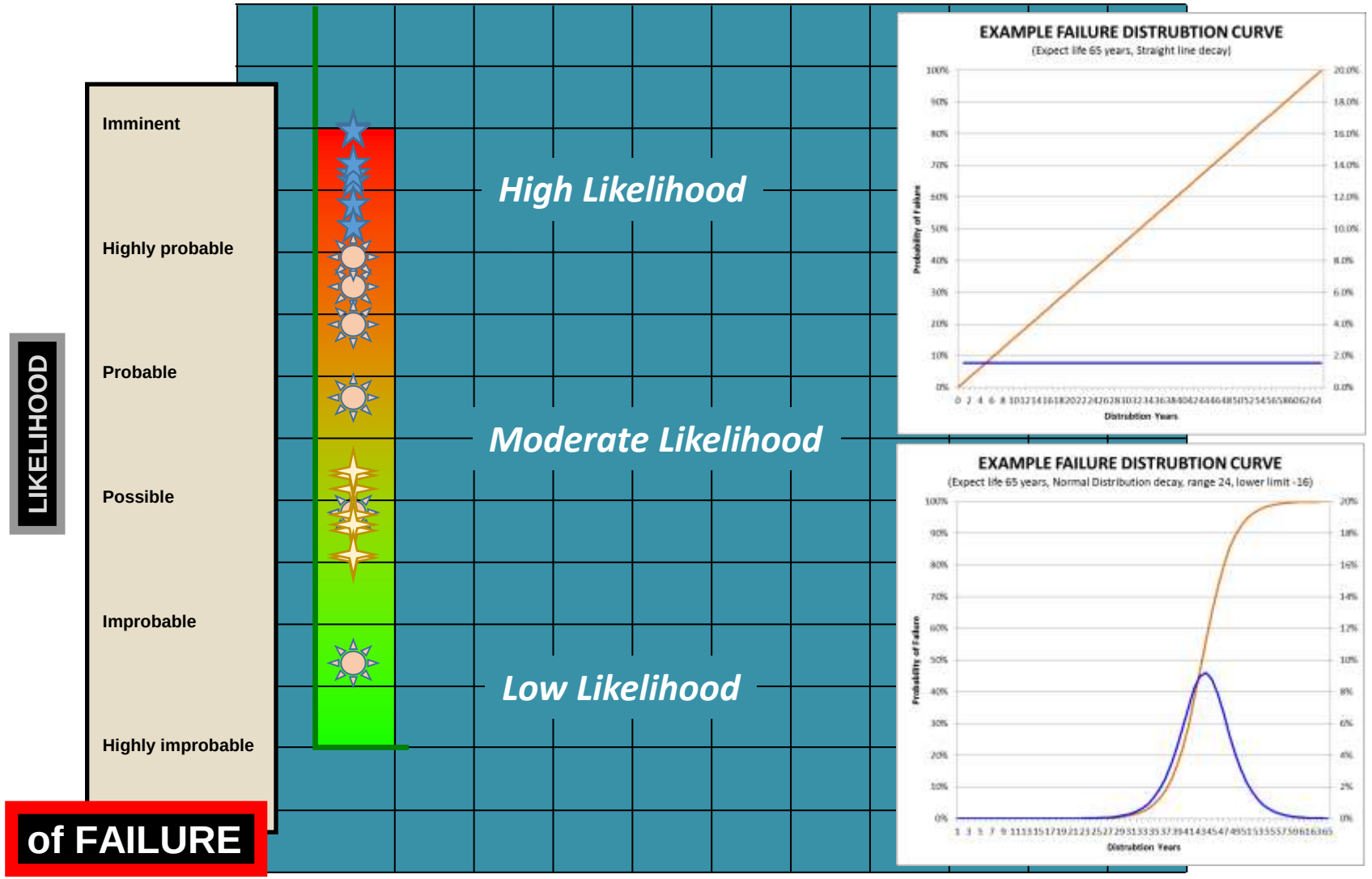
BUCHANAN and ASSOCIATES
INFRASTRUCTURE PLANNING ... INFRAP

BUCHANAN and ASSOCIATES
INFRASTRUCTURE PLANNING ... INFRAP



remaining life

f(Prime Failure Modes)



likelihood

LIKELIHOOD

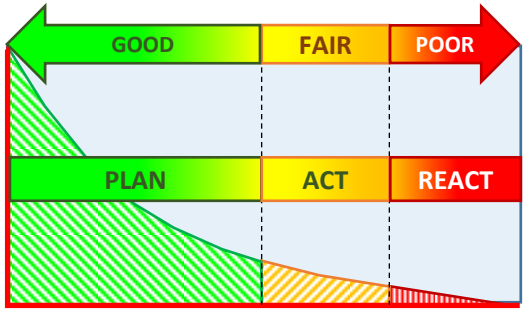
Note:
Likelihood ≠ Risk

BUCHANAN and ASSOCIATES
INFRASTRUCTURE PLANNING ... INFRAP

FOR ANY GIVEN SINGLE ASSET

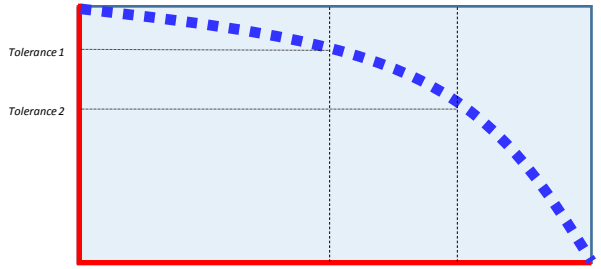
Over Time

Number of Potential Solution to Solve an Issue



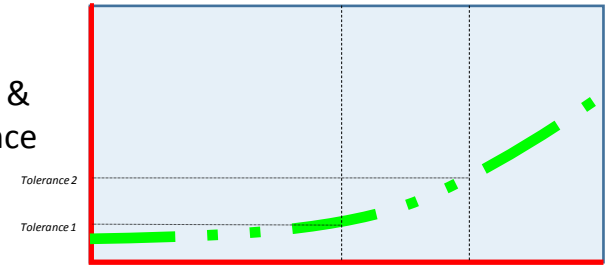
Time

Level of Service



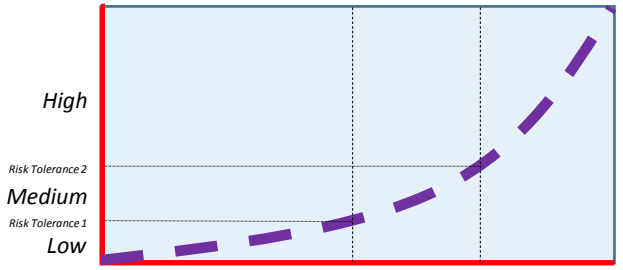
Time

Operation & Maintenance Cost



Time

Risk

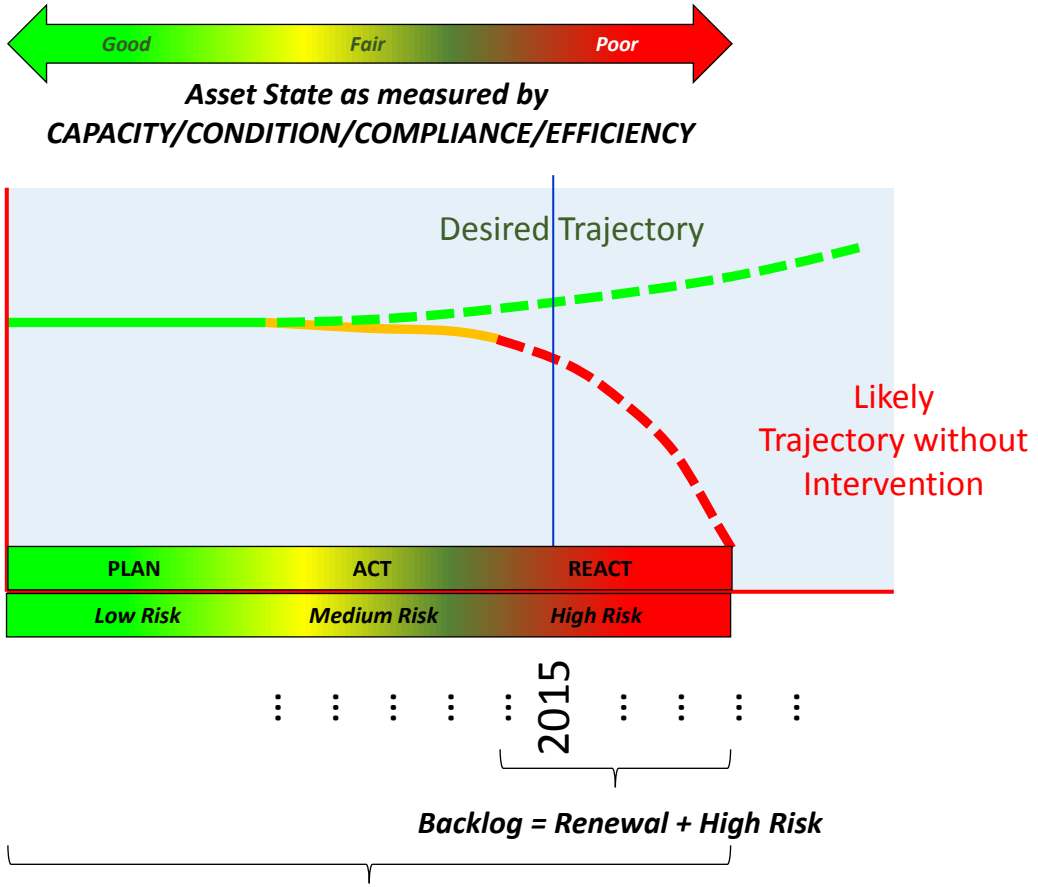


Time

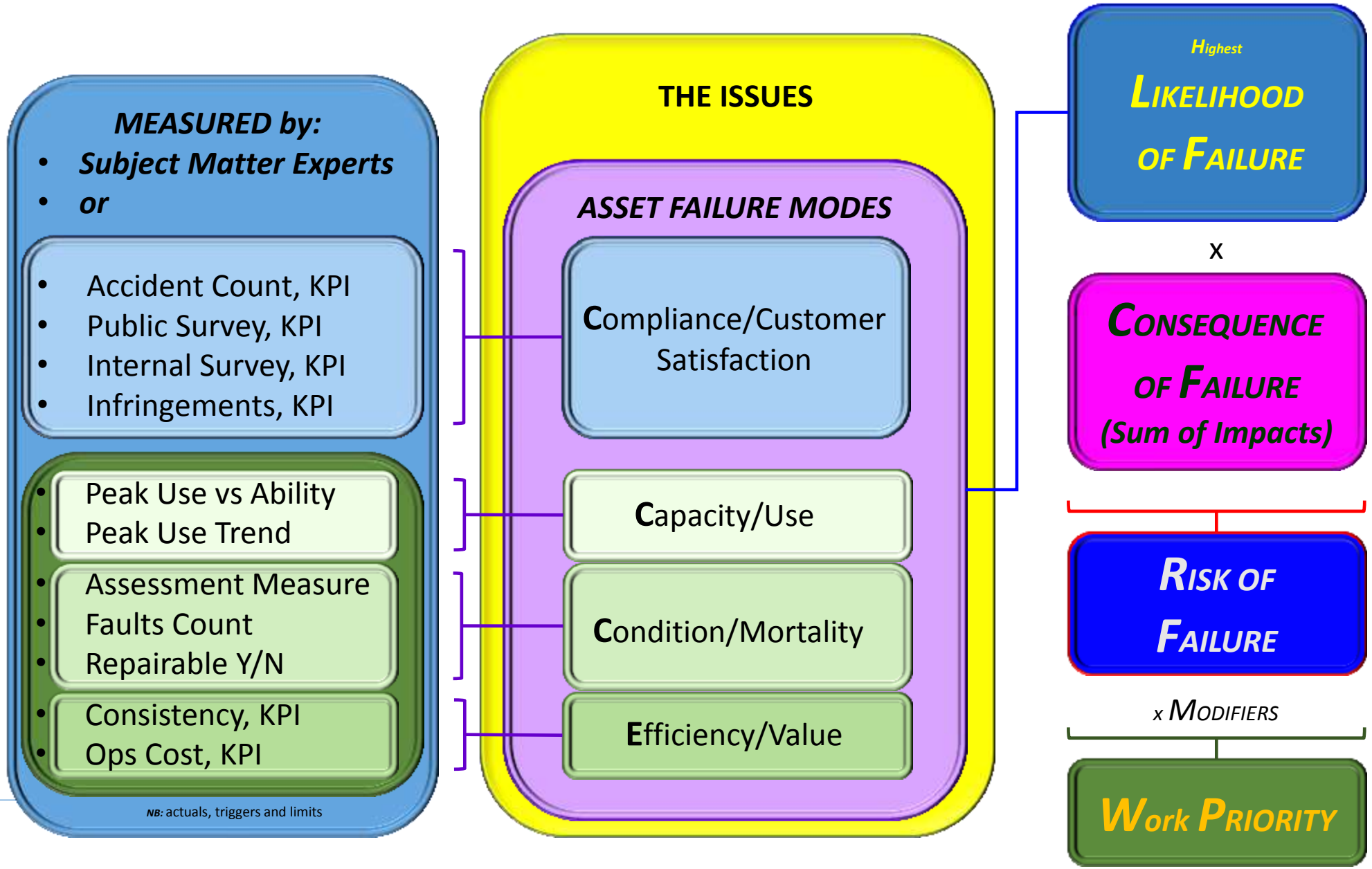
Safe Reliable Quality Service

A SYSTEM UNDER STRAIN –

Key Indicators: Increasing Maintenance. Increasing faults and failures, Slipping service levels ...



break – back in 10


MEASURED by:
• Subject Matter Experts
• or
• Accident Count, KPI
• Public Survey, KPI
• Internal Survey, KPI
• Infringements, KPI
• Peak Use vs Ability
• Peak Use Trend
• Assessment Measure
• Faults Count
• Repairable Y/N
• Consistency, KPI
• Ops Cost, KPI
NB: actuals, triggers and limits
THE ISSUES
ASSET FAILURE MODES
Compliance/Customer Satisfaction
Capacity/Use
Condition/Mortality
Efficiency/Value
Highest
LIKELIHOOD OF FAILURE
x
CONSEQUENCE OF FAILURE (Sum of Impacts)
RISK OF FAILURE
x MODIFIERS
Work PRIORITY

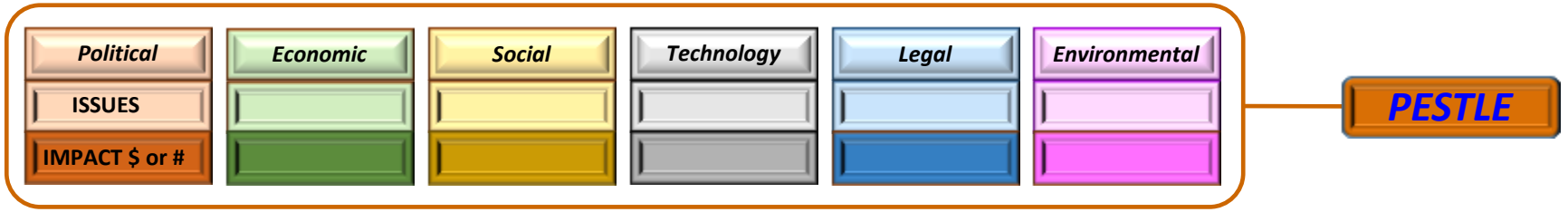
BUCHANAN and ASSOCIATES
INFRASTRUCTURE PLANNING ... INFRAP

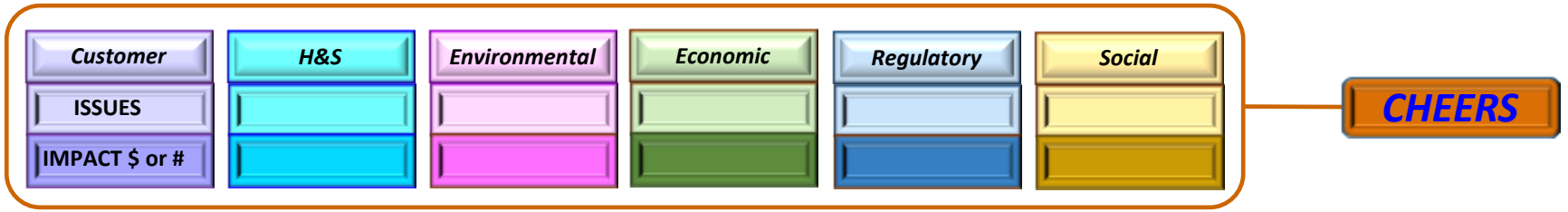
Consequence - synonymous with:

- Cost …
- Impact/Value …
- Criticality …
- Importance …
- Significance … of the failure

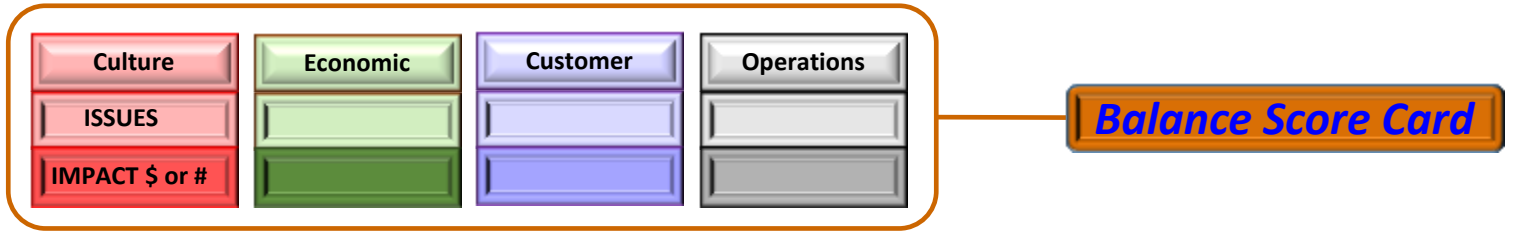
what is consequence?

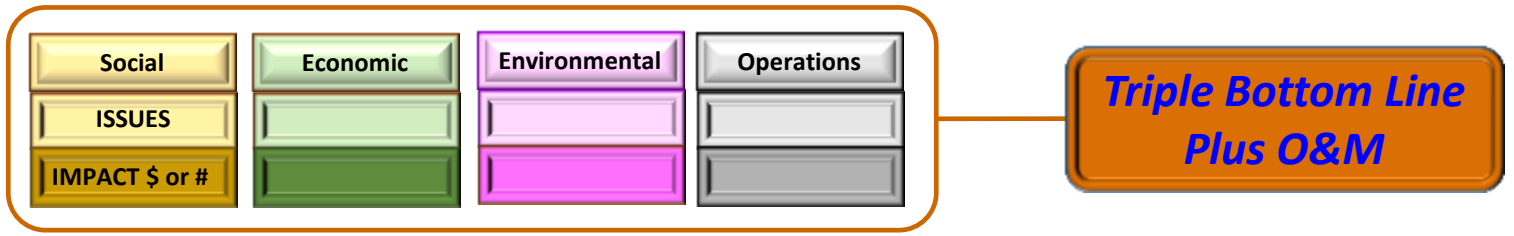
Qu 10





CONSEQUENCE CATEGORY OPTIONS
(Choose one or make up your own)





options

Consequence of Failure

• Social Impact/Breadth	$:00 or #
• Economic Impact/Breadth	$:00 or #
• Environmental Impact/Breadth	$:00 or #
• O&M Impact/Breadth	$:00 or #
TOTAL	$:00 or #

Social Impacts: customer (satisfaction, fairness, equality), political significance, public response, image change, cultural heritage, community health and safety, security/accidents, accessibility, human diversity

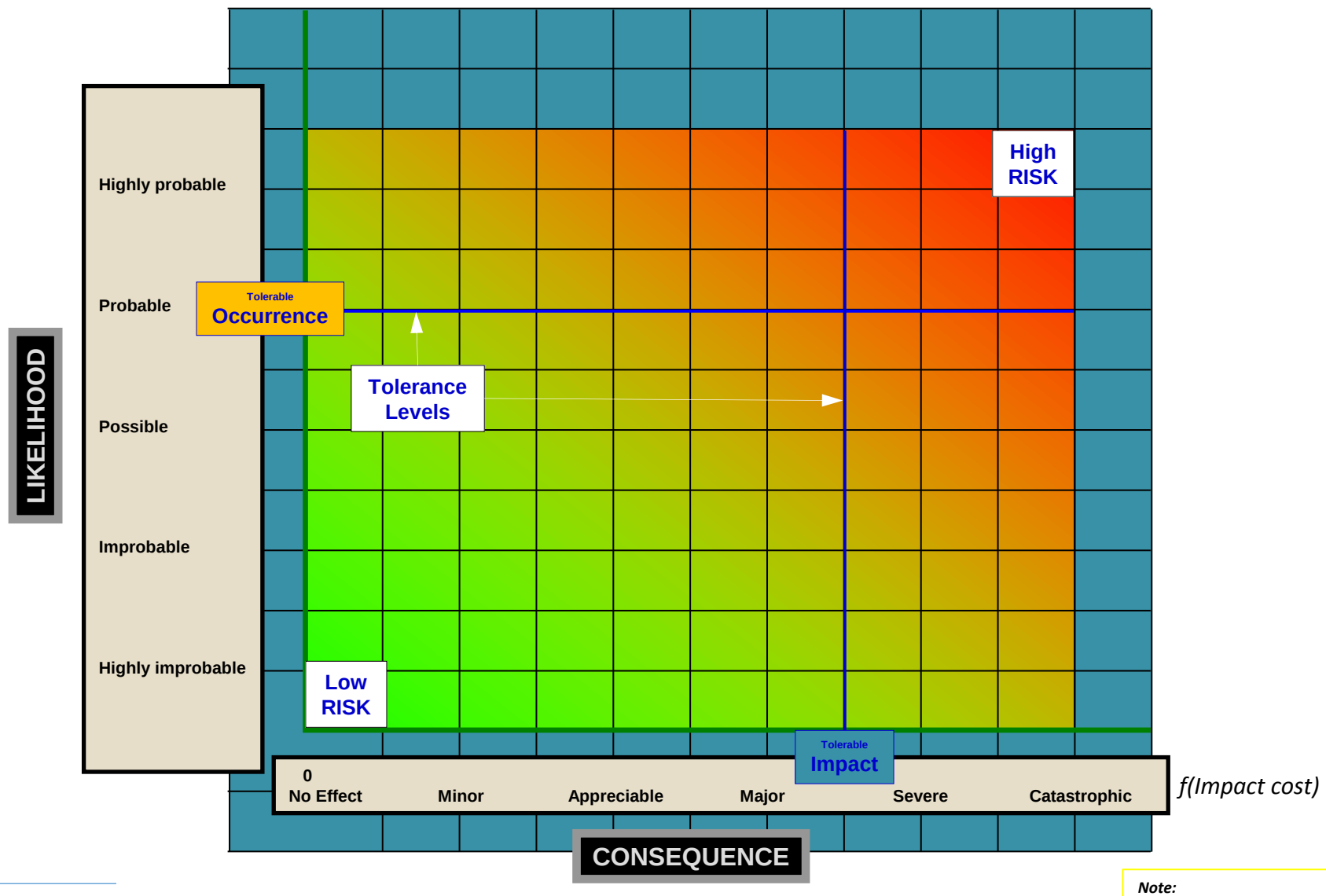
Economic Impact: financial cost (capital, operating, maintenance/intervention, repair, renew, refurbish, replace, disposal, carbon footprint, financing), legal cost, income loss, regulatory penalties, insurance change

Environmental Impact: air, water, soil, noise, greenhouse gasses, landscape, biodiversity, geology, flora, fauna, architectural heritage, archaeological heritage

O&M Impact: quality, quantity, workplace health and safety, security, accidents, permitting

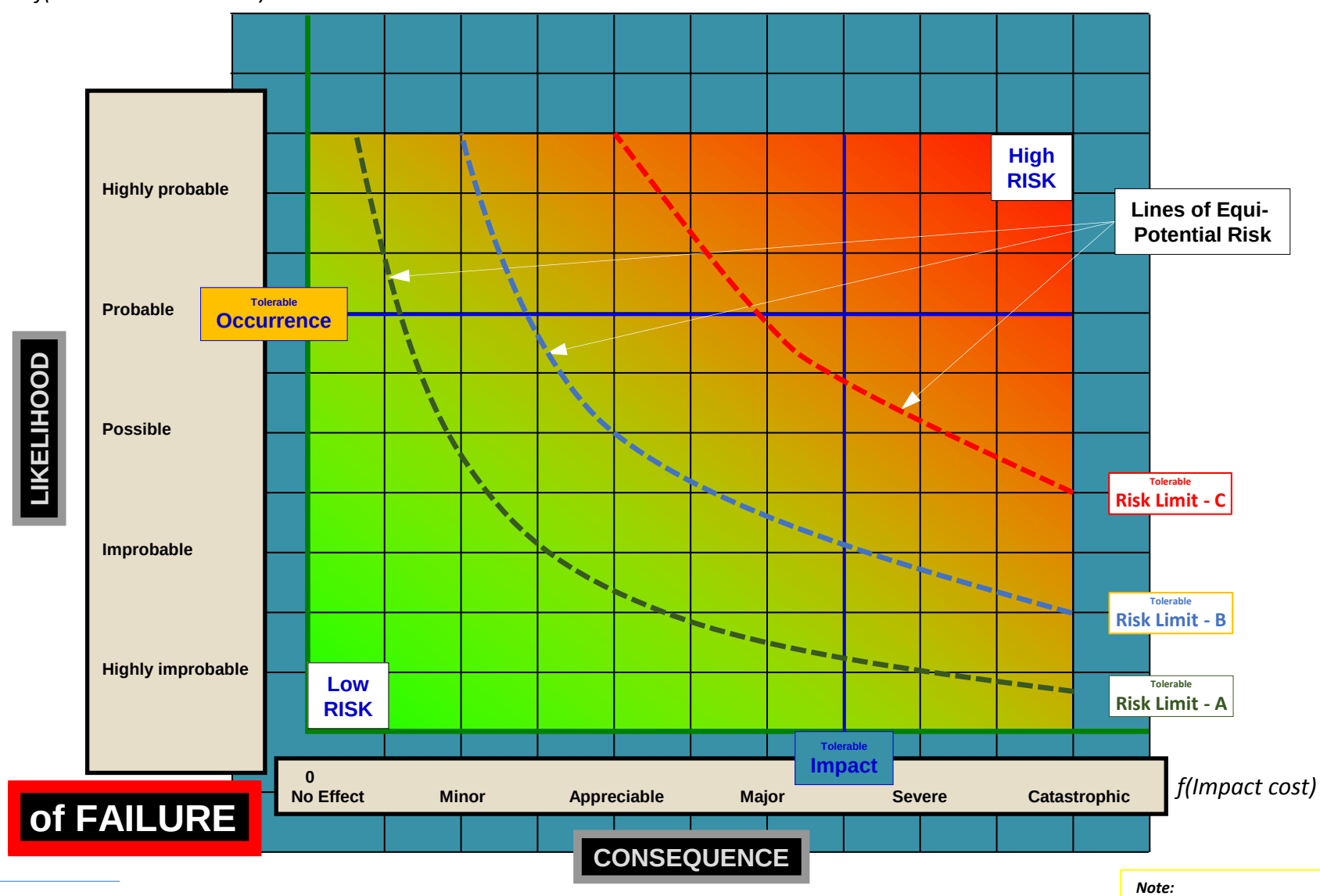
triple bottom line + o&m

BUCHANAN and ASSOCIATES
INFRASTRUCTURE PLANNING ... INFRAP



Note:
Impact Cost ≠ Replacement Cost

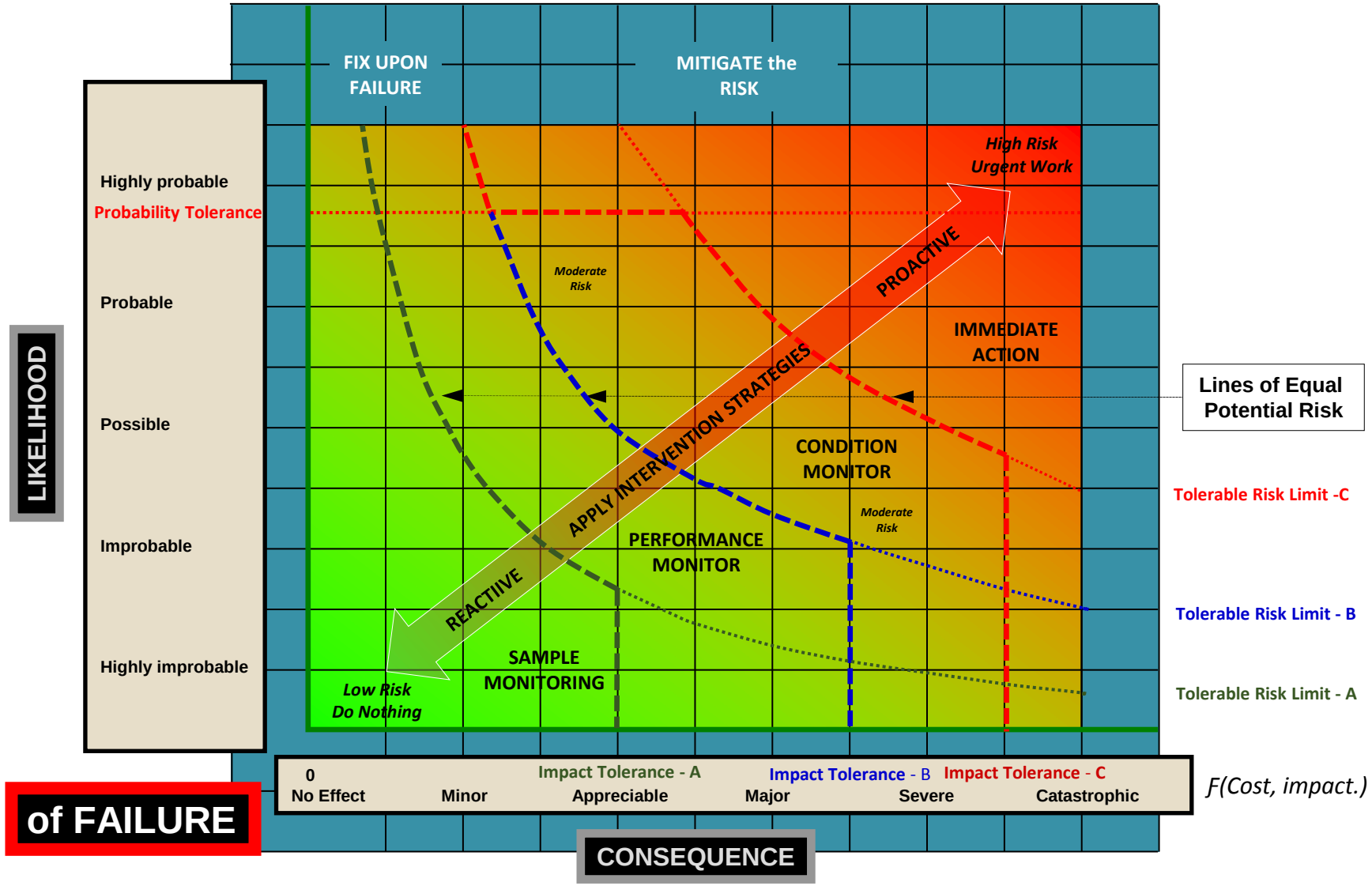
basic risk chart



equi-potential risk

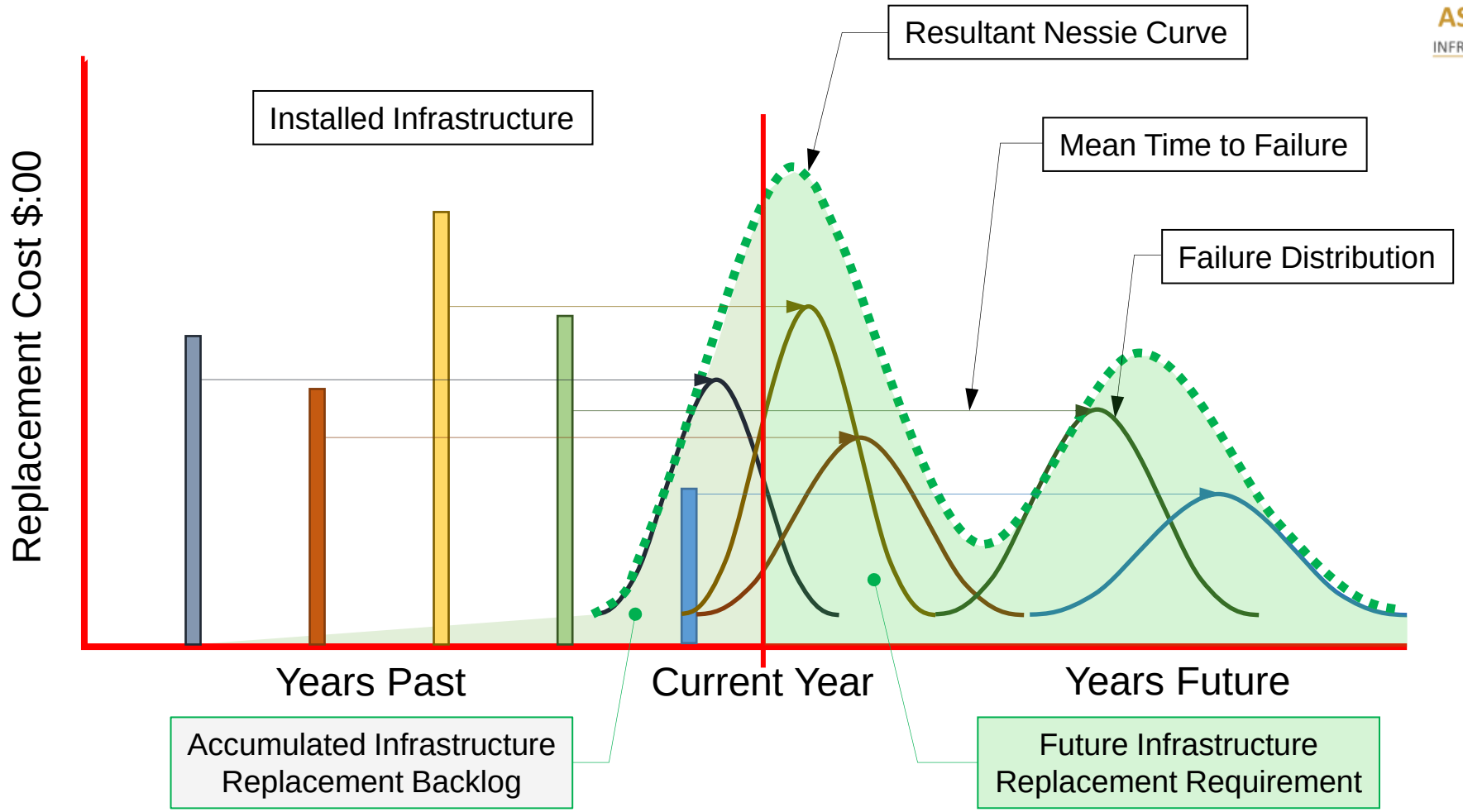
BUCHANAN and ASSOCIATES
INFRASTRUCTURE PLANNING ... INFRAP

f(Prime Failure Modes)

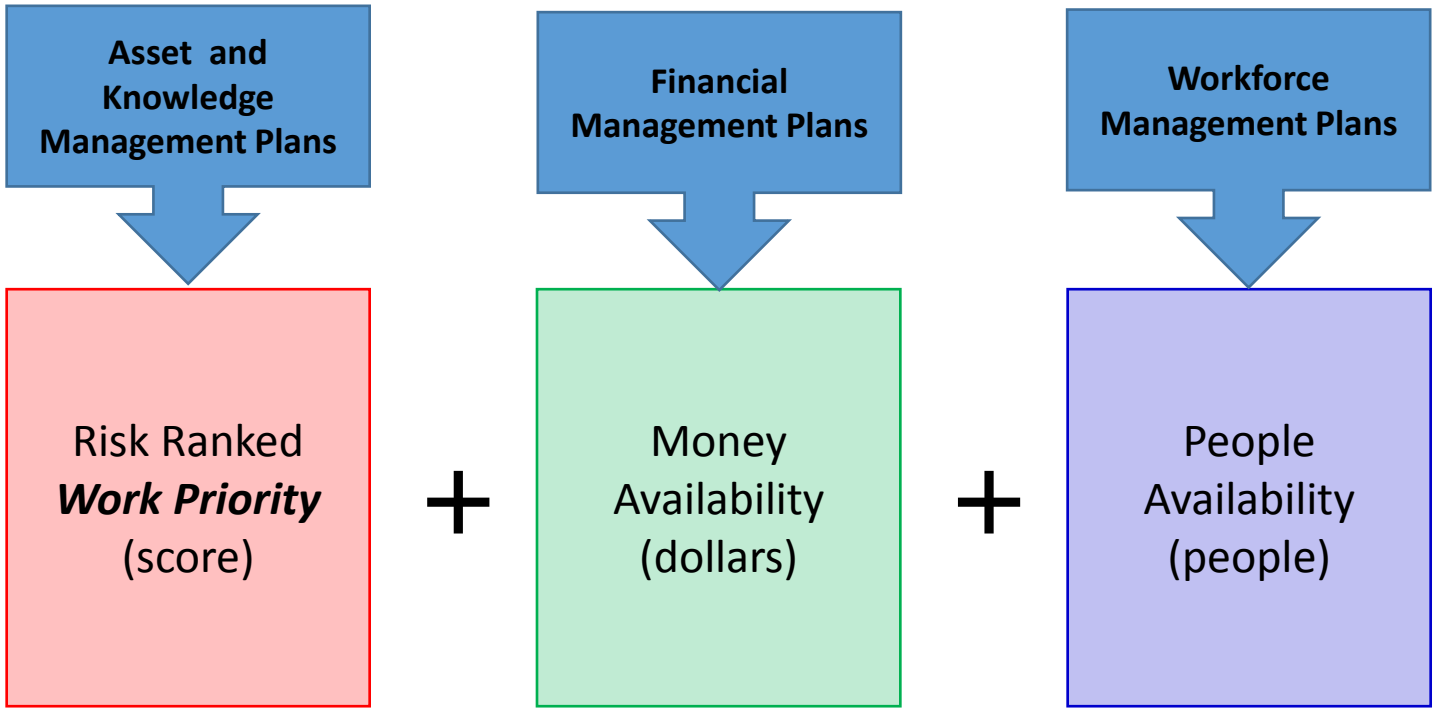


F(Cost, impact.)

risk matrix



infrastructure replacement profile



= **Capital/Operating Improvement Plan & Annual Budget (Risk Based Prioritization)**

implementation reality

Sharing Shed:

- Start 7:30 am
- 4 x two hour work session per day, 6 days per week
- ½ hour breaks at 9:30 am and another at 3:00 pm
- 1 hour lunch 12:00 – 1:00 pm

A gun machine sharer shares:

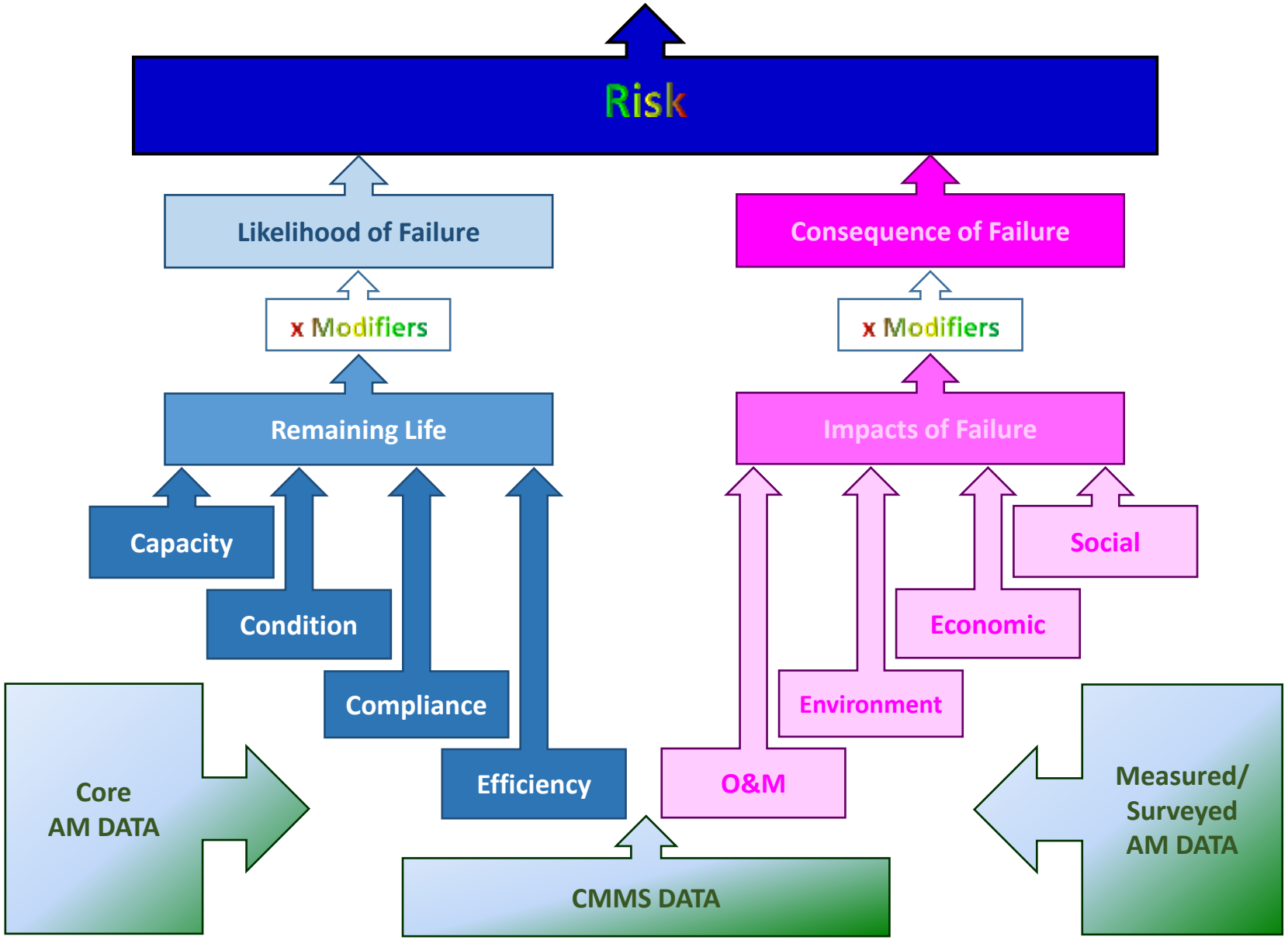
- 150-250 fine wool sheep per day
- 350-450 crossbreed sheep per day

A gun blade sharer shares:

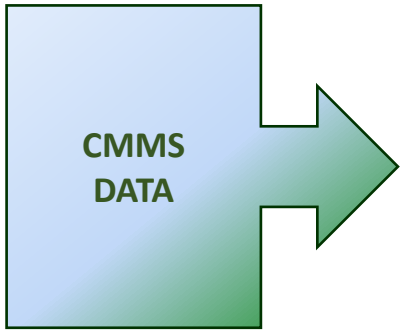
- 50-70 sheep per day

break – back in 10

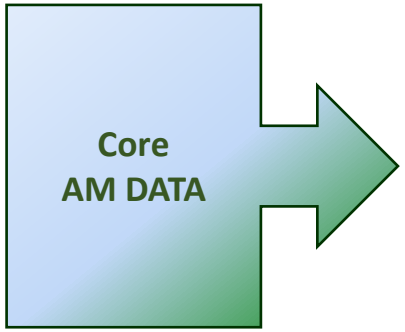
Risk Ranked Work Priority



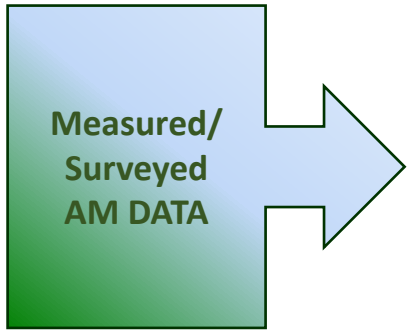
data



- Unique ID
- Location
  - Town/Area/street/etc.
  - Land Use
- Make/Model/Type
- Material
- Size/Dimensions
- Installation Details
  - Depth
  - Ground type/condition
- Scheduled Maintenance
- Defects/Failures History

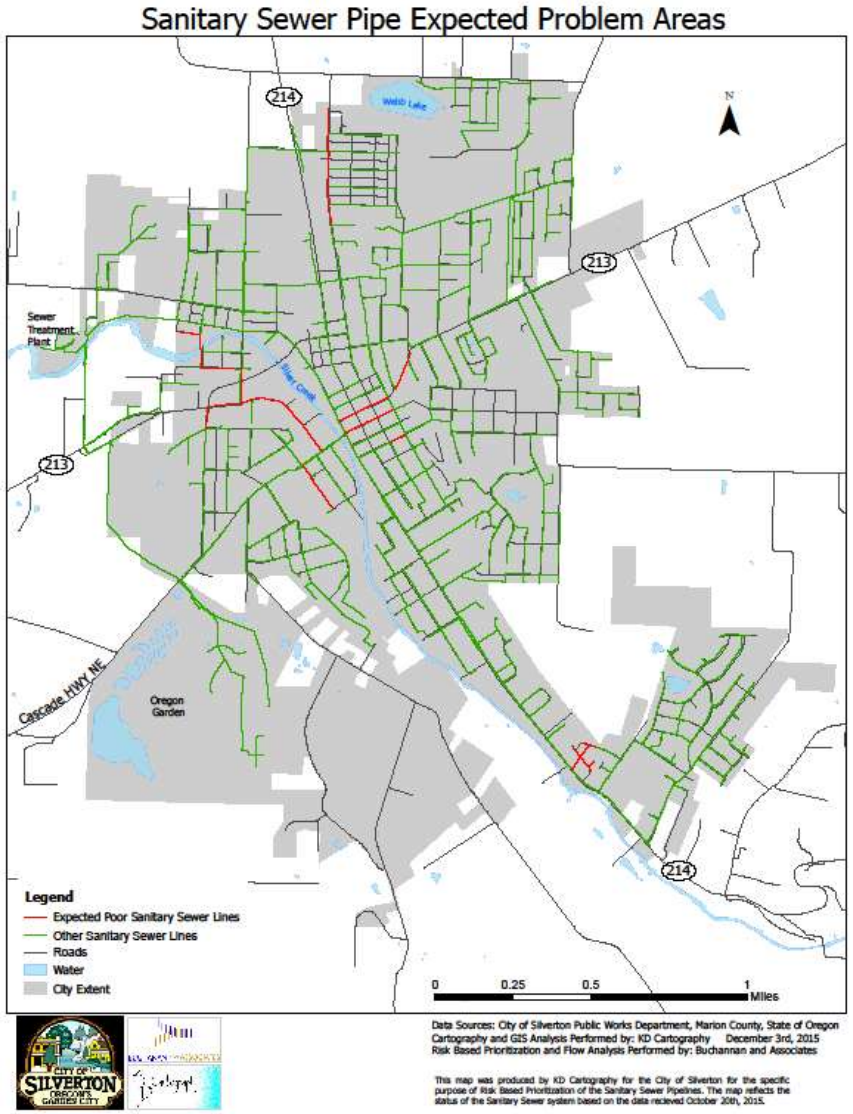


- Installed Date
- Expected Life
- Replacement Cost
- Demand/Growth Rates
- Buffer/Peaking Factors
- Special Conditions Affecting Life



- Capability
  - Capacity
  - Condition
  - Compliance
    - Regulatory
    - Customer Satisfaction
  - Efficiency
- Impacts
  - Social
  - Economic
  - Environmental
  - Operational

Defined
Mission, Vision, Goals, & Objectives
and Agreed Levels of Service



data – pipe inventory

The City has a ***relatively*** complete GIS inventory of the Wastewater Collection system

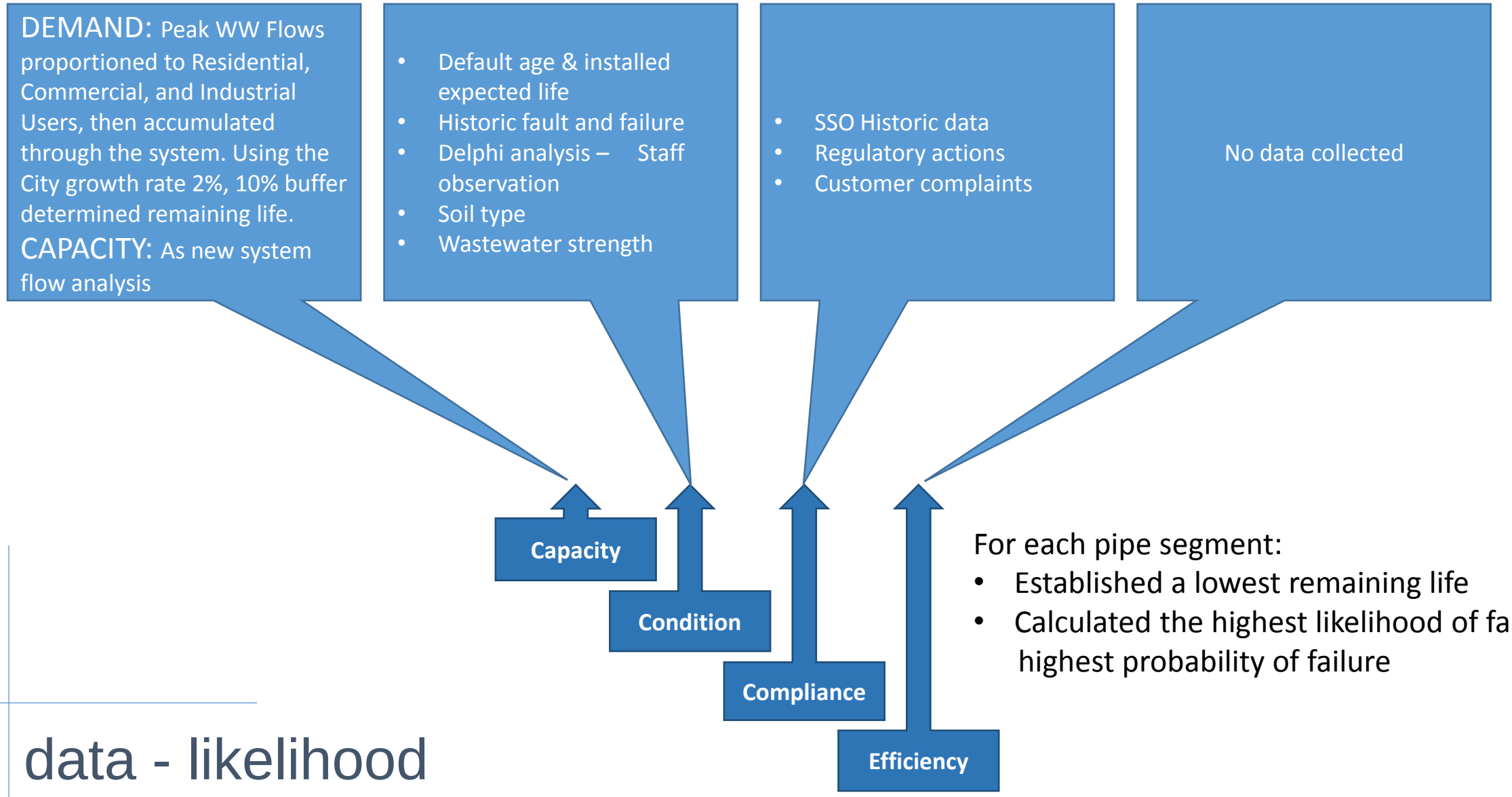
This provided the pipe inventory:

- Length of pipe (205,000 +/- 31,000 ft)
- Size: diameter (8” – 21”), segment lengths
- Type: (AC, PVC, Clay, Concrete, DI)
- Installed Dates (1920’s to present)
- Location, Area, Basin
- MH #, Rim elevation, In/Out invert elevations
- Connections # (possible and current)

But:

- It was not complete, about 95%;
- There were data gaps, unknowns; and
- There were data errors in about 30% of the 1,100 lines
  - Size, type, location, dates, connectivity …
  - Data was inconsistently entered type and/or form, there were no documented data standards

data - likelihood



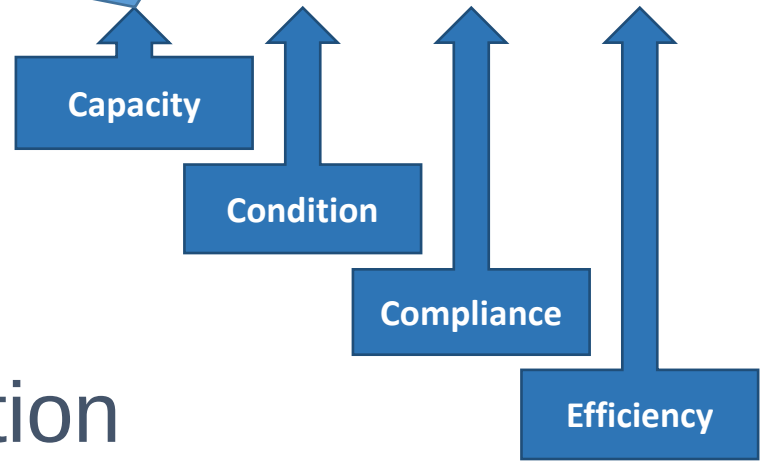
For each pipe segment:

- Established a lowest remaining life
- Calculated the highest likelihood of failure; highest probability of failure

capacity computation

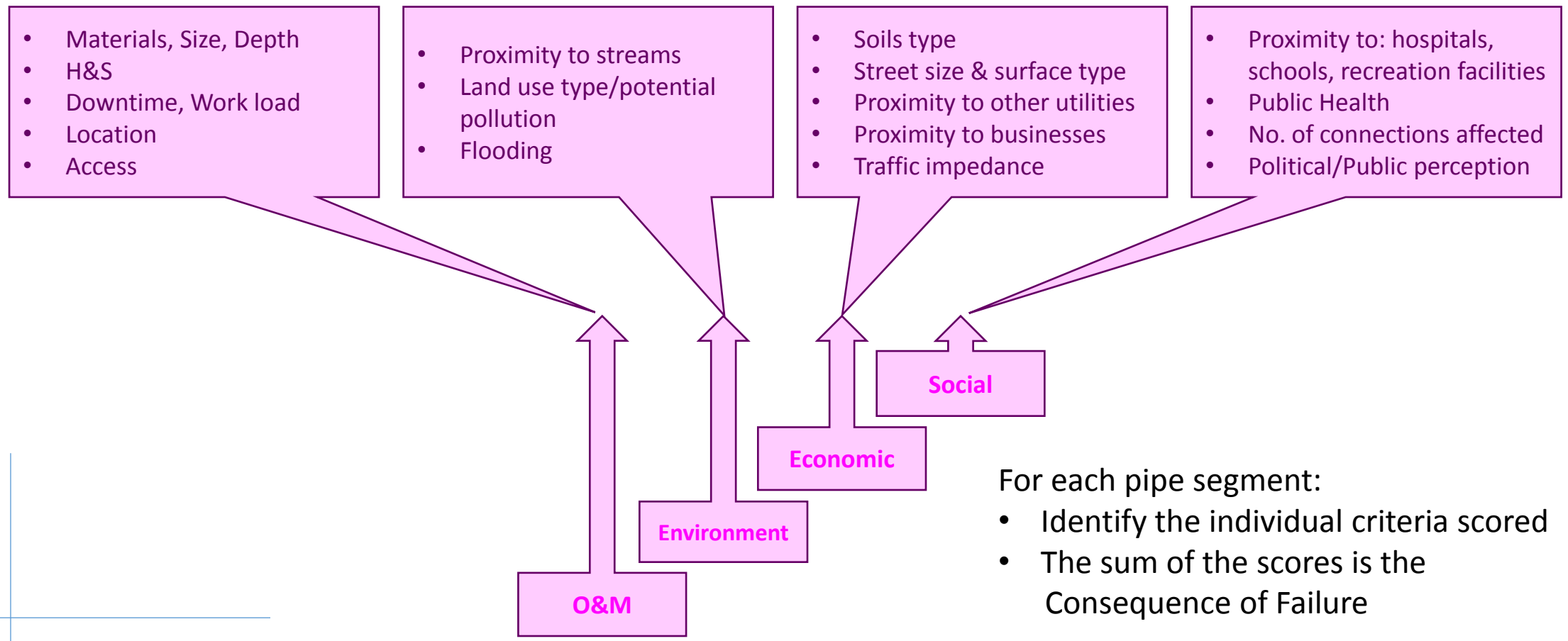
To determine utilization and capacity of the wastewater collection system we followed the approach presented by Richard Ludlow and Trevor Lierman in 2015, which they used in their analysis of the Oak Lodge Sanitary District trunk sewers

1. Obtained the water use figures for the winter months
2. Determined the peaking factors: Peak day WWF at the WWTF/the average winter daily water usage, with a modifier proportionate to the pipe size
3. Established the cumulative flows in the system by summing the flows per connection, given the PF and the water use for the given connection
4. Determined the sewer capacity using the modified manning formula and the installed system data
5. Given a 2% growth factor and a 10% safety factor we then determined the remaining year of life, in capacity terms, of the individual pipe segments ... In years.



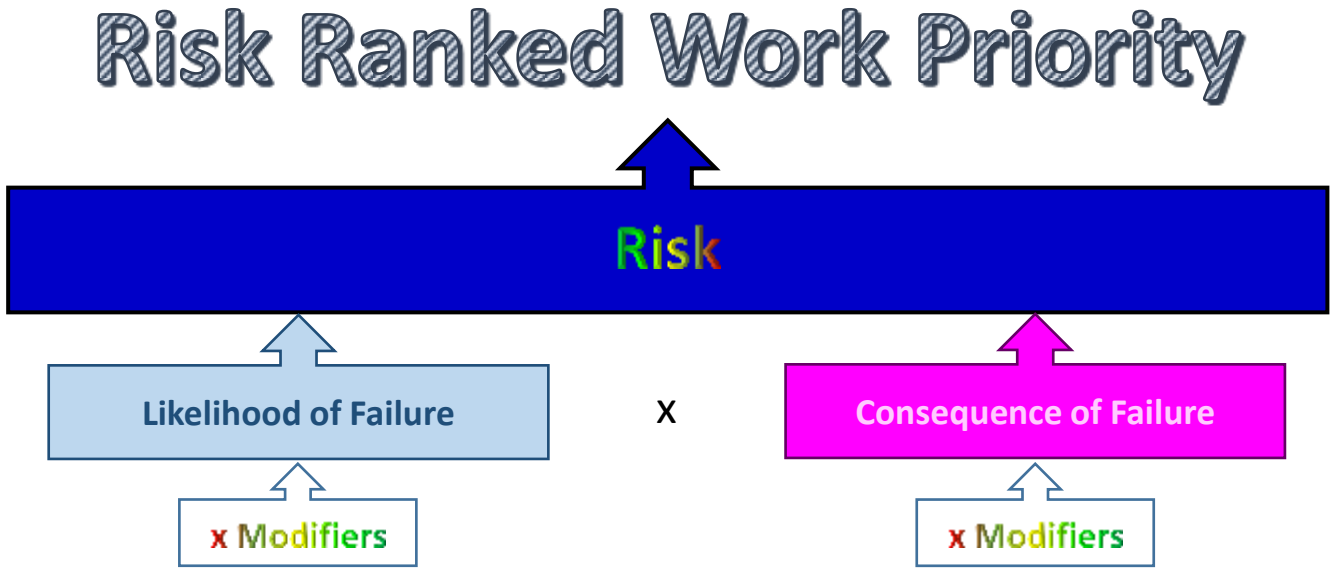
data - consequence

Staff helped develop a scoring system for each criteria, the scores were either applied directly or using GIS



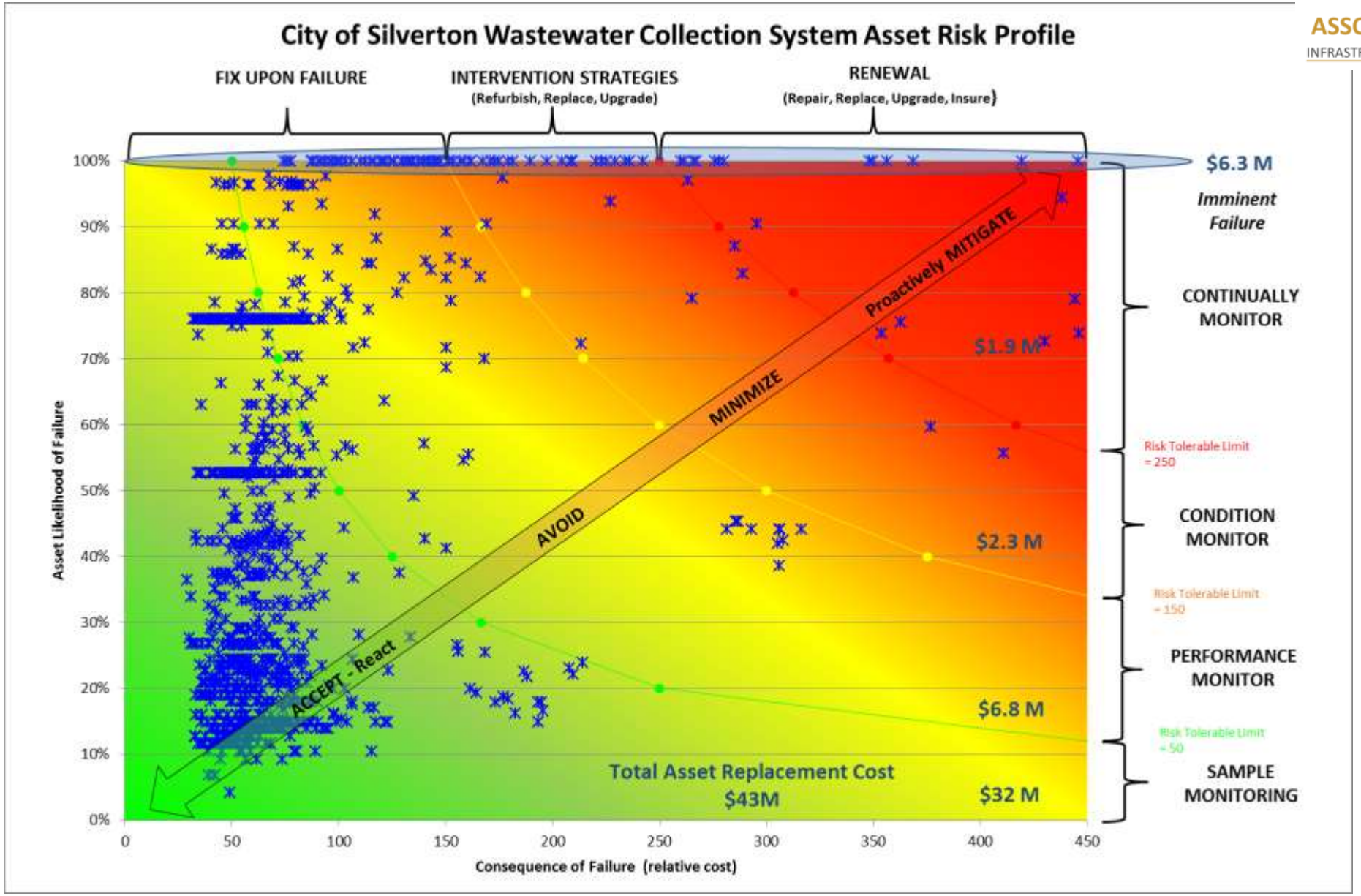
For each pipe segment:

- Identify the individual criteria scored
- The sum of the scores is the Consequence of Failure

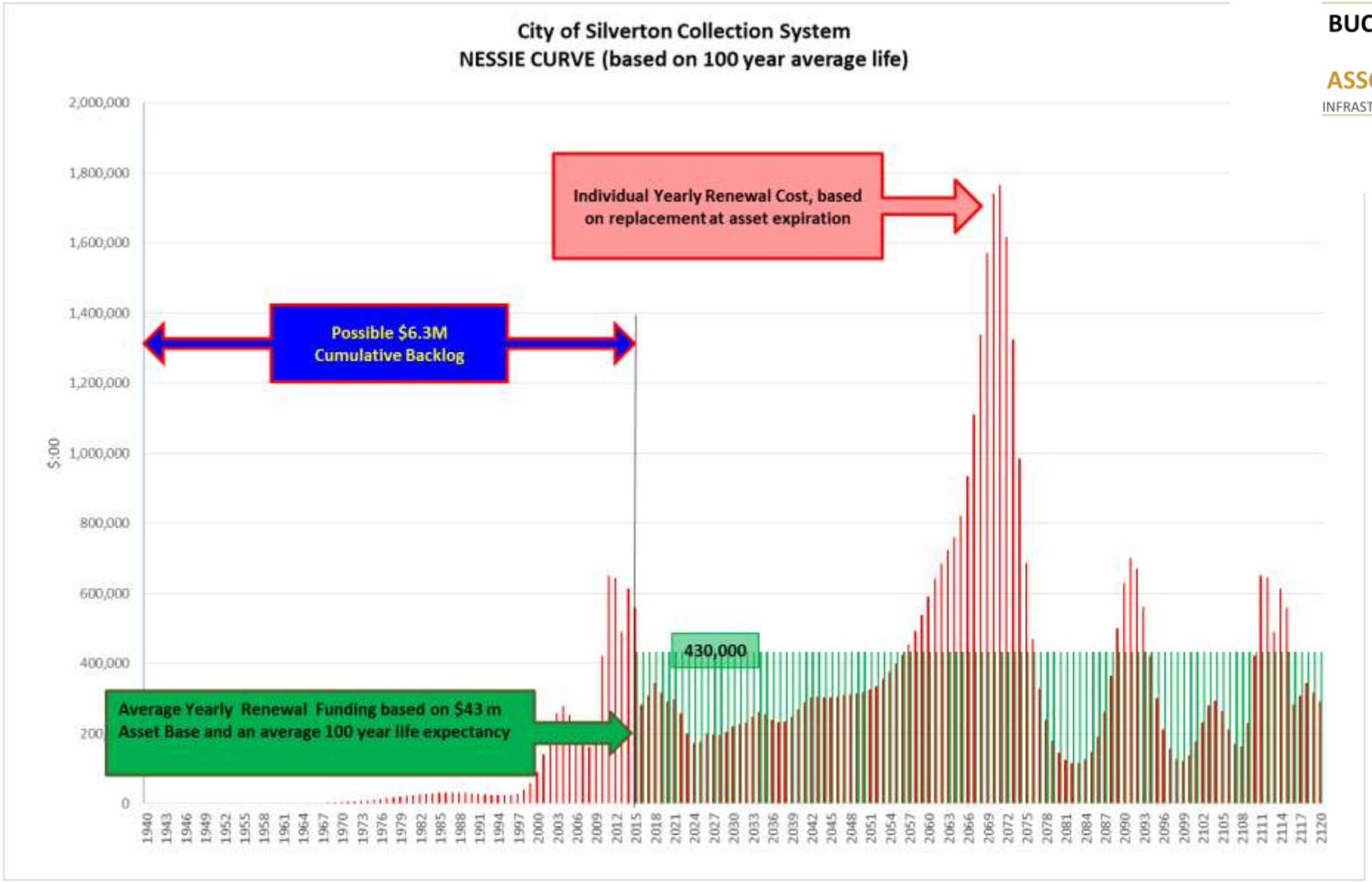


We did not apply any modifiers to our calculations

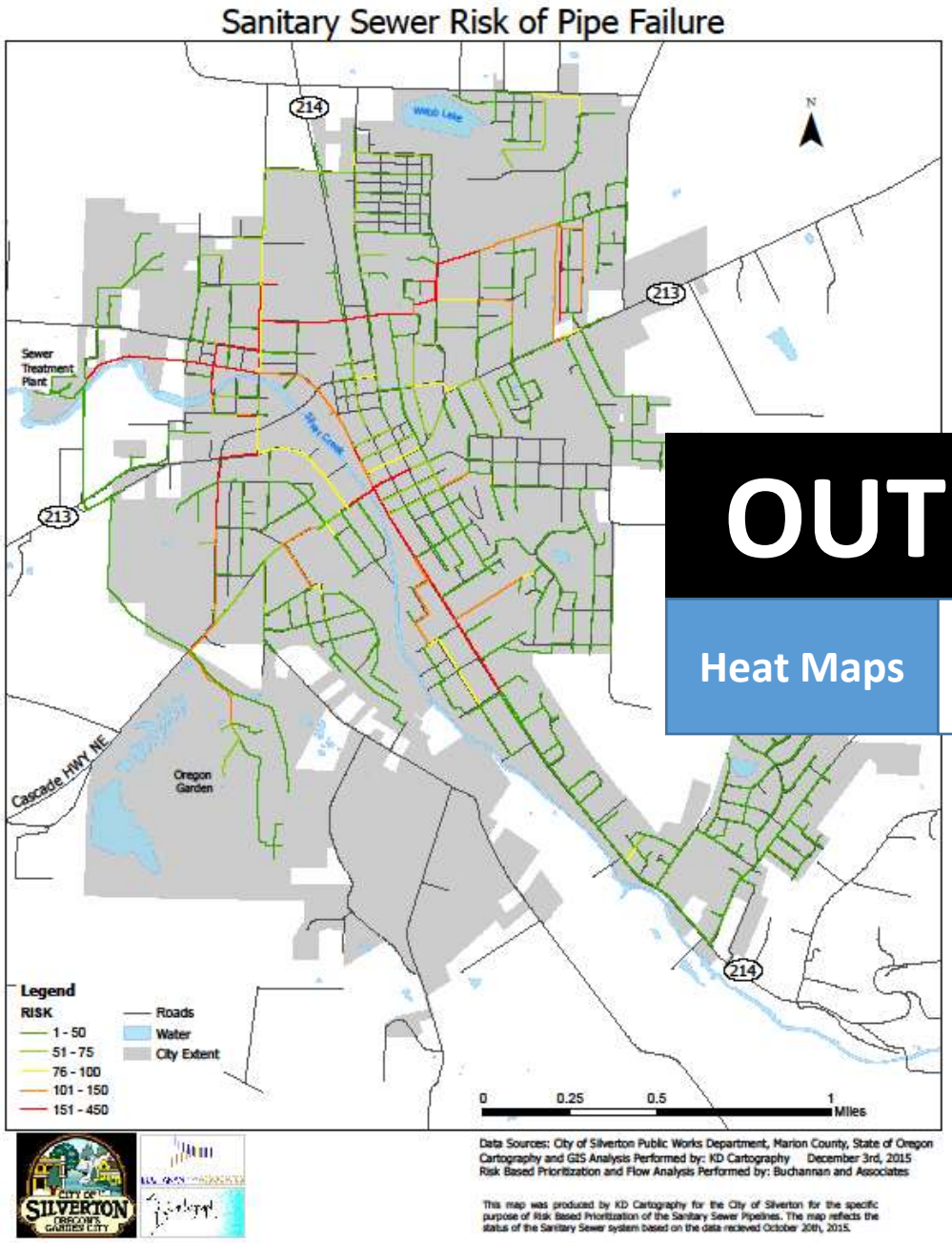
Risk - computation


City of Silverton Wastewater Collection System Asset Risk Profile
FIX UPON FAILURE
INTERVENTION STRATEGIES
(Refurbish, Replace, Upgrade)
RENEWAL
(Repair, Replace, Upgrade, Insure)
Asset Likelihood of Failure
Consequence of Failure (relative cost)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
50
100
150
200
250
300
350
400
450
Proactively MITIGATE
MINIMIZE
AVOID
ACCEPT - React
$6.3 M
Imminent Failure
$1.9 M
$2.3 M
$6.8 M
$32 M
Total Asset Replacement Cost
$43M
CONTINUALLY MONITOR
Risk Tolerable Limit = 250
CONDITION MONITOR
Risk Tolerable Limit = 150
PERFORMANCE MONITOR
Risk Tolerable Limit = 50
SAMPLE MONITORING

BUCHANAN and ASSOCIATES
INFRASTRUCTURE PLANNING ... INFRAP



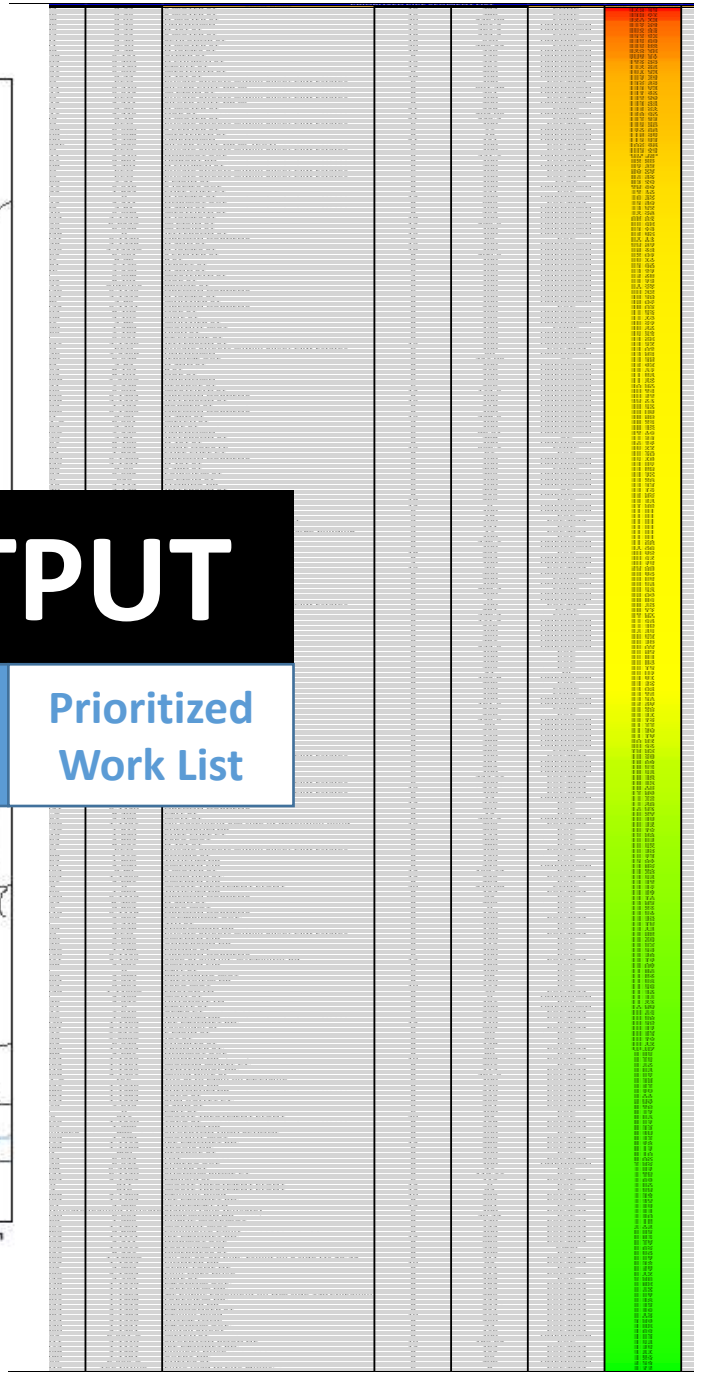
resultant nessie curve



OUTPUT

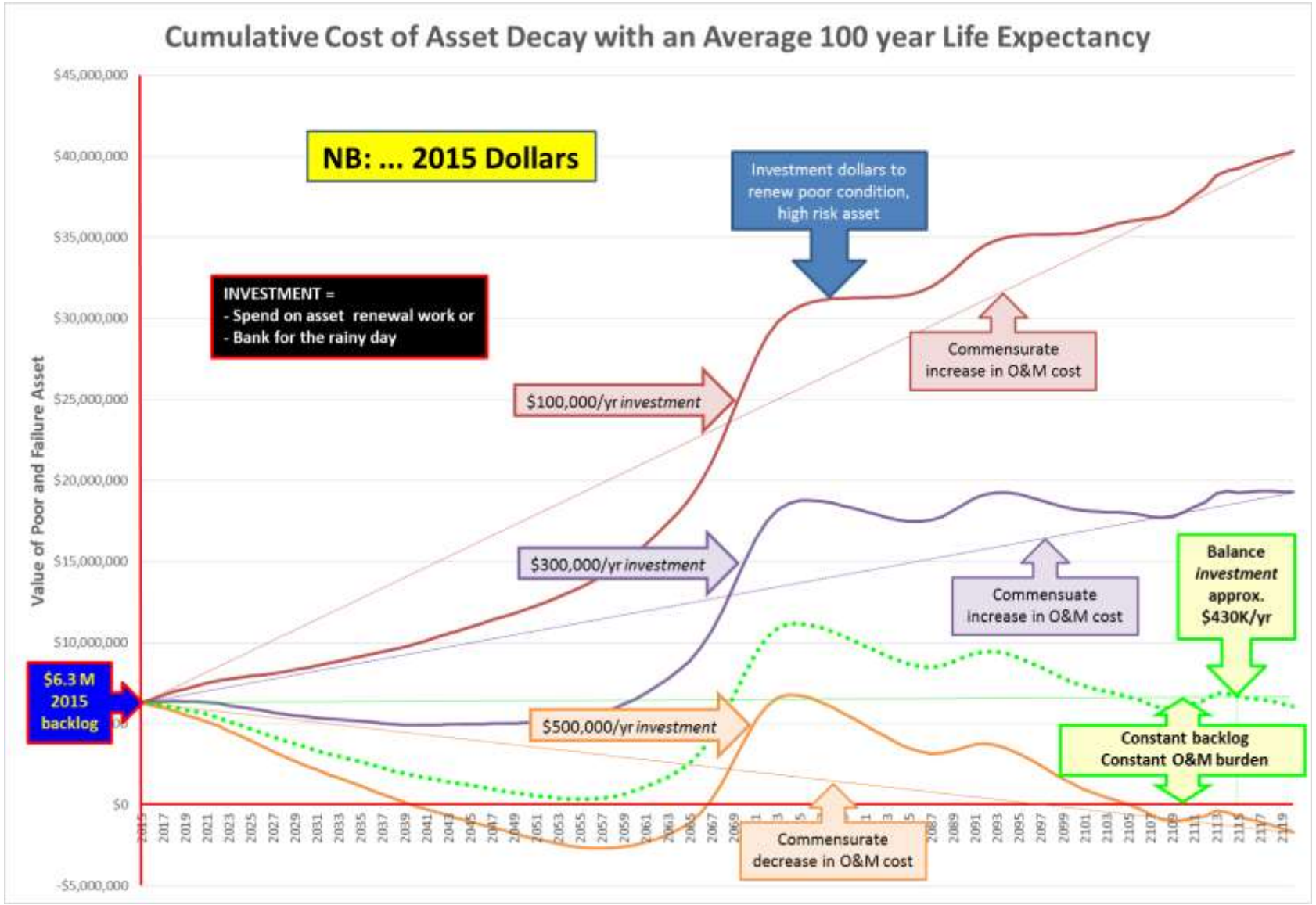
Heat Maps

Prioritized Work List



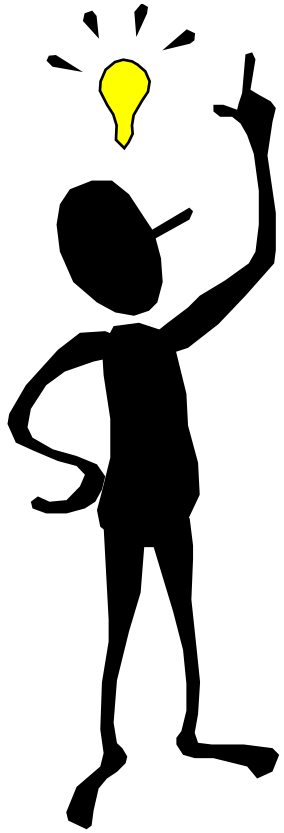
BUCHANAN and ASSOCIATES
INFRASTRUCTURE PLANNING ... INFRAP

BUCHANAN and ASSOCIATES
INFRASTRUCTURE PLANNING ... INFRAP

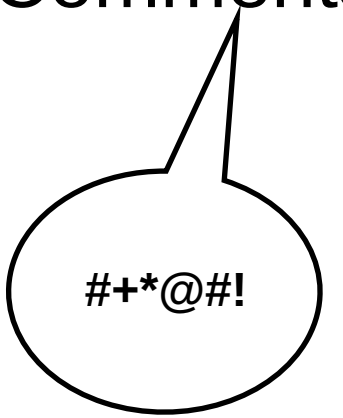


investment strategies

Thank you for listening



- Questions
- Ideas
- Thoughts
- Comments

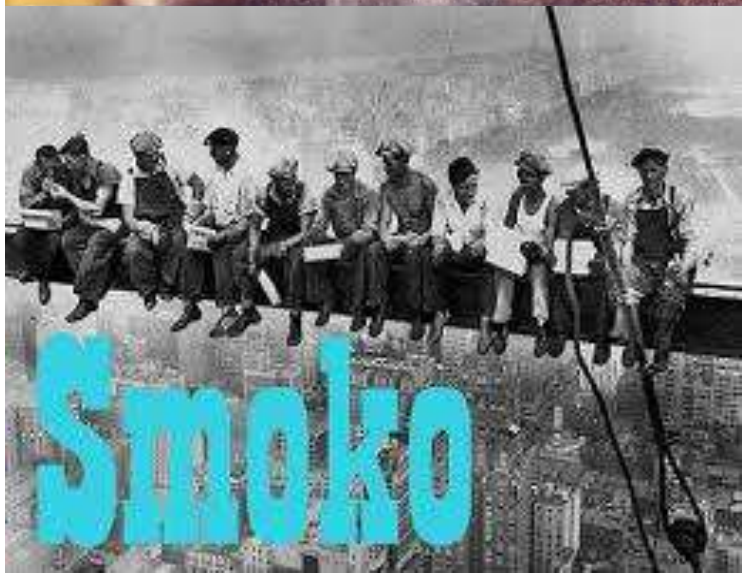


BUCHANAN and ASSOCIATES
INFRASTRUCTURE PLANNING ... INFRAP

2735 Alvarado Terrace S, Salem OR 97302
phone: 360 901 1564 e-mail Barry@BuchananAndAssocaites.com

City of Silverton
Wastewater Collection System
Initial **Risk Assessment**

CITY OF SILVERTON
• EST 1854 •
OREGON'S GARDEN CITY



Smoko: *Noun*

- Royal Navy – an informal cigarette break
- NZ commercial and construction industries – a 15 minute break taken at 10:00 am and 3:00 pm
- Australasia shearers – the morning snack break

smoko