Burgess & Niple

March 23, 2016

Practical Water Utility Asset Management Plans

BURGESS & NIPLE


Instructions
not INCLUDED

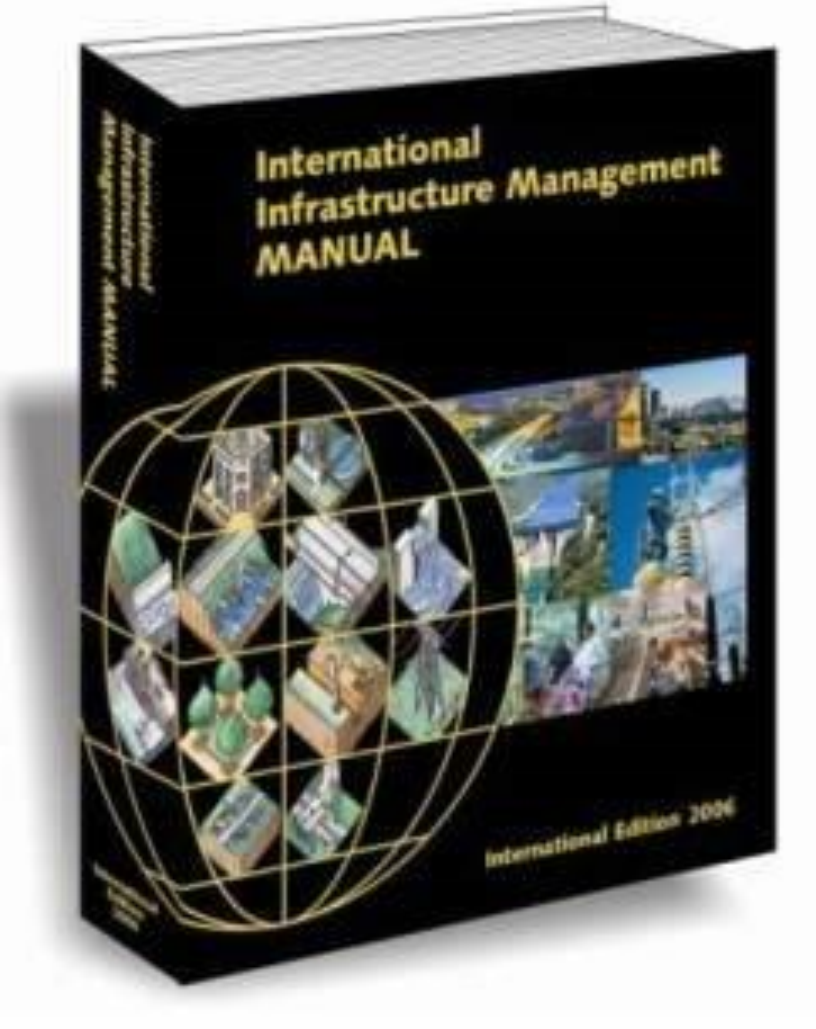
Inconsistency

- Treatment plants
  - One tracked pencils, another didn't track small motors, valves
  - One plant had a diesel generator to shave power peaks, another had a green roof
  - Varying degrees of preventive versus reactive maintenance
- Engineering
  - Different levels of service for projects depending on the project manager (due to lack of formal policy)
  - Project managers responsible for up to 12 projects at a time, very little scrutiny of proposed solutions
- Operations
  - Varying degrees of conservatism vs. operating closer to margin

Asset Management Plans are Maps

- They document where you are
  - State of assets
  - Performance levels
- Help you determine which way to go
  - Riskiest assets – risk exposure
  - Performance below targeted levels

International Infrastructure Mgmt Manual



Sample AM Plan Table of Contents

Appendix A: Asset Management Plan Structure

A recommended structure for an asset management plan is outlined below. While this structure has been successfully adopted by many organisations, it is noted that there is no ideal structure as long as the key AM elements are covered in a logical order.

Section 1: Executive Summary

The Executive Summary should emphasise the key issues contained in the body of the AM plan and provide readers with a succinct overview of the entire AM plan. Some readers who are not concerned with the finer details of the AM plan may only read the Executive Summary.

1.1 The Purpose of the Plan

- To demonstrate responsible management
- To communicate and justify funding requirements
- To comply with regulatory requirements

1.2 Asset Description

- Summary of assets covered by the plan

1.3 Levels of Service

- Summarise levels of service and performance measures and how they were set

1.4 Future Demand

- Factors influencing future demand
- Impact of changing demand on assets

1.5 Lifecycle Management Plan

- Summary of lifecycle management strategies (operations, maintenance, disposal, etc.)

1.6 Financial Summary

- Long-term income and expenditure (cashflow) projections for each significant asset group (e.g. pavements, footpaths, streetlights)
- Sources of funding

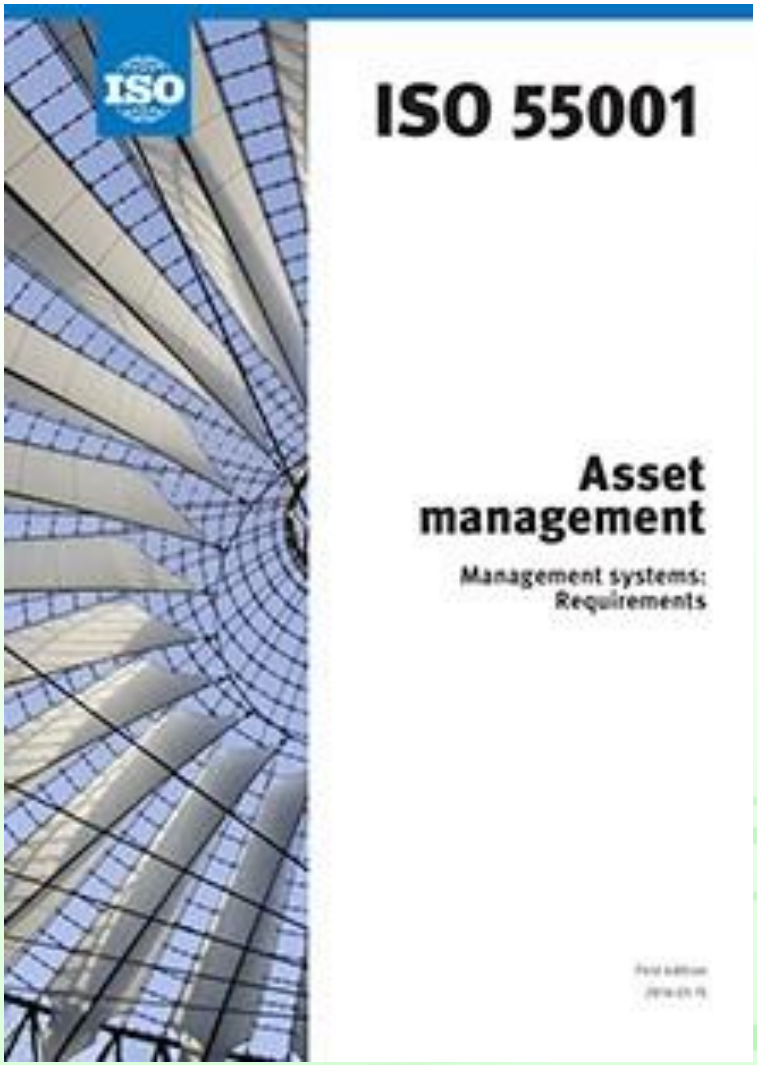
1.7 Asset Management Practices

- Summary of AM data, information systems, processes (decision-making) and implementation tactics

1.8 Monitoring and Improvement Programme

- Summary of how performance of the AM plan will be monitored
- Summary of actions required to improve accuracy and confidence in the AM plan
- Timetable for review of the AM plan

ISO 55001


ISO
ISO 55001
Asset management
Management systems: Requirements

Example contents of a AMP for a utility

1. Introduction
2. Asset Management within the Context of the Organization
3. Leadership and Organizational Elements of Asset Management
4. Performance Management
5. Asset Management Lifecycle Strategies
6. Key Asset Management Enablers
7. Asset Management Plans
8. Asset Management Improvement Strategies

Acronyms and Abbreviations

Glossary

References

Appendices

Example contents of a AMP for a utility

1. Introduction

1.1 Objectives of the Strategic Asset Management Plan

1.2 Contents of the Strategic Asset Management Plan

1.3 Assets Included in the Asset Management System

1.4 Current Condition of the Infrastructure Assets

1.5 The Approach to Asset Management

Includes the list of Asset Management Objectives

Describes AMPs sections and the alignment with ISO 55000

Summary of infrastructure, approximate quantities, value, and high-level hierarchy

Summary of asset condition based on existing information

Brief description of how AM is being implemented in the Utility

Example contents of a AMP for a utility

2. AM within the Context of the Organization

2.1 The Organizational Strategy

2.2 Stakeholder Analysis

2.3 Aligning AM with the Organizational Context

Overview of the organization's strategic plan, financial plan and ongoing initiatives

Lists of needs and drivers influenced by external and internal stakeholders

Graphic showing the alignment of the AM Policy's principles with the organization's strategic goals (Policy is in the appendix)

Example contents of a AMP for a utility

3. Leadership and Organizational Elements of Asset Management

3.1 AM Governance

Description of the organizational structure, the AM governance structure and roles and responsibilities

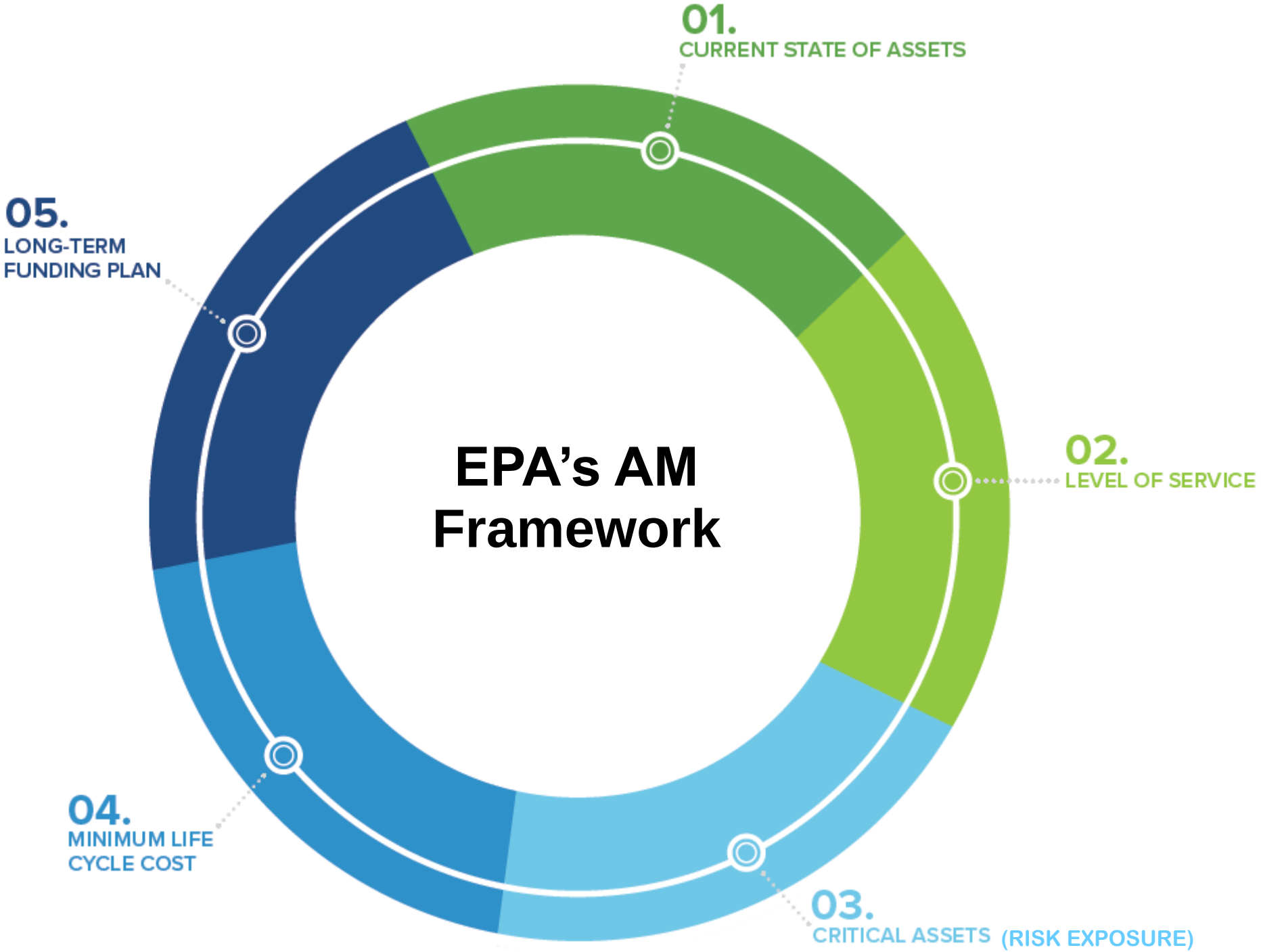
3.2 Asset Management Policy

Description of the AM Policy and its principles (Policy is in the appendix)

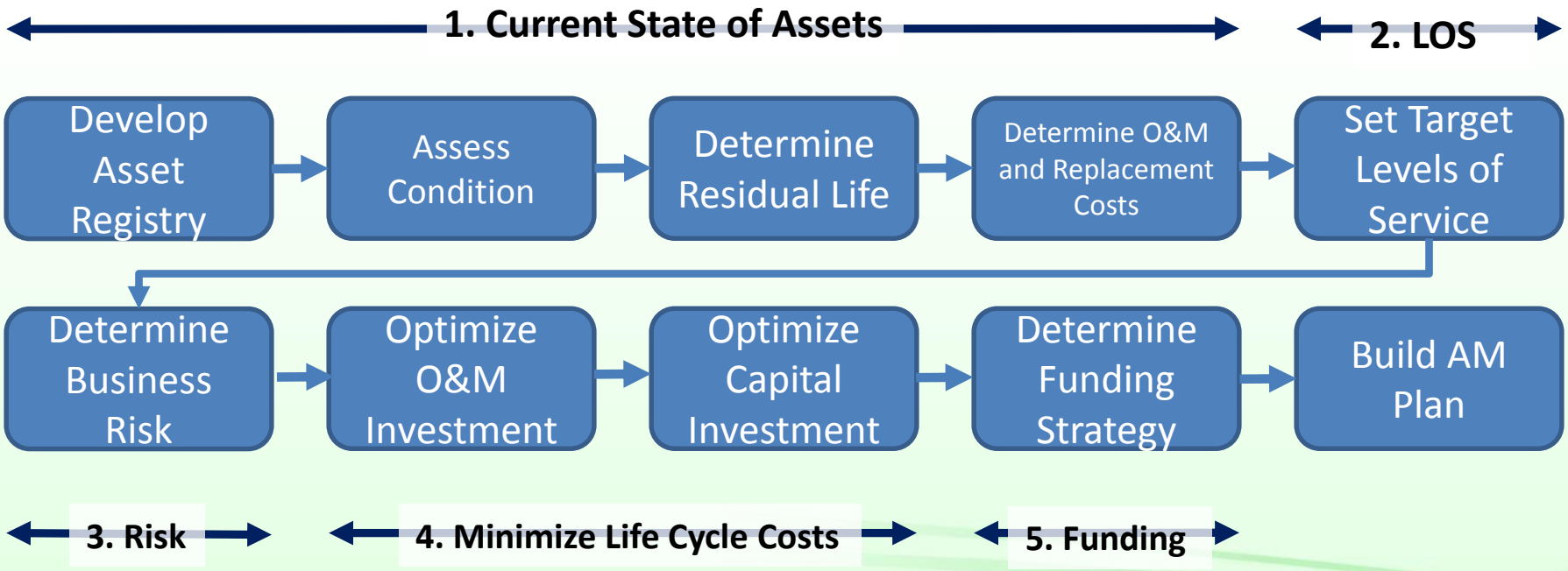
Does Your AMP Look Like This?

Drivers for Asset Management Plans

- Probably NOT International Best Practice!
- Clean Water Act State Revolving Fund Loan Eligibility and Priority
- Document asset information
- Improve structure to managing assets
- Concerned about the sustainability of your infrastructure (What should my rates be?)
- Consistent operating strategy


01.
CURRENT STATE OF ASSETS
02.
LEVEL OF SERVICE
03.
CRITICAL ASSETS (RISK EXPOSURE)
04.
MINIMUM LIFE CYCLE COST
05.
LONG-TERM FUNDING PLAN
EPA's AM Framework

EPA 10-Step Framework



Practical Asset Management Plans (AMPs)

Chapters in the AMP

- 1. Level of Service (What are the expectations?)
- 2. Current State of Assets (What do I own?)
- 3. Understand Risk Exposure (Where do I focus?)
- 4. Life Cycle Costing (What do I need/want to do?)
- 5. Long-term Funding (What can I afford to do?)

Keep It Simple

Combined Waterworks and Sewage System Board of Wellsburg

Asset Management Plan

October 2012

Prepared by:

Burgess & Niple, Inc.
4424 Emerson Avenue
Parkersburg, WV 26104

Keep It Simple

TABLE OF CONTENTS

The Good News…

- Asset Management Plans can be simple!
- You don’t have to have everything done – it’s a PLAN!
- First draft – document what you have and what you do (this may be good enough for funding)
- Second draft – document improvement plan

Some Asset Management Basics

- Level of Service (What are expectations?)
- Current State of Assets (What do I own?)
- Understand Risk Exposure (Where do I focus?)
- Life Cycle Costing (What do I want to do?)
- Long-term Funding (What can I afford to do?)

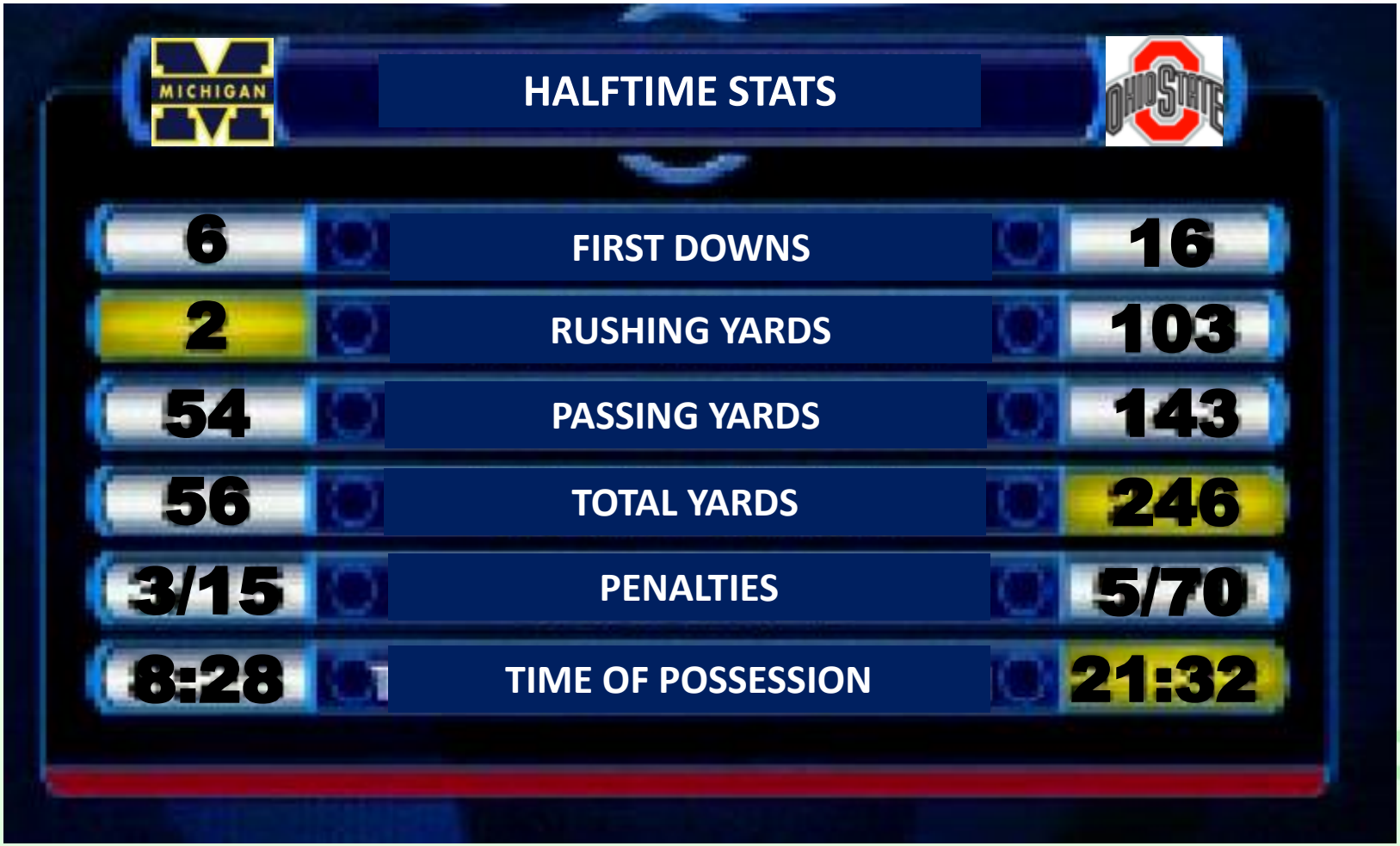
Levels of Service

- A “Level Of Service” (LOS) is a measure of the quality of service provided to customers, such as by a government to its citizens.

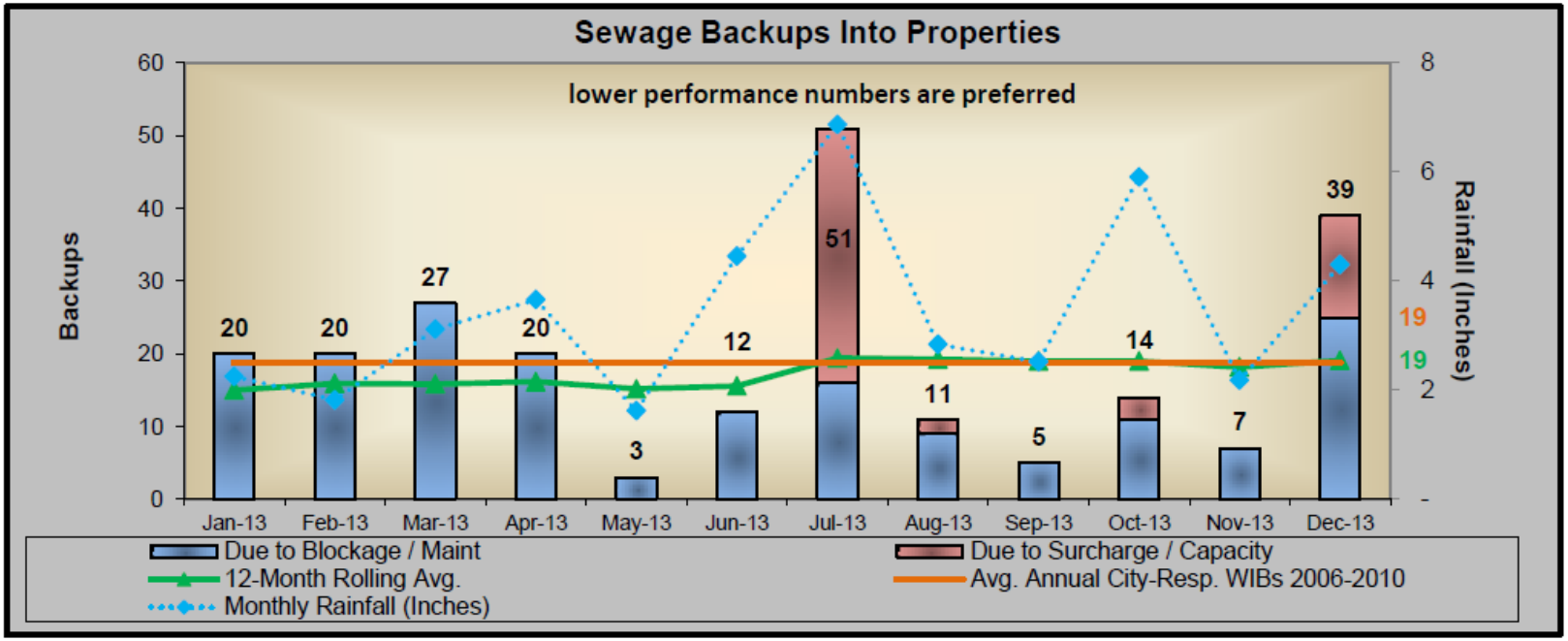

OHIO STATE
SUGAR BOWL CLASSIC
CHAMPION
NOT DONE
84
SUGAR BOWL CHAMPIONS

Level of Service

Performance Measures (Key Performance Indicators (KPI's)



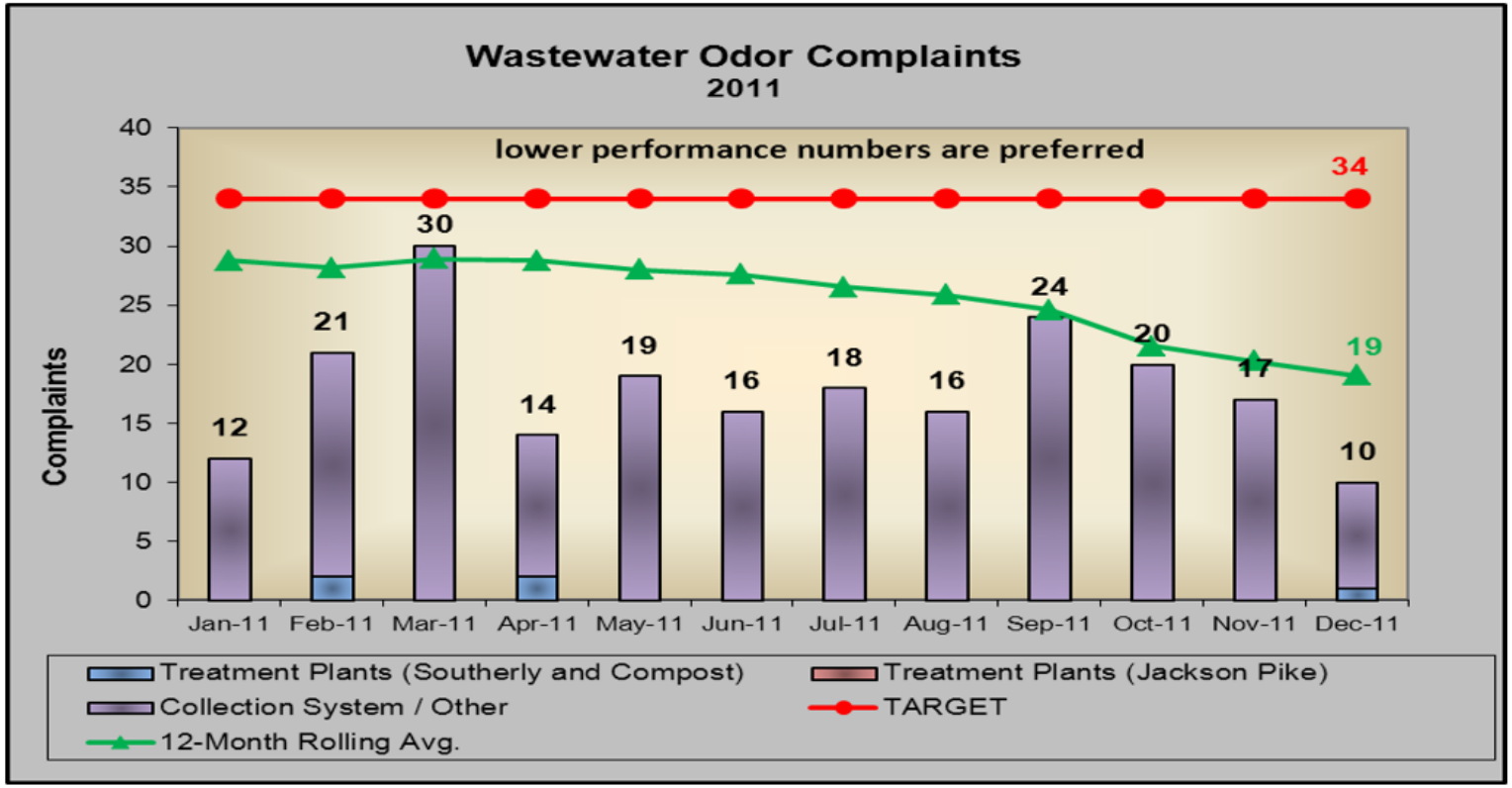
Sewer Collection



Definition: Measure of overall collection system reliability and capacity, and can also be reflective of asset condition and the effectiveness of inspection, maintenance and cleaning programs. The primary correlating factor to sewage backups into property is weather events and storm intensity. Property flooding incidents are one of the most visible sewer system service levels for customers that are impacted by these events, and can cause significant property damage and nuisance. Therefore, sewage backups into properties are a critical measurement both in terms of absolute events and trends over time. This measure can also be used to track cause of the flooding (blockage, surcharge, etc.) and identify strategies to rectify persistent issues. The 2006-2010 averages are actually August 2006 thru June 2010 averages and identify the time period before the WWTP's capacity expansion. DOSD hydraulic model data (available in 2013) will be used for setting a target that is appropriate to the present stage of the Wet Weather Management Plan. **There is not currently a target for this measure.**

Notes on Performance: There were 39 sewage backups in the month of December, the 2nd highest total of 2013. Again, this was largely due to the big rain and snow thaw event that occurred the week before Christmas. The 12-month rolling average remains on par with the average from 2006-2010.

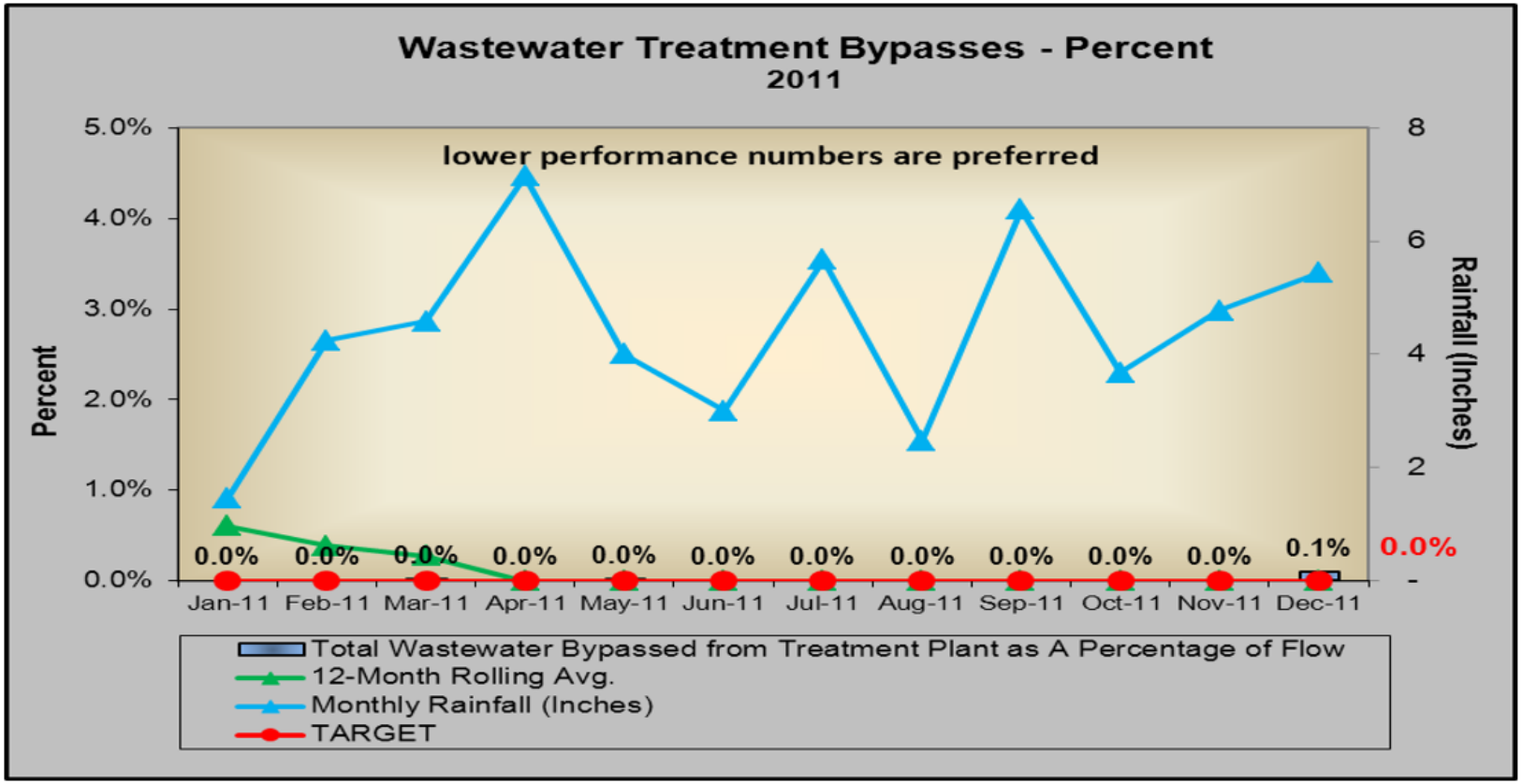
Sewer Collection



Definition: Indicates total odor complaints received from customers and can be impacted by local issues, such as proximity of populated areas to treatment facilities. It can sometimes be used to track sources and potential causes of odor complaints (from treatment plant, sewers, pump stations, etc.) but is very subjective and not definitive. This measure is reported as total work orders as there may be complaints made by multiple individuals regarding the same odor. Trends over time are especially important in determining if some customers have persistent odor issues. **Current target is 34 complaints per month or less.**

Notes on Performance: Performance was better than target for all months in 2011. Almost all complaints are related to the collection system or classified as "Other." There was a spike in the number of complaints in March but overall held steady between 10-25 complaints per month throughout the year.

Wastewater Treatment



Definition: This is an indicator of the volume of bypass events. Bypass events include those where untreated wastewater is sent to receiving waters due to excessive flow to the wastewater treatment plant. This measure is currently tracked for the Southerly and Jackson Pike plants as required by the EPA. The measure is calculated by capturing the total number of events and the volume of flow bypassed from the treatment plant as compared to the total wastewater flow at each plant. **Current target is 0%.**

Notes on Performance: There were three months in 2011 where bypass events were recorded and DPU did not meet target of 0%. While the monthly target is zero (0) bypasses, the Wet Weather Management Plan indicates a target of 1 bypass per 1.4 years. Volume released in three of the events was relatively small (< 0.1% of flow).

More Good News!

- You shouldn’t track everything!
  - If you are meeting specific service level targets, do not create an additional report
  - Focus on areas where performance versus service level targets is not as desired
  - Focus on areas where current performance will not meet future demands (help determine when to act)

What Levels of Service to Track

- Drinking Water Utility
  - Finished Water Quality (# of permit violations)
  - Availability (number and duration of outages)
  - Pressure (number of pressure complaints)
- Wastewater Utility
  - Overflows (dry and wet weather)
  - Plant Bypasses
  - Basement Backups
  - Odor Complaints

Set Service Level Targets

- Regulatory Compliance = Baseline Target
- Track performance over time to determine current service levels – “Compliance versus Performance”
- Use Customer Feedback (complaints) and cost data to adjust targets

Benefits of Establishing Service Levels

- Common goals across the organization
- Consistency in the utility's activities
- Focus on the things that matter
- Utility can communicate LOS goals to customers, and customers will know what to expect

What Goes Into the AMP?

- If you don't formally track Levels of Service, the AMP can state which ones you will track → lay out the plan
- If you formally track Levels of Service, describe the process and indicate how you'll use the information to improve performance

Some Asset Management Basics

- Level of Service (What are my expectations?)
- Current State of Assets (What do I own?)
- Understand Risk Exposure (Where do I focus?)
- Life Cycle Costing (What do I want to do?)
- Long-term Funding (What can I afford to do?)

First: Know What You Own

First: Know What You Own


USED CARS
WOW
LIKE NEW

If you're not sure…

- Asset Walk Downs for Existing Assets
  - Two-way check between asset on the floor and in the system of record (asset register)
- O&M Ready for New Assets
  - Get assets and PM's into the maintenance cycle before assets go live

Condition of Assets

- Assess condition based on understanding of failure modes (1-5 scoring system)
  - Physical condition (i.e. PACP for pipes)
  - Performance (cost to maintain)
  - Capacity (can it perform its intended function?)
  - Obsolescence (Can I get replacement parts?)

Condition Assessment – Physical Condition

Pump

Condition	1	2	3	4	5
Vibration	None	Minor	Moderate	Considerable	Major
Temperature	Normal	Minimal heat from casing	Heat detected by hand	Heat uncomfortable to the touch	Excessive
Noise	Normal/None	Slight whine/rattle detected	Moderate whine/rattle detected, easily heard over pump noise	Loud whine/rattle	Disturbingly loud vibrations during operation
Leaking	None visible	Minor	Moderate	Considerable	Major

Condition Assessment – Performance Based

Water Main

1	2	3	4	5
0 Leaks/year	1-2 leaks/year	3-5 leaks/year	> 5 and < 10 leaks/ year	> 10 leaks/year

Condition Assessment – Capacity Related

Sewer

1	2	3	4	5
No hydraulic surchargin in the design storm	Surcharging occurs, but overflows and basement backups are not known to occur	Overflows occur within regulatory limits	Overflows occur within regulatory limits / basement backups in large storms	Overflows in excess of regulatory limits / regularly occuring basement backups

What goes into the AMP for Current State of Assets?

- Description of assets (types, quantity)
- Estimate of Completeness of Asset Register
- Approach to assessing condition
- Condition of assets
  - Can use age in the absence of condition data
  - Can extrapolate condition data if some available

Some Asset Management Basics

- Level of Service (What are my expectations?)
- Current State of Assets (What do I own?)
- Understand Risk Exposure (Where do I focus?)
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Consequence = Criticality

- Consequences can include:
  - Financial – direct cost to the utility
  - Social – property damage, traffic, noise, lost water…
  - Environmental – overflows, spills
- Can be assessed on a 1-5 scale
- Consequences can be assessed in $$

Example – Consequence of Failure Matrix

5 (or >5)	4	3	2	1
Deaths as a result of incident.	Extensive injuries requiring major medical treatment but not life threatening	Follow up medical treatment required	First aid treatment necessary but no follow up medical treatment	No injuries as a result of incident
Major unplanned outage	Minor unplanned outage to customers	Moderate planned service interuption to customers	Minor planned interuption to customers	No interruption to customer
Significant irreplaceable loss of data	Significant but replaceable loss of data	Loss of minor data	No data loss, but data not accessible for short period	No impact to function
Hazardous material release - immediately life threatening	Hazardous material release - not immediately life threatening	Hazardous material release requiring external assistance to make safe	Hazardous material release contained safely	No hazardous material release
Financial loss (greater than 1% AOB Annual Operating Budget)	Financial loss (0.5% to 1% AOB)	Financial loss (0.25% to 0.5% AOB)	Financial loss (0.1% to 0.25% AOB)	Negligible financial loss (0 to 0.1% AOB)
Disruption to routine operation which may extend beyond 2 weeks	Disruption to routine operation which may extend for 1 to 2 weeks	Disruption to routine operation which may extend for up to 1 week	Disruption to routine which can be managed immediately	Observation only

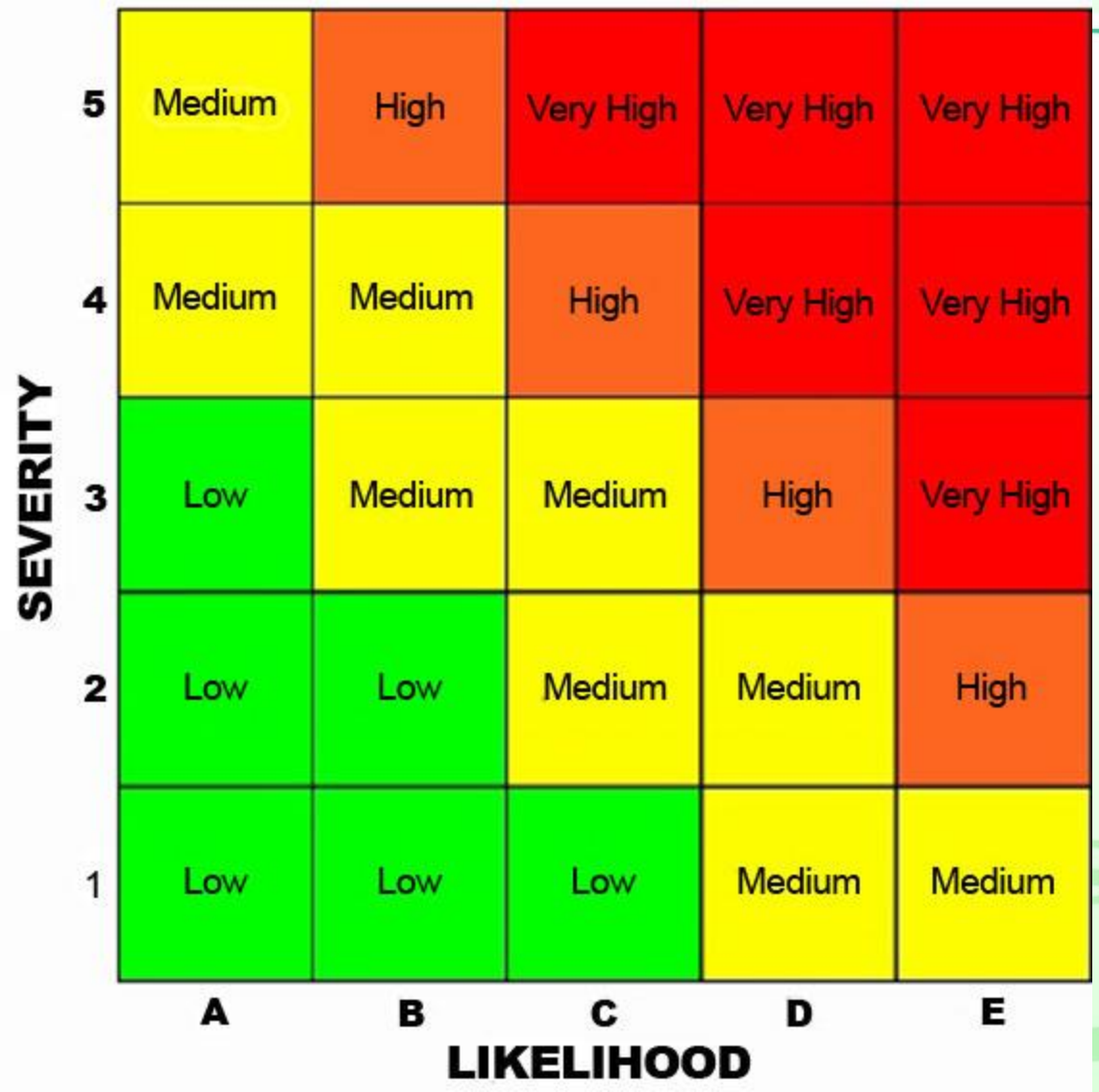
Risk

Risk

Risk	=	Likelihood of Failure	X	Consequence of Failure

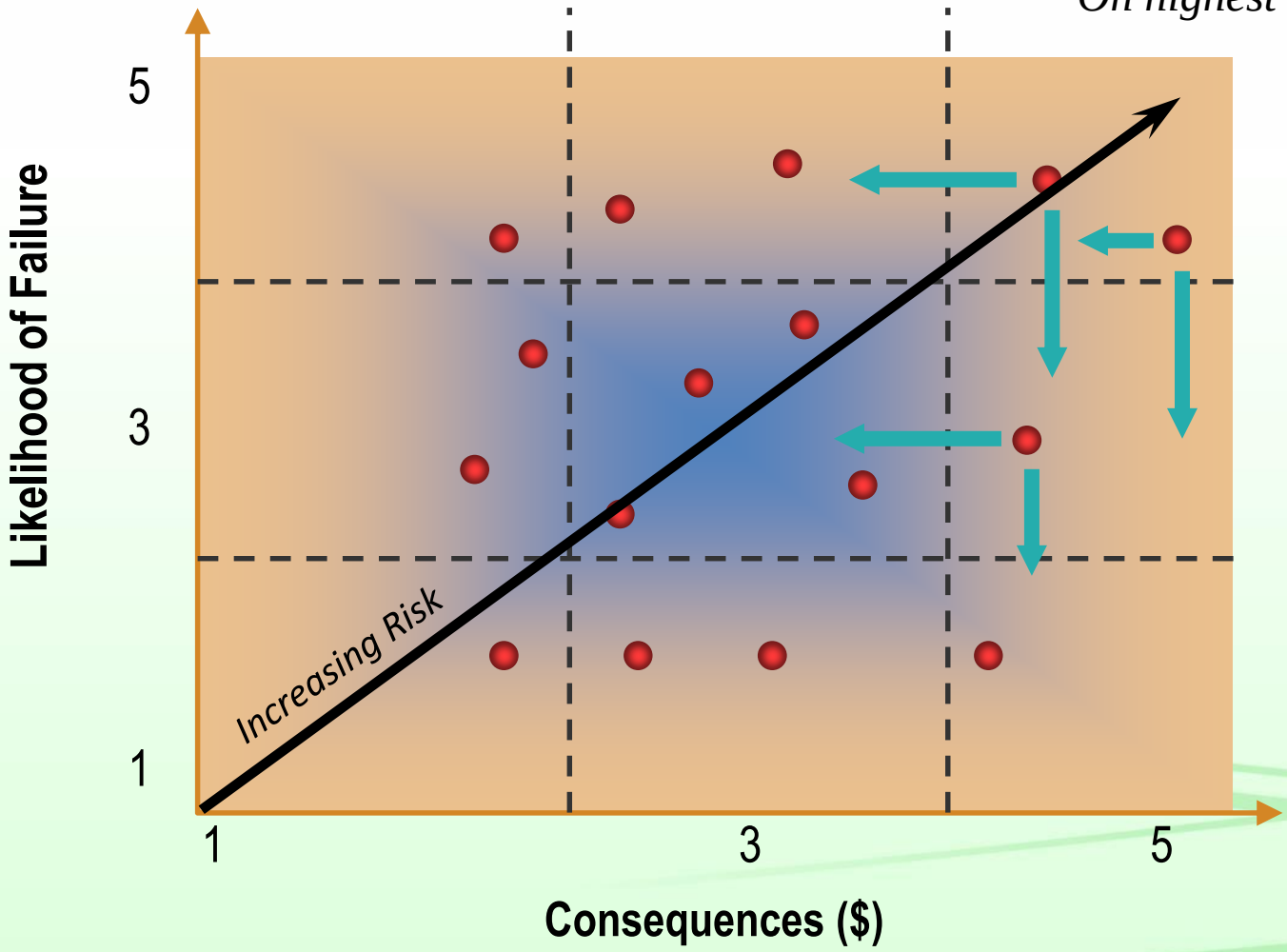
- Generating a “risk register” for all assets in a system requires simplicity!
- Condition and consequence scores don’t have to be perfect
  - Relative risk will allow you to prioritize
  - Examing riskiest assets in more detail later

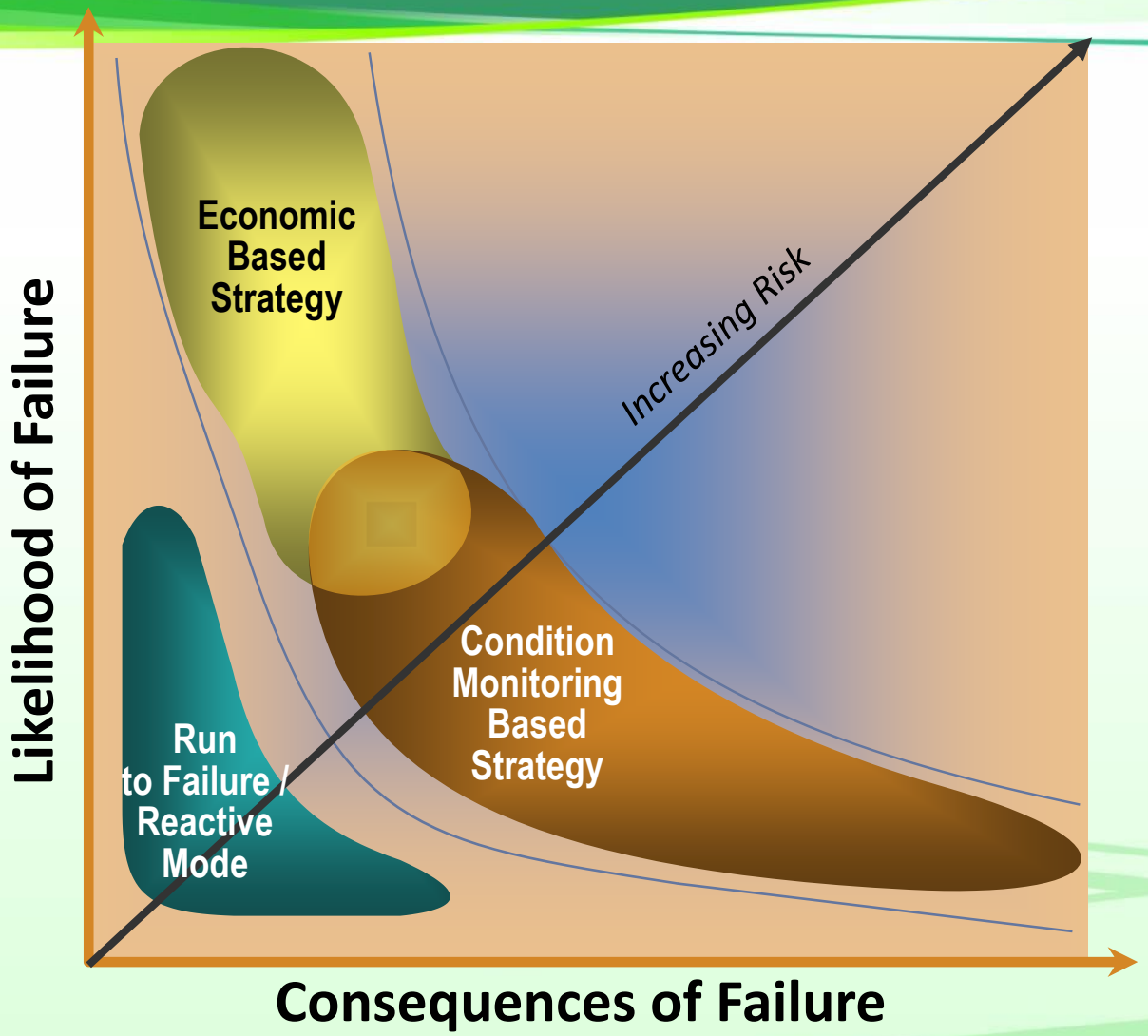
Illustrating Risk



Managing Risk

Concentrate your efforts
On highest risk assets




Likelihood of Failure
Economic Based Strategy
Increasing Risk
Condition Monitoring Based Strategy
Run to Failure / Reactive Mode
Consequences of Failure

Some Asset Management Basics

- Level of Service (What are my expectations?)
- Current State of Assets (What do I own?)
- Understand Risk Exposure (Where do I focus?)
- Life Cycle Costing (What should I do?)
- Long-term Funding (What can I afford to do?)

Minimizing Life-Cycle Costs

An Asset Management Plan Should Include Strategies for Minimizing Costs:

- Capital Costs
- Operating Costs
- Maintenance and Reliability

Only one strategy above may be necessary – depends on the context of the utilities anticipated needs.

Business Case Evaluations to Optimize Capital Spending

- BCE's are about forcing projects to be justified to a higher degree of scrutiny
- The Asset Management Plan may state something like this:
  - Business Case Evaluations will be conducted on all projects with a capital budget over $1M

Business Case Evaluations (BCE)

- Level of Service Improvement
- Life-cycle Cost-reduction
- Risk Reduction
- Project Costs

Business Case Framework

Capital Improvement Project XXX-XXX

1. Define Problem

2. Summary of Alternatives Evaluated

    Service Level Impacts

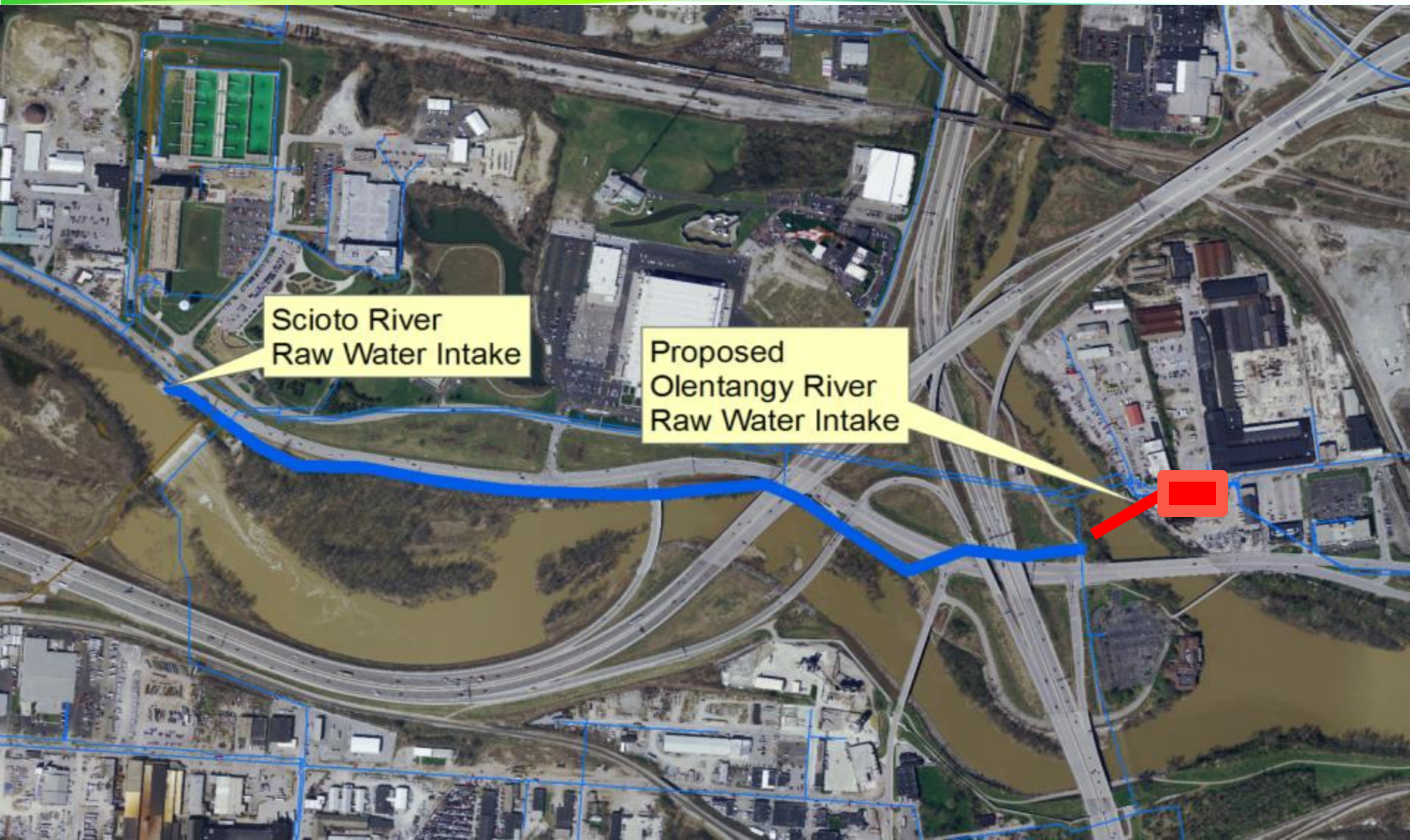
    Condition, Criticality, and Risk Analysis

3. Project Cost Analysis

    Life-Cycle Cost Analysis
    Risk Costs

4. Recommended Course of Action

BCE Case Study: Secondary Water Intake



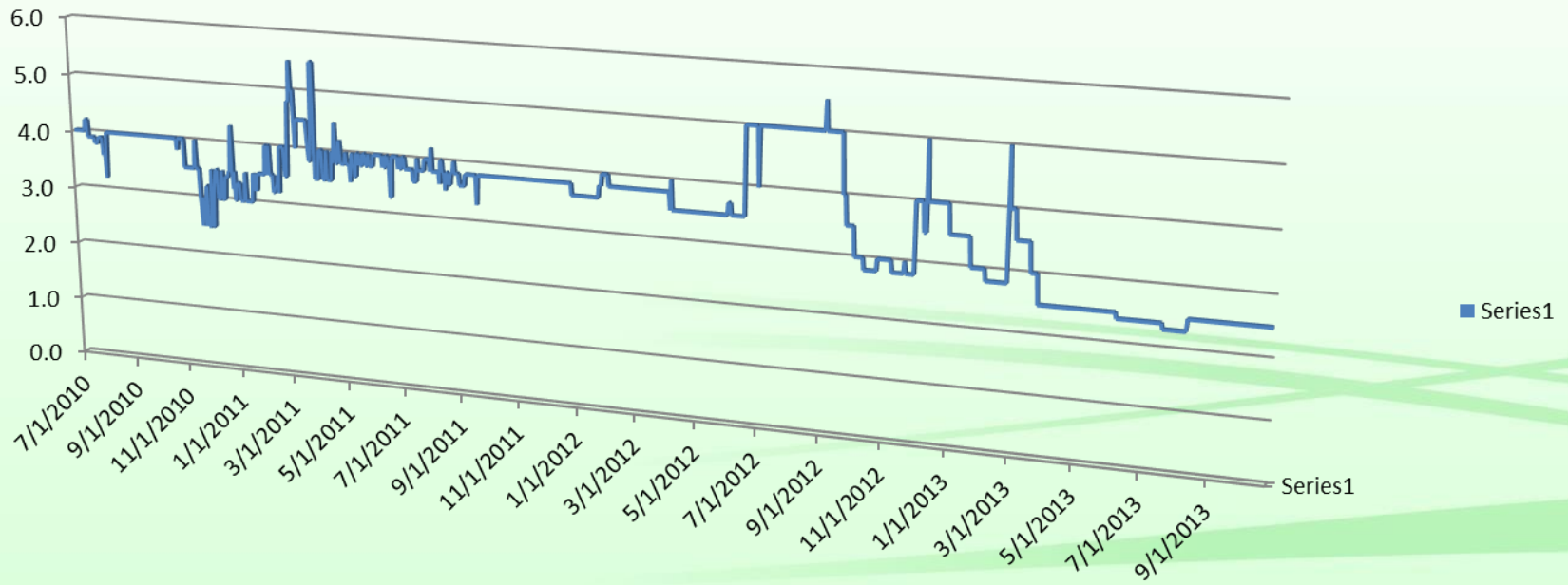
Operations Optimization

Operations Optimization

- Three Water Treatment Plants Studied in 2011
- Two WWTPs Evaluations in 2012
  - $400k (for all plants) total for study
  - Focused on chemical and energy savings

Plant changes – design

- New diffusers – more efficient transfer of air
- Improved control of Dissolved Oxygen (D.O) Set Points through the SCADA system



Digesting Waste Activated Sludge

- To digest all WAS, the plant must be able to digest 40 gallons per minute
- Foaming issues over 30 gallons per minute
- Temporarily installed a Bio-Crack Unit
- Worked through foaming issues gradually
- Currently able to digest 42 gallons per minute without foaming
- Significant reduction in solids

Optimize Primary Clarifiers

- Reduce # of primary clarifiers in service by 1.
- Energy reduction ≈ 131,000 kWh per year
- Annual cost savings of $10,400

Lighting Fixture Replacement

- Lowers energy cost
- Reduces carbon footprint
- Better lighting reduces accidents
- Lower maintenance cost (and less waste) due to infrequent replacement

Lighting Fixture Replacement - 2 WWTP's

- Total capital investment: $683,000
- 2.2 year payback period
- Estimated annual electrical savings: $312,000

Maintenance Process Improvements

Why Modernize Maintenance Strategies?

- Increased capacity = More assets to maintain
- Advanced equipment technology = Maintenance is complex
- More stringent standards = Less downtime
- Existing assets are aging; reactionary maintenance and replacements alone are too costly
- Proactive maintenance is safer!
- Maintenance tools are more sophisticated

Reactive Mode

Does it move?

Yes

No

Should it?

Should it?

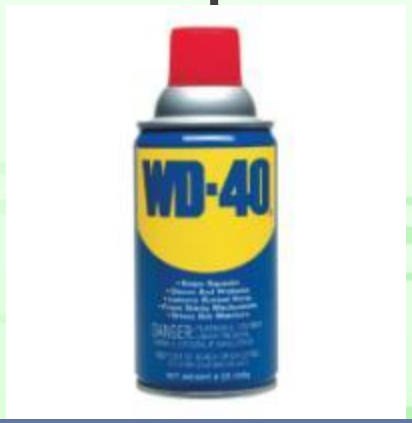
Yes

No

Yes

No

No problem



No problem

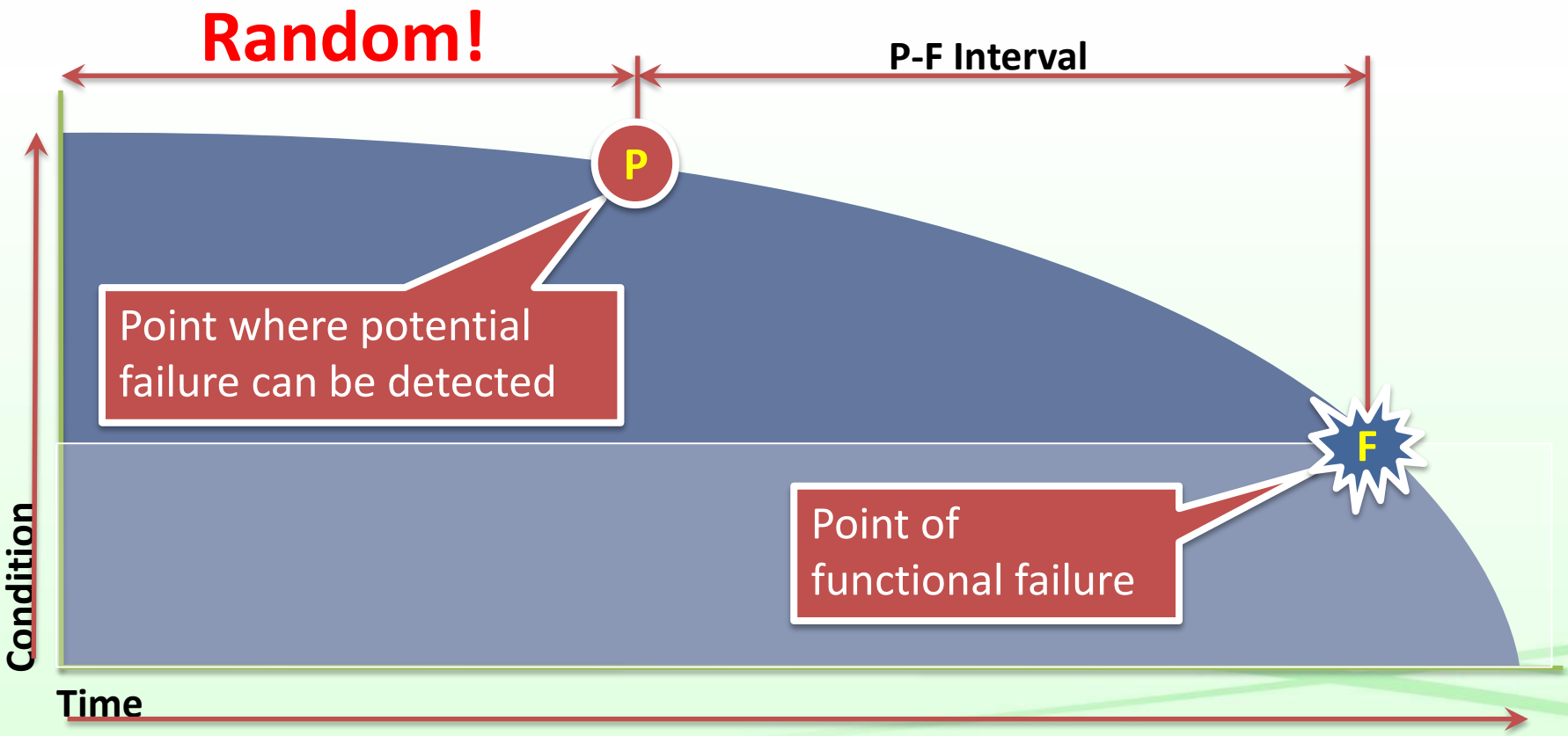
Preventive Mode

Preventive Maintenance Alone is Not the Answer

"The principles and applications of RCM were documented in Nowlan and Heap's publication, Reliability-Centered Maintenance. The work demonstrated that ***a strong correlation between age and failure rate did not exist and the basic premise of time based maintenance was false for the majority of equipment****. Additional studies performed by the Department of Defense (DOD) and several nuclear utilities confirmed Nowlan and Heap's work."*

-NASA Handbook *"RELIABILITY CENTERED MAINTENANCE GUIDE FOR FACILITIES AND COLLATERAL EQUIPMENT"*

The “P-F” Curve

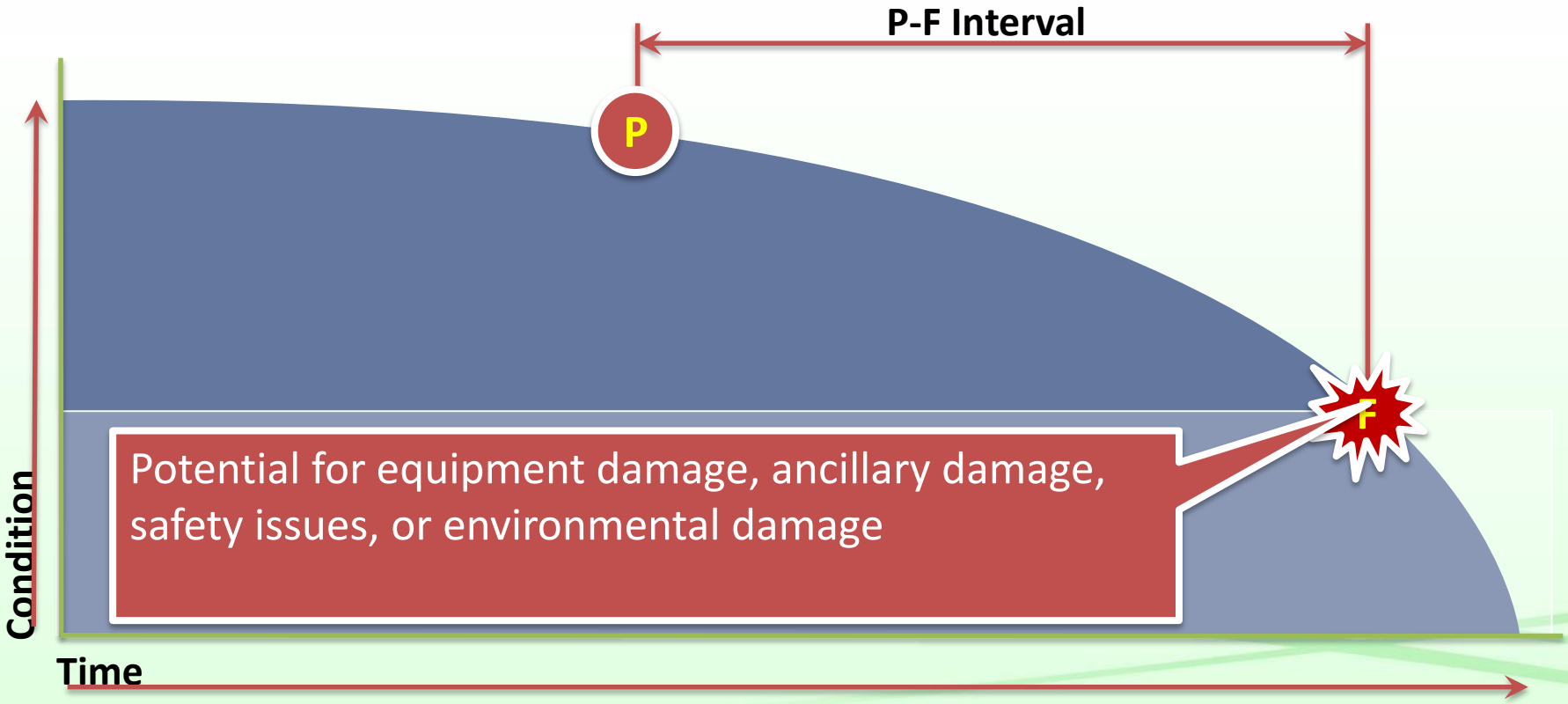

Random!
P-F Interval
P
Point where potential failure can be detected
F
Point of functional failure
Condition
Time

Findings

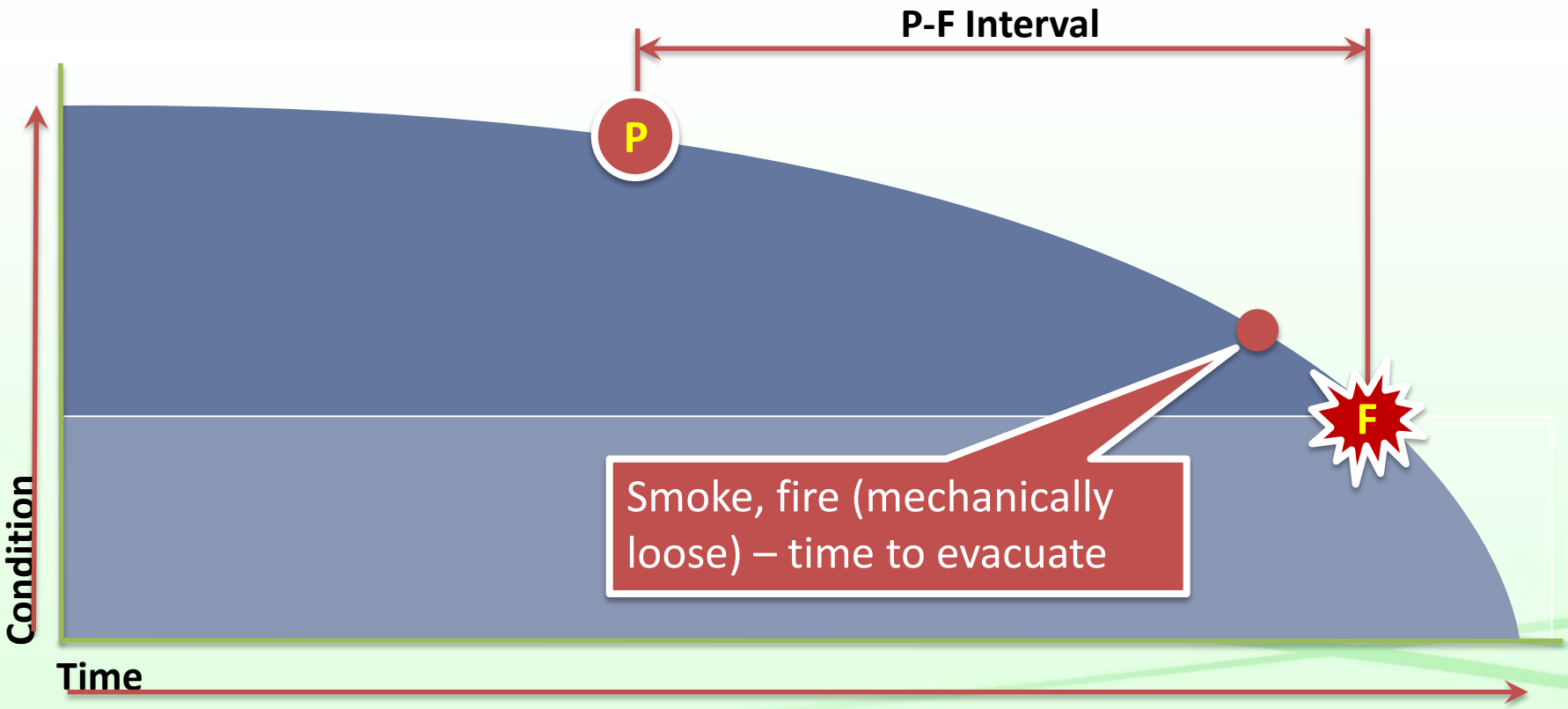
- Most failures are not traditional “wear and tear” time-bound failures; they are random
  - Preventive tasks not effective at preventing failure
  - Predictive Maintenance would be more effective

Predictive Mode

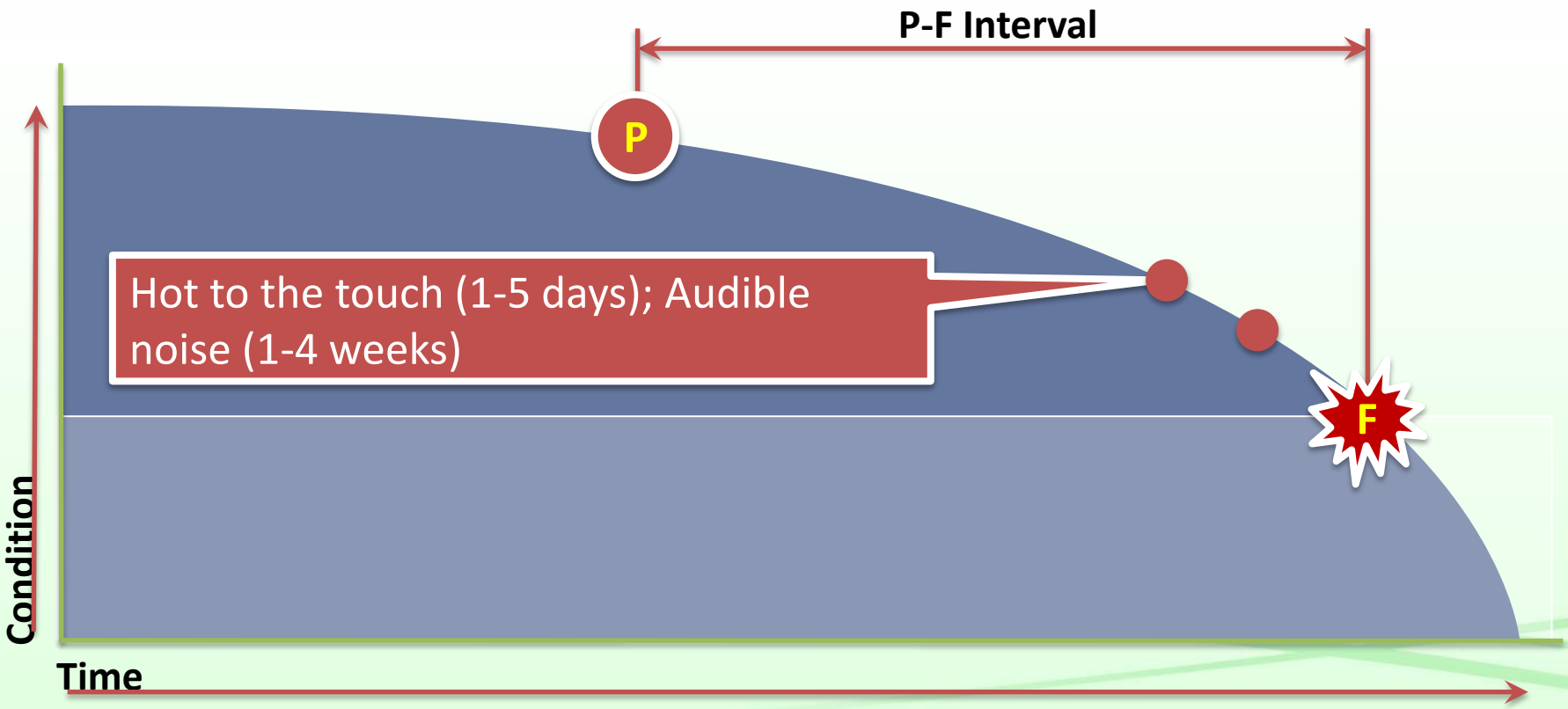
The “P-F” Curve


P-F Interval
P
F
Potential for equipment damage, ancillary damage, safety issues, or environmental damage
Condition
Time

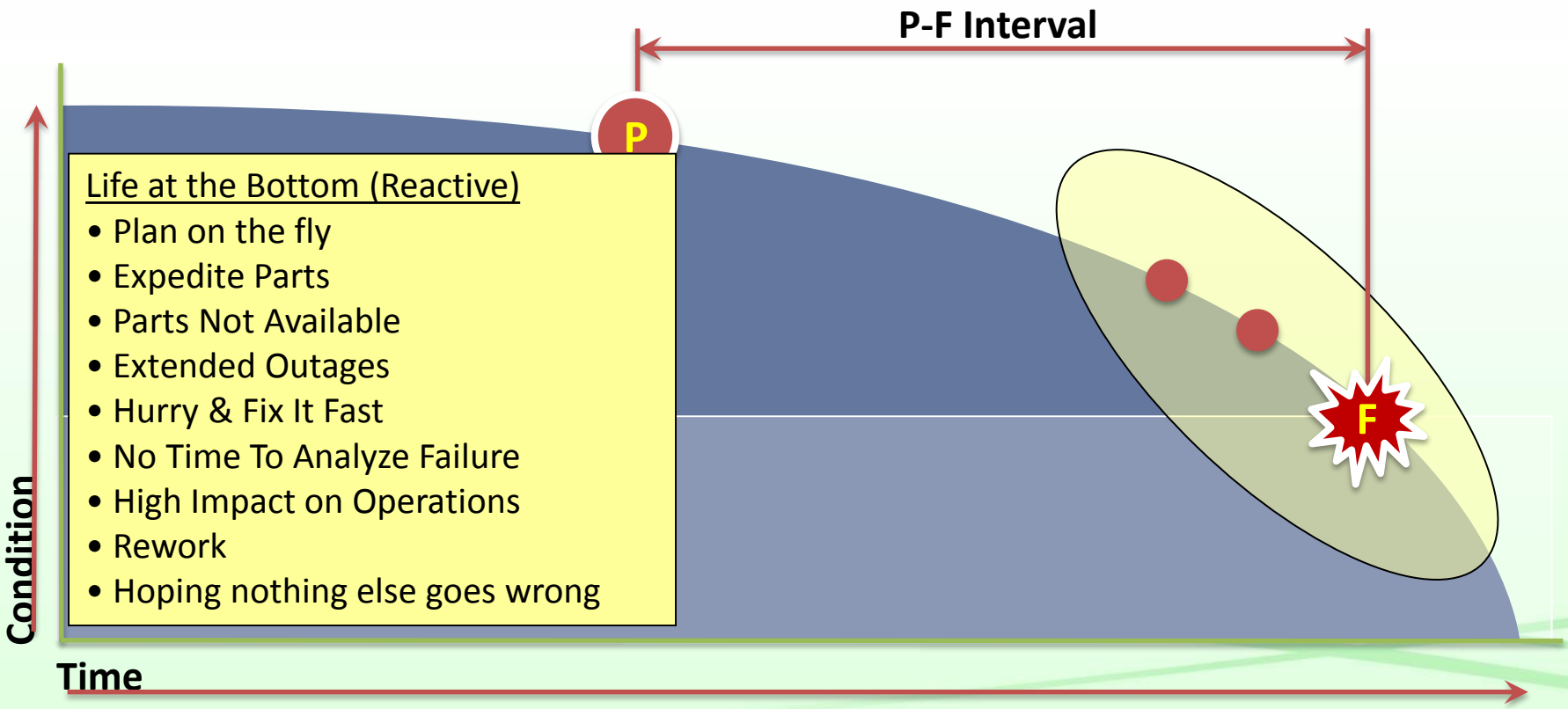
The “P-F” Curve


P-F Interval
P
F
Smoke, fire (mechanically loose) – time to evacuate
Condition
Time

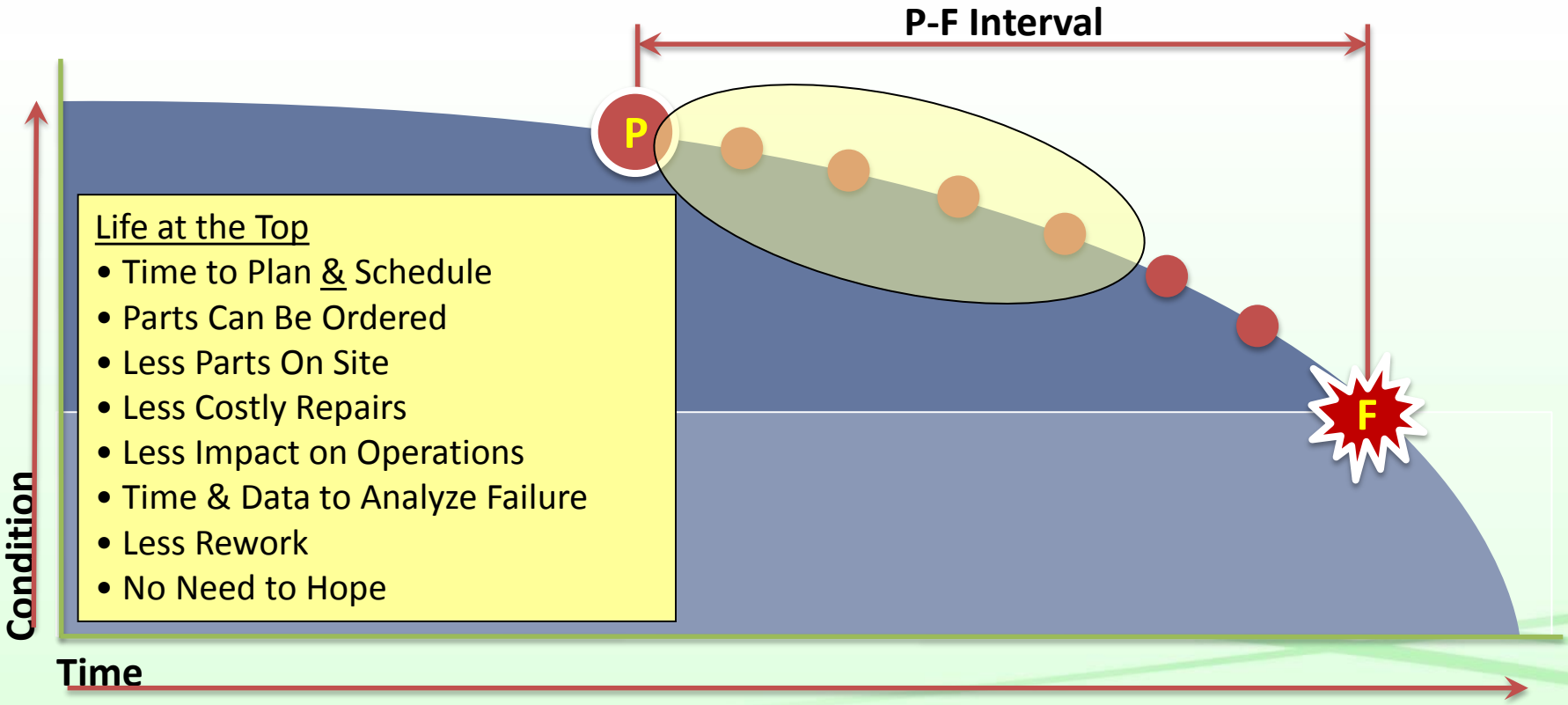
The “P-F” Curve


P-F Interval
P
Hot to the touch (1-5 days); Audible noise (1-4 weeks)
F
Condition
Time

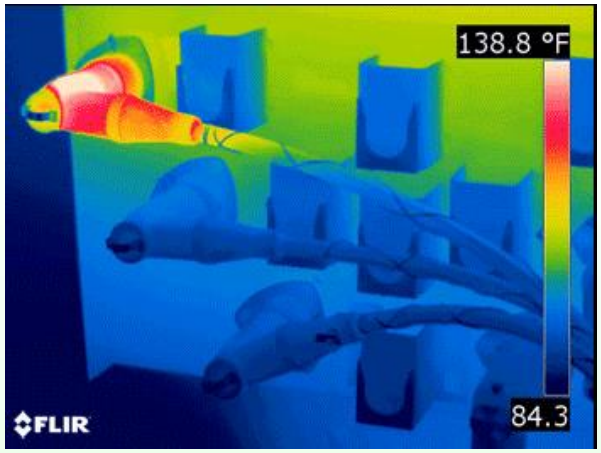
The “P-F” Curve


P-F Interval
P
F
Condition
Time
Life at the Bottom (Reactive)
• Plan on the fly
• Expedite Parts
• Parts Not Available
• Extended Outages
• Hurry & Fix It Fast
• No Time To Analyze Failure
• High Impact on Operations
• Rework
• Hoping nothing else goes wrong

The “P-F” Curve


P-F Interval
P
F
Life at the Top
• Time to Plan & Schedule
• Parts Can Be Ordered
• Less Parts On Site
• Less Costly Repairs
• Less Impact on Operations
• Time & Data to Analyze Failure
• Less Rework
• No Need to Hope
Condition
Time

Thermography



Electrical Panel

Motor

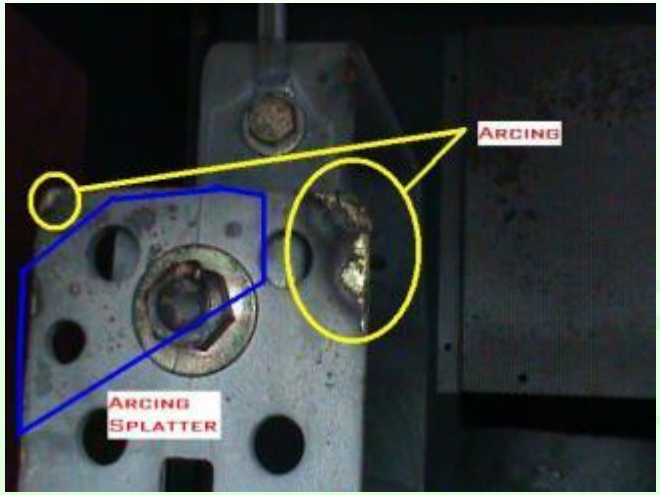
Power distribution: Overloading, Insulation, Connection

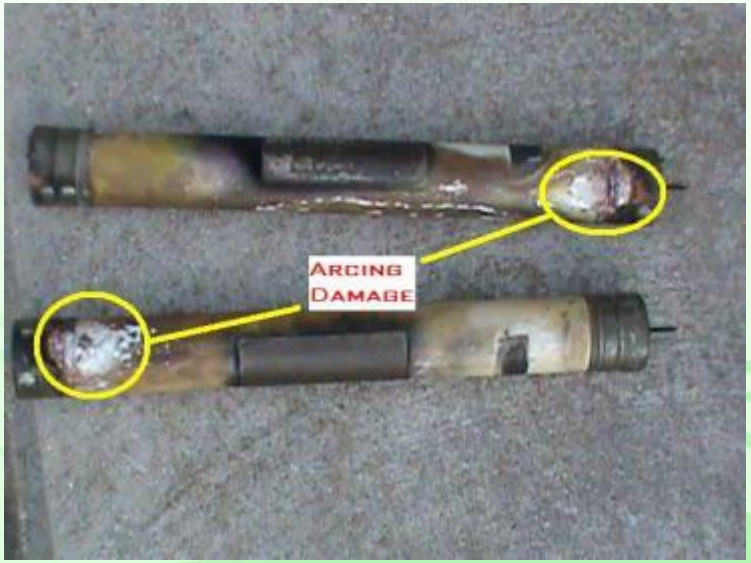
Vibration Analysis

Ultrasound (Vibration and Lube)

Ultrasound (Electronics)

Ultrasound for Electrical
Types of Trouble Found





Some Asset Management Basics

- Level of Service (What are my expectations?)
- Current State of Assets (What do I own?)
- Understand Risk Exposure (Where do I focus?)
- Life Cycle Costing (What do I want to do?)
- Long-term Funding (What can I afford to do?)

Building a Plan – Work on Priorities

- Use service level data to determine when new asset systems are needed
- Use risk data to determine when replacements will be needed
- Prioritize all work based on risk

Conclusions

- Asset Management Plans (AMPs) do not need to be complicated
- You do not need to show best-in-class asset management practices – you need to show a plan to improve your AM practices
- AMPs are living documents
- AMPs assist with communication on many levels
- AMPs bring structure to how you manage assets
- AMPs help you focus resources to minimize cost

Questions and Comments

Thank you!

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