




Guam Waterworks Authority  
January 23, 2006

## Asset Management Learning Session 1: What IS Asset Management?






## As a Preface...



"In the beginner's mind there are many possibilities, but in the expert's mind there are few."

--Shunryu Suzuki



## Overview of the Learning Sessions

1. What IS Asset Management?
  - ◆ What are its basic elements? What does it mean for us? For our customers?
2. Customer Service Levels
  - ◆ Who are our customers? What services of value do we provide? How can we measure service levels?
3. The Business Case Evaluation
  - ◆ How do we ensure that our projects are the right ones for our customers, at the right time?
4. Managing Risk
  - ◆ How do we incorporate risk into asset decisions?
5. Community Costs and Benefits
  - ◆ How do we account for community and social costs in our asset decisions?





## Outline of Session 1

- ◆ Why Asset Management?
- ◆ What IS Asset Management?
- ◆ Element 1: A Structured Program
- ◆ Element 2: Specified Service Levels
- ◆ Element 3: Minimizing Costs of Asset Ownership
- ◆ Conclusion: Where are we Headed?
- ◆ Participative Exercises


## Why Asset Management?




## Why Asset Management?



- ◆ Better service and Lower Costs
- ◆ Sustainable infrastructure
- ◆ Federal funds
- ◆ Good business!





### Why? Better Service, Lower Costs

- ◆ Know the condition of your system and its value
- ◆ Optimize asset lives
- ◆ Optimize O&M practices
- ◆ Optimize R&R decisions
- ◆ Balance O&M vs. capital expenditures for lowest life-cycle costs
- ◆ Allocate resources to where they're needed—and away from where they're not





### Why? Sustainable Infrastructure

- ◆ Much infrastructure was “free,” contributed by developers or others
- ◆ Other infrastructure may have been provided by grant funds
- ◆ This “hidden treasure,” usually not reflected in utility rates, is getting old and is enormously expensive to replace
- ◆ Lack of prior AM means that huge bills are coming due without the means to pay





### Why? Federal Funds

- ◆ WIN Report shows a \$500 billion “gap” in replacement funding for water and sewer systems over the next 20 years
- ◆ In the future, SRF funding will almost certainly be tied to good AM (four bills so far, SB 2550 is current)
- ◆ For now, better AM means lower costs, making those huge R&R expenditures more affordable





### Why? Good Business!

- ◆ Service levels tied to expenditures
- ◆ Unnecessary capital investment minimized
- ◆ Life-cycle cost approach means costs and benefits better balanced
- ◆ Better allocation of day-to-day resources
- ◆ Overall, improved delivery of *value* and not just delivery of *service*




### Benefits of Asset Management

- ◆ The infrastructure's condition is known in detail and it can be better managed
- ◆ Unexpected failures are minimized
- ◆ O&M activities are optimized — not just “manufacturer's recommendation”
- ◆ R&R actions are taken at the right time – not too soon and not too late




### Benefits (2)

- ◆ Life-cycle approach means that the utility always get the most asset for its money
- ◆ By measuring actual costs against plans, utilities learn to make better asset decisions and incur lower costs
- ◆ By tying costs to asset condition, and by long-term planning for each asset, policy makers get the facts they need to help keep the infrastructure from decaying







## What IS Asset Management?



## What IS Asset Management?

- ♦ A computer system?
- ♦ A set of tools and techniques?
- ♦ Procedures for improved planning?
- ♦ A way to make better asset decisions?
- ♦ New business processes?




Well, maybe all of the above, but mostly...



## Asset Management is...

...a way of doing business!



Specifically, it is a way of doing business suitable to agencies whose main mission is the delivery of service using large networks of expensive, long-lived assets.



## A Definition of AM

“Asset management is a structured program to deliver the service levels your customers require while minimizing the whole-life costs of asset ownership.”



Let's look at this definition closely...



## Element 1: A Structured Program

“Asset management is a **structured program** to deliver the service levels your customers require while minimizing the whole-life costs of asset ownership.”


- ♦ AM is highly structured
- ♦ Asset decisions are made in repeatable and supportable ways, based on good data!
- ♦ AM's structure always includes continuous improvement cycles



## Element 2: Specified Service Levels

“Asset management is a structured program to deliver the **service levels your customers require** while minimizing the whole-life costs of asset ownership.”

- ♦ AM doesn't want to deliver the *best* service—it wants to deliver *specified levels* of service
- ♦ These levels are selected based on service level/cost tradeoffs
- ♦ Ideally, service levels are “agreed” with customers in full knowledge of those tradeoffs



**Element 3: Minimizing the Costs of Asset Ownership**

“Asset management is a structured program to deliver the service levels your customers require while **minimizing the whole-life costs of asset ownership.**”

- ♦ ALL asset decisions (acquire, maintain, refurbish, replace) are made on a *life cycle basis*
- ♦ Each decision minimizes the *present value* of all future ownership costs
- ♦ Costs must include the *risk cost of ownership*

**Asset Management: A Summary**

- ♦ AM is intensely *customer-focused*
- ♦ What levels of service do our customers need?
- ♦ How can we deliver these services at the lowest cost?
- ♦ In a mature AM organization, this is a reflexive way of thinking!

**Element 1: A Structured Program**

**Programmatic Foundation is Essential to Successful AM**

Objectives  
Targets  
Action Plan

Procedures  
Practices  
Systems

**The Continuous Improvement Cycle**

Plan

Act

Measure

Control

**An Example: Asset Planning**


Enterprise Asset Management Plan

Individual Asset Plans

Acquire Maintain Refurb Replace




Condition Monitoring/Economic Analysis

Audits

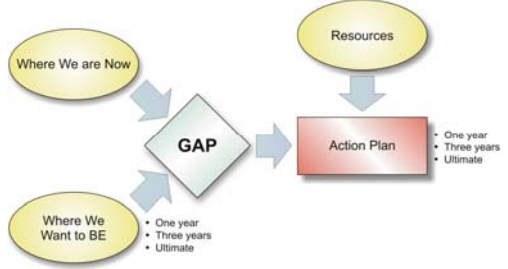




### Getting Started in a Structured Way

- ♦ Two components: Where are we now, and where do we want to be?
- ♦ Evaluate both, then do a “gap analysis”
- ♦ Enterprise AM Plan and subsidiary action plans must support closing the gaps



### The AM Program Evaluation (AMPE) Process

### Results are Expressed in Evaluation Matrix



(partial matrix)

Attribute	Metric	Vision and Support				Organization				AM Program Development				Asset Knowledge			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Excellence	100																
Competence	75																
Systematic Approach	50																
Awareness	25																
Innocence	0																



### How do we Rate Each Area?

- ♦ **Excellence:** Approach is "normal" practice, measured, fully controlled, and has improvement cycle focused on results
- ♦ **Competence:** Defined and documented approach, proactive, practiced, and measured, but not controlled
- ♦ **Systematic Approach:** Defined approach with no controlled documentation and not practiced consistently
- ♦ **Awareness:** Aware but no systematic approach
- ♦ **Innocence:** Total unawareness within organization






### Going from “Gap” to “Plan”

- ♦ AMPE methodology prioritizes improvements in each of 135 topic areas
- ♦ This leads to the Enterprise Asset Management Plan
- ♦ The Plan is the framework for implementing strong AM over a number of years
- ♦ The Plan (like all other aspects of AM) incorporates continuous improvement cycles

## Element 2: Specified Service Levels







## AM Concepts Are Simple!

Service Levels

↔



Life-Cycle Costs

- Getting Buy-In
- Understanding Risk
- Understanding Financial Impacts
- Understanding Tools and Decision Frameworks
- Understanding Culture



## Sample Service Levels (Water)

- ♦ Clean, safe drinking water (all regulatory guidelines met)
- ♦ Outages of water (percentage of customers out of water more than five hours in a one-year period, etc.)
- ♦ Low pressure (percentage of customers experiencing less than 25 or 30 psi in a one-year period, etc.)
- ♦ Water usage restrictions (in place less than once every "x" years on average)

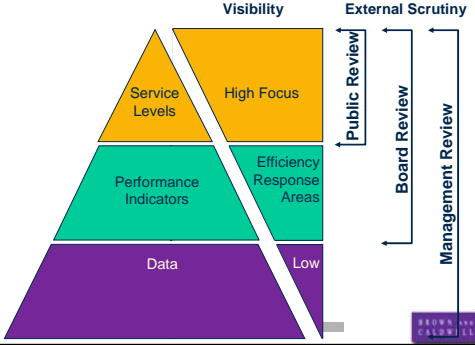




## Sample Service Levels (Wastewater)

- ♦ Treatment facilities meet all permit requirements
- ♦ Number of beach/river swimming warnings caused by overflows/exfiltration
- ♦ Number of customers reporting odors from the wastewater system.
- ♦ Number of sewer overflows on customer's property, reaching receiving waters, etc.
- ♦ Number of back-ups of sewer within customers' premises ("flooding")





## Service Levels are Supported by Performance Indicators

## Performance Indicators are SMART Measures


- ♦ **S**imple
- ♦ **M**easurable
- ♦ **A**ccurate
- ♦ **R**esponsive
- ♦ **T**argeted






## Asset Management is Performance Management

- ♦ Our performance indicators help us manage:
  - The levels of service we deliver
  - The costs we incur
- ♦ So, we measure ourselves by how well we deliver the specified levels of service and manage our costs
- ♦ We transparently report service level targets AND achievement to our customers







## Element 3: Minimizing Whole-life Costs of Asset Ownership



### Asset Ownership Costs: Each Sees Part of the Elephant

- ◆ O&M sees: Trucks, crews, parts, etc.
- ◆ Engineering sees: Studies, capital costs (concrete and steel)
- ◆ Finance sees: Interest, other financial costs
- ◆ IS sees: Cost of IT systems (CMMS, other O&M support, GIS, productivity, etc.)
- ◆ Few see: Internal and external overhead

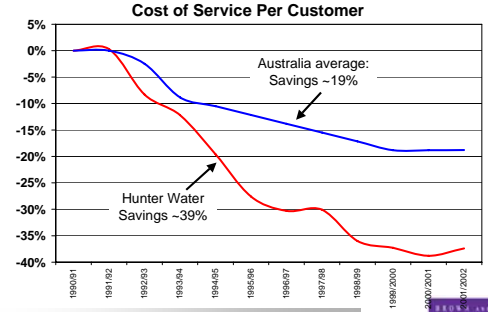



### These Costs Add Up. . .



- ◆ USEPA estimates that good AM will result in at least a 20% reduction in asset ownership costs
- ◆ How significant are asset ownership costs? Question: *What would be your agency's annual budget if it had no infrastructure to manage?*
- ◆ The difference between this and your budget now can be attributed to ownership of your infrastructure assets

### Realized AM Savings in Australia (O&M Costs, Constant Dollars)





Year	Australia Average Savings (%)	Hunter Water Savings (%)
1980/81	0	0
1981/82	-2	-5
1982/83	-5	-10
1983/84	-8	-15
1984/85	-10	-20
1985/86	-12	-25
1986/87	-14	-30
1987/88	-16	-32
1988/89	-18	-33
1989/90	-19	-34
1990/2000	-20	-35
2001/2002	-20	-35

### Some Details. . .

- ◆ An effective AM program is, ultimately, cost-based
- ◆ A consistent and effective approach is detailed in the *International Infrastructure Management Manual*
- ◆ This approach has been pioneered over the past ten to fifteen years in Australia and New Zealand

## Aligning Costs and Service Levels: Risk!



**Just About Everything We Do...**

...is intended to address risk

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**Examples: Why do We ---**

- ♦ Replace pipes? Reduce risk of water outages or SSOs
- ♦ Monitor pumping stations? Reduce risk of asset failure (and water outages, SSOs)
- ♦ Have redundant pumps? Ditto
- ♦ Do preventive maintenance? Ditto
- ♦ Expand our systems? Reduce risk of capacity-related delivery constraints

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**Asset "Risk Signature" Helps Make Asset-Based Decisions**

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**"Criticality" is the Key to Risk-based Management**

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**Example: Pumping Station Risk Assessment**

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**Example: Pumping Station Risk Concentrating your Efforts**



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### Risk Cost: A Rational Approach

- ♦ Risk cost is an inherent cost of asset ownership
- ♦ It is measured in dollars per year
- ♦ It is the product of the likelihood of an event and the dollar consequence of that event
- ♦ Once we know the risk cost, we can make *rational decisions* on reducing risk
- ♦ We're now *managing* risk!






### Risk Quantification

**RISK COST =**




Frequency of Failure (Projected events per year)	X	Consequence of Failure (Dollar cost of each event)
-----------------------------------------------------	---	-------------------------------------------------------

**MEASURE: \$/YEAR**




### Example: Risk Cost of Having Your Car Towed

- ♦ Average towing bill: \$240
- ♦ Average frequency of needing a tow for your make/model of car: 8 years
- ♦ Annualized risk cost = \$240 X 1/8 = \$30
- ♦ Add overhead and profit of \$10
- ♦ Insurance company assumes your risk cost of towing for \$40 a year



### Consequences of Failure include Both Direct and Community Costs

- ♦ Direct repair costs
- ♦ Loss of production/revenue
- ♦ Social costs (traffic, cleanup, health, etc.)
- ♦ Image repair costs
- ♦ Legal costs
- ♦ Fines, penalties







### Example of "External" Failure Cost

- ♦ San Diego water/wastewater team evaluated alternatives for dealing with WW pump station problems
- ♦ Risk of spills if nothing done, also if various modifications were made
- ♦ Team priced spills at \$1/gallon
- ♦ Given estimates of spill probabilities and likely volumes, team was able to quantify risk cost of spills for all alternatives
- ♦ More in Session 4!



**Conclusion: Where are We Headed?**







### *Planning/Engineering*

- ◆ Supports all major capital investments with quantified business cases
- ◆ Knows the life-cycle costs of ownership before facilities are constructed
- ◆ Knows R&R needs and costs well in advance
- ◆ Maintains an accurate long-term CIP
- ◆ Works with O&M and Finance to optimize the capital program





### *O&M*

- ◆ Key player in planning capital facilities
- ◆ A measured and accountable organization
- ◆ Knows the costs of the activities it undertakes
- ◆ Unceasingly works to optimize maintenance programs, balance repair versus R&R, minimize costs
- ◆ A “learning” organization





### *Finance*

- ◆ Provides other segments with the activity- and asset-based cost information they need to manage their activities
- ◆ Constantly optimizes funding programs for least cost to ratepayers
- ◆ Plans funding programs on a 30-50 year basis
- ◆ Accurately reports financial results including the management of future infrastructure-related obligations




### *Customer Service*

- ◆ Works with customers to determine the service levels they’re willing to pay for
- ◆ Works closely with other segments to define service level/cost relationships
- ◆ Measures service levels delivered and provides transparent reporting to customers



### *Top Management*

- ◆ Knows the levels of service that customers require
- ◆ Through meaningful performance indicators, monitors performance and levels of service achieved
- ◆ Is confident that ratepayers’ money is being used effectively
- ◆ Recommends funding policies that support a sustainable infrastructure
- ◆ Is responsive to governing body concerns in all these areas



### *Discussion/Exercises*






Guam Waterworks Authority  
January 24, 2006


## Asset Management Learning Session 2: Customers and Service Levels








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## Outline of Session 2

- ♦ Who are our Customers?
- ♦ Approaches world wide
- ♦ Categories
- ♦ Trade off – service level and cost
- ♦ Service levels vs performance indicators and penalties
- ♦ What makes a SMART indicator?
- ♦ Discussion on Service levels for the GWA




## Who are our Customers?

- ♦ Residential
- ♦ Commercial
- ♦ Industrial
- ♦ “Wholesale”
- ♦ Community at large (environmental)




## Setting Service Levels: Approaches Worldwide

- ♦ Fixed mandatory levels under an operating contract /licence with high penalties
- ♦ Continuous improvement to higher service levels
- ♦ Maintaining condition of assets (a proxy approach)
- ♦ Determined in consultation with customers

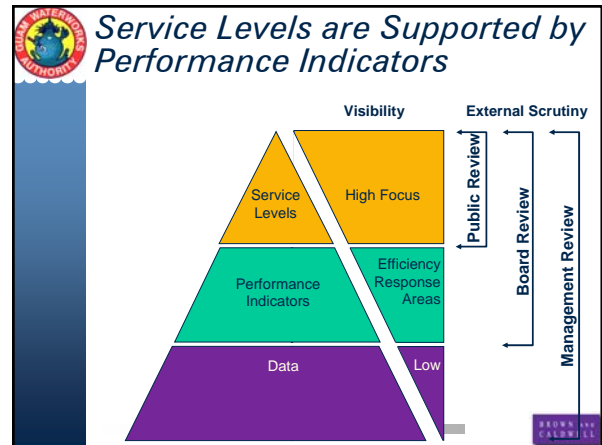
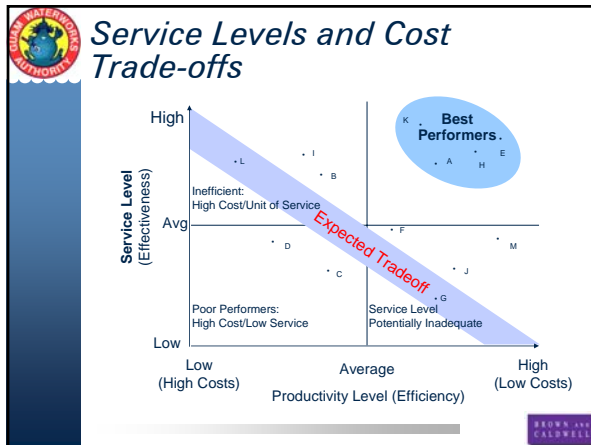


**Continuous Improvement to Higher Service Levels**

- ◆ By benchmarking
- ◆ By “league tables” - comparison by embarrassment
- ◆ Need good information of cost /service level trade-off

**Setting Service Levels**

- ◆ Requires alignment of service levels with Business Plan/Corporate Planning
- ◆ A number of categories:
  - Environment: Regulated requirements or self imposed
  - Health
  - Safety
  - Customers
- ◆ Is cost a service level?

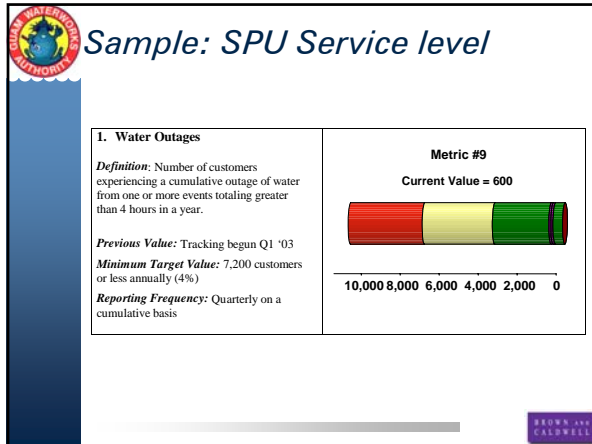


**Performance Indicators are SMART Measures**

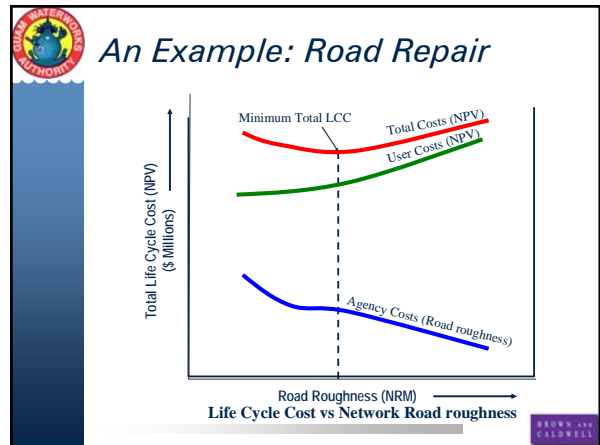
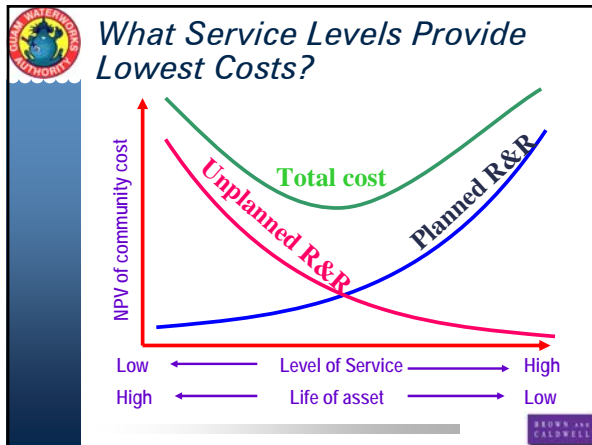
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**Asset Management is Performance Management**

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- ### Costs for Not Hitting a Service Level Target?
- ♦ Additional capital/O&M costs
  - ♦ Excessive social/environmental costs
  - ♦ Loss of reputation/political comment/media response
  - ♦ Fines/penalties
  - ♦ Poor morale
  - ♦ Other costs?



- ### Sample Service Levels (Water)
- ♦ Clean, safe drinking water (all regulatory guidelines met)
  - ♦ Outages of water (percentage of customers out of water more than five hours in a one-year period, etc.)
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- ♦ Treatment facilities meet all permit requirements
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  - ♦ Number of sewer overflows on customer's property, reaching receiving waters, etc.
  - ♦ Number of back-ups of sewer within customers' premises ("flooding")




### *Setting Service Levels Requires:*

- ♦ An understanding of customers' and regulator's requirements and the cost trade-offs
- ♦ Knowledge of asset life /degradation and repair/replace trade-offs
- ♦ A thorough understanding of asset risks
- ♦ Assessment of full community costs
- ♦ Pricing to be based on full costs of asset replacement and servicing
- ♦ Good asset management to lead regulatory debate









### *Discussion/Exercises*







Guam Waterworks Authority  
January 25, 2006

## Asset Management Learning Session 3: Business Case Evaluation



## Overview of the Learning Sessions

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## Outline of Presentation

- ♦ What a Business Case Evaluation (BCE) is and How it Works
- ♦ Economic Dimensions of a BCE: Present Value
- ♦ Present Value Example: Pump Purchase
- ♦ A Real-life BCE: The UDCRIP Project
- ♦ Summary
- ♦ Introduction to the Case Studies



## What is Business Case Evaluation?

- ♦ Business Case Evaluation (BCE) is used in the asset creation process
- ♦ Repeatedly revisits the drivers for a project
- ♦ Validates the need for a solution in terms of customer value
- ♦ Seeks the lowest life-cycle cost solution with due consideration for risk and non-quantified factors


## How Does a BCE Work?

- ♦ Looks at the *problem* first, not the project
- ♦ Determines the need for a solution from the *customer's* point of view (as always, service levels and cost)
- ♦ Proposes alternative approaches to creating the solution, if a solution is needed
- ♦ Analyzes alternatives from the standpoints of *service levels, costs, and risk*

## The Economic Dimension of a BCE

- ♦ Typically, projects have costs and benefits that are realized over a long period of time
- ♦ Comparing the economics of different projects might seem difficult...
- ♦ The concept of *present value* is used in such cases
- ♦ This is exactly how capital decisions are "penciled out" in private industry







**Now for a Real-life SRCSD Example of a BCE**

- ◆ SRCSD established a Team to evaluate a proposed capital project, the Upper Dry Creek Relief Interceptor project (UDCRIP)
- ◆ The BCE was accomplished through a series of facilitated workshops
- ◆ Lots of “homework” by Team members was required between the workshops
- ◆ *Results:* A considerable cost savings, reduced project risk, and a quicker solution to a real problem

**UDCRIP Background**

- ◆ Existing interceptor was surcharging in heavy rains, causing upstream spills
- ◆ SRCSD planned a new 36” relief interceptor with pump station midway (UDCRIP)
- ◆ 30% design completed, RFP for final design was about to be issued
- ◆ Capital cost was \$13.8 million
- ◆ Running costs averaged \$167K/year (2003 dollars)
- ◆ Total PV of ownership (50 years) was \$17.5 million

**Map of Proposed Relief Interceptor**

The map shows the layout of interceptors in the area. Key features include:
 

- Existing interceptor:** A red line connecting Rio Linda Relief and Dry Creek Relief.
- Proposed relief interceptor:** A blue line branching from the existing one.
- DRR-1:** A circular structure on the proposed line.
- UNWI-3, UNWI-4, UNWI-5, UNWI-6:** Various interceptors along the main line.
- UPPER NORTHWEST INTERCEPTOR:** A green line on the left.
- DRY CREEK INTERCEPTOR:** A red line at the bottom.
- McCLELLA:** A street shown at the bottom right.

**The BCE Team Goes to Work...**

- ◆ SRCSD established a BCE Team primarily from Engineering and Field O&M
- ◆ The team defined 14 alternative approaches!
- ◆ Several were “fatal flawed” out but seven remained
- ◆ Timing, capital costs, and 50-year O&M refurbishment costs were estimated for each of the remaining seven plus the existing UDCRIP project

**Alternative Set 1: Non-construction alternatives**

- ◆ Do nothing—**Fatal flaw** (customer service and regulatory)
- ◆ Dry Creek connection moratorium—**Fatal flaw** (general policy, customer service, possible legal issues)

**Alternative Set 2: Use Current UDCI Alignment**

- ◆ Reduce Dry Creek I&I—**Fatal flaw** (potential cost, technical risk, I&I probably not the problem)
- ◆ Parallel UDCI with new gravity pipe—**Fatal flaw** (cost)
- ◆ Expand UDCI diameter via bursting—**Fatal flaw** (technical risk, costs uncertain)
- ◆ Convert UDCI to force main—**Examined**

### Alternative Set 3: Use proposed UDCRIP Alignment

- ♦ Pipe plus lift station as planned—**Examined**
- ♦ Gravity pipe only, lower UNWI accordingly—**Examined**

### Alternative Set 4: Peak-Shaving Storage at Highlands WWTP

- ♦ Build storage capacity to 2010—**Fatal flaw** (initial storage calculations too low, short-term solution)
- ♦ Below-grade basin storage—**Examined**
- ♦ Above-grade tank storage—**Examined**
- ♦ Above-grade tank storage, phased—**Examined**

### Alternative Set 5: Upstream Treatment, Sales of Reclaimed Water

- ♦ Reclamation for landscape irrigation, winter storage—**Fatal flaw** (cost and policy issues)
- ♦ Reclamation for landscape irrigation, winter surface discharge—**Fatal flaw** (cost and policy issues)
- ♦ Reclamation for year-round industrial users—**Examined**

### PV Template for UDCRIP BCE Analysis

**Parameters** (From Summary Sheet):  
 Year of analysis: 2003  
 Escalation rate: 3%  
 Discount rate: 5%

**Risk Factors** (Sensitivity analysis +/- percent):  
 Capital cost  
 M&O cost  
 Benefits


	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Facility Costs	unescalated										
				13,836							
O&M Costs:											
M&O					74	74	74	74	74	74	74
Power					1	1	1	1	2	2	2
Chemicals					7	7	7	7	9	9	9
Compliance monitoring					4	4	4	4	4	4	4
Unexpected events					10	10	10	10	10	10	10
Other											
Total O&M					96	96	96	96	99	99	99
Reburbishments:											
Pump refurbishment								10			10
Site maintenance											
Other											
Total reburbishments								10			10
Total costs				13,836	96	96	106	96	99	109	99

### Summary of the Seven Surviving Alternatives

Alternative	Name	Year in Service	Capital Cost (thousands)	50-yr NPV (thousands)	Savings over 5-1
Use Current UDCRIP Alignment:					
4-3	Convert Existing Interceptor to Force Main	2009	\$14,745	\$17,622	-1%
Use Proposed UDCRIP Alignment:					
5-1	Currently Planned Interceptor and Lift Station	2007	\$13,836	\$17,524	0%
5-2	Currently Planned Alignment, Gravity Flow	2006	\$10,418	\$10,030	43%
Peak-shaving Storage at Highlands WWTP:					
6-2	Off-line Peak Storage, Sub-grade Basin	2008	\$8,979	\$16,468	6%
6-3	Off-line Peak Storage, Above-grade Tanks	2008	\$9,622	\$15,129	14%
6-4	Off-line Peak Storage, Phased Above-grade Tanks	2008	\$9,709	\$14,985	14%
Upstream Treatment and Reclaimed Water Sales:					
7-3	Industrial Reclaimed Water	2010	\$35,206	\$32,082	-83%



### UDCRIP BCE Results

- ♦ Team determined that the need to eliminate existing surcharging was valid
- ♦ Four new alternatives were less expensive (50-year PV basis) than the planned approach
- ♦ Project concept changed from pipe and pump station to simple gravity pipe
- ♦ This required lowering the receiving interceptor by several feet





### *UDCRIP BCE Benefits (Substantial!)*

- ♦ Capital cost was \$3 million lower
- ♦ Total 50-year PV ownership cost was \$7.5 million lower
- ♦ Project could be in place a year sooner




### *Summary: The BCE at SRCSD*

- ♦ The BCE is an extraordinarily powerful tool
- ♦ Helps ensure that the best approach is taken to meeting real customer needs
- ♦ The department is working now to fit the BCE into its normal business processes
- ♦ One key: BCE is done repeatedly through the project development cycle to keep projects "on track" and to account for new developments



### *Three BCE Case Studies*

- ♦ Sewer line: Root cleaning
- ♦ Truck cleaning
- ♦ Replacing a failed water line



### *Discussion/Case Studies*






Guam Waterworks Authority  
January 26, 2006


### Asset Management Learning Session 4: Managing Risk



### Overview of the Learning Sessions

1. What IS Asset Management?
  - ♦ What are its basic elements? What does it mean for us? For our customers?
2. Customer Service Levels
  - ♦ Who are our customers? What services of value do we provide? How can we measure service levels?
3. The Business Case Evaluation
  - ♦ How do we ensure that our projects are the right ones for our customers, at the right time?
4. Managing Risk
  - ♦ How do we incorporate risk into asset decisions?
5. Community Costs and Benefits
  - ♦ How do we account for community and social costs in our asset decisions?





### Key Areas of Workshop

- ♦ Risk and Risk Cost of Asset Ownership
- ♦ Distribution of Risks in Our Infrastructure
- ♦ Managing Failure
- ♦ Managing Risk: A Case Study
- ♦ Summary: Managing Asset Risks
- ♦ Exercises: Risk Management Case Studies




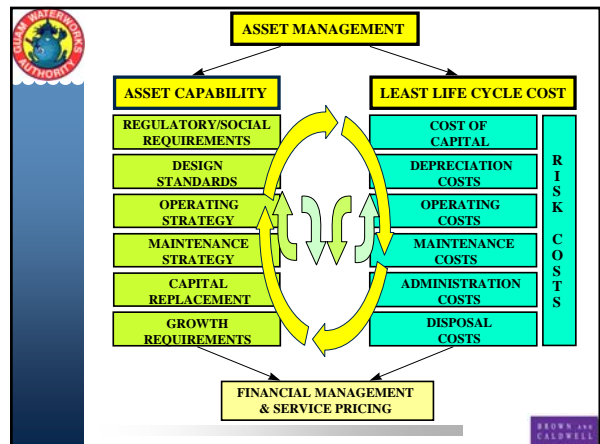



### Risk and Risk Cost of Asset Ownership

### What is Risk?



- ♦ A probabilistic measure of loss exposure
- ♦ Quantifiable in \$ per year
- ♦ An inherent cost of asset ownership



### What is Risk Cost?

- ♦ The product of the likelihood of an event occurring and the dollar consequence of the event
- ♦ Risk cost is expressed in dollars
- ♦ Attempts to quantify both direct and indirect costs (*i.e.*, includes community and environmental costs)






### Risk Quantification

# RISK COST =

Frequency of Failure (Projected events per year)	X	Consequence of Failure (Dollar cost of each event)
-----------------------------------------------------	---	-------------------------------------------------------

**MEASURE: \$/YEAR**



### Example of Risk Cost Calculation

A particular event has consequences totalling \$100,000

Best assessment of rate of occurrence is once every 5 years



∴ Projected frequency of occurrence = 1/5 or 0.2

Risk = Frequency x Consequence  
 = 0.2 annually X \$100,000  
 = \$20,000 per year



### Which has the Greatest Risk Cost?

- ♦ A failure that occurs every year with a cost of \$10,000, or
- ♦ A failure that occurs once every 100 years with a cost of \$500,000?
- ♦ Group discussion

### Example: Risk Cost of Having Your Car Towed

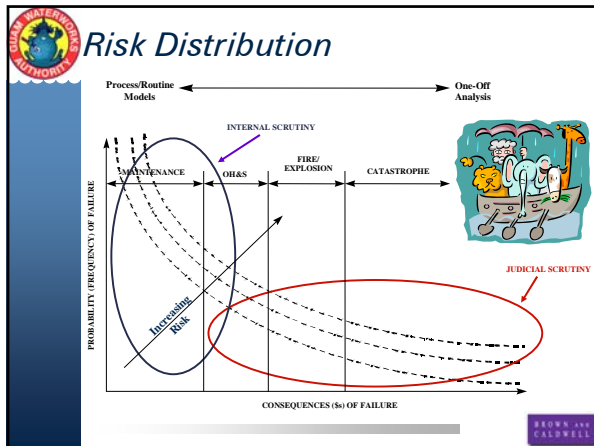
- ♦ Average towing bill: \$240
- ♦ Average frequency of needing a tow for your make/model of car: 8 years
- ♦ Annualized risk cost = \$240 X 1/8 = \$30
- ♦ Add overhead and profit of \$10
- ♦ Insurance company assumes your risk cost of towing for \$40 a year



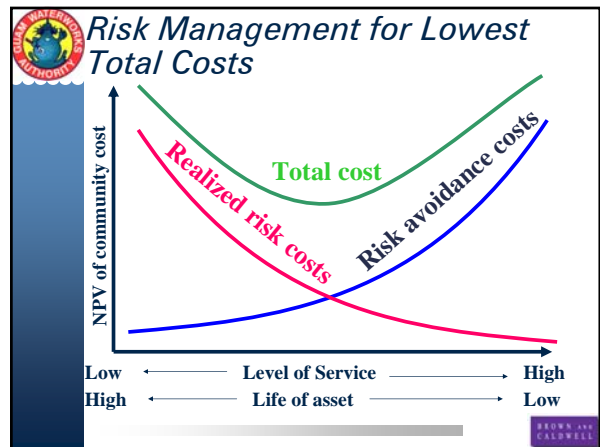
### Distribution of Risks in Our Infrastructure

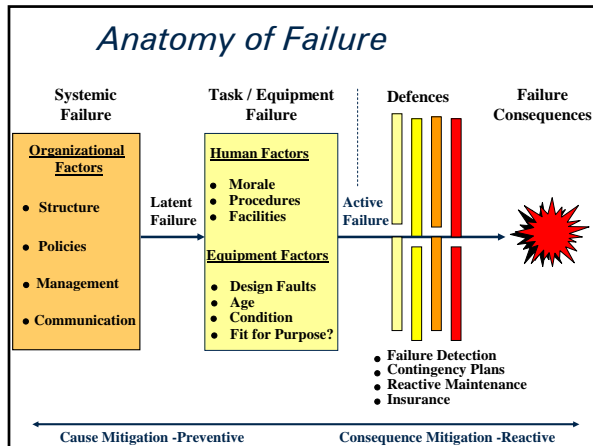




- How do we Estimate Frequency of Failure?**
- ♦ Projecting historical records of failure allowing for degradation
  - ♦ Where no history available, by engineering assessment (but build that history!)
  - ♦ By condition monitoring
  - ♦ Group discussion:
    - What is failure?
    - How do we assess frequency of failure?
    - How do we collect data on asset failure?

- Consequences of Failure**
- ♦ Direct repair cost
  - ♦ Loss of production
  - ♦ Social costs
  - ♦ Image damage costs
  - ♦ Failure administration
  - ♦ Legal costs, claims
  - ♦ Fines, penalties
- 





### Background to Case Study

- Experienced by Hunter Water, a major Australian water/wastewater utility
- Situation: Large water main section replacement
- Decision was made exactly in the manner discussed

### Description of the Main Segment


- Aboveground segment of large diameter supply main, lead-jointed steel, location subject to rare flooding
- Incremental O&M costs (joint stresses from temperature changes and ground movement) are about \$400K annually
- Replacement cost is \$10.4 million (buried, so avoiding O&M costs)
- PV analysis shows that replacement is not worth avoided O&M costs alone

### But What about Risk?

- Research discovered that a 100-year storm in 1955 washed out this pipe segment
- 50,000 customers were without water for 14 days
- Today, 90,000 customers and various industries and businesses would be affected
- What would be the cost?



### Loss of Water Cost

- Mobilizing every water tanker available and tankering water to the area
- Expected claims for loss of production, etc.
- Estimated values of residential customer water interruption (very high for such a long-duration outage)
- Costs of emergency response to pipe failure over and above routine response
- Total cost estimate: \$60 million






### Converting this to Risk Cost

- ◆ We are exposed to a total direct and community cost of asset failure of \$60 million
- ◆ We expect this to occur, on average, every 100 years
- ◆ So, the *risk cost of asset ownership* for this segment of pipe is \$60 million divided by 100 years, or \$600 thousand annually






### What does this Mean for our Replacement Decision?

- ◆ Total cost of ownership annually is O&M at \$400K plus risk at \$600K, or \$1 million
- ◆ Replacement (buried) avoids both costs
- ◆ PV analysis shows that replacement at \$10.4 million is a very good investment if both O&M and risk costs are considered
- ◆ *Decision:* Replace the pipe segment.


### Summary: Managing Asset Risks

### The Risk Mitigation Decision

```


    graph TD
      A["Status Quo - Social, Economic, Environmental Cost Streams, including Risk"] --> B["For Each Mitigation Option - Social, Economic, Environmental Cost Streams, including Risk"]
      B --> C["Economic Benefit/Cost for Each Mitigation Option"]
      C --> D{"Benefit/Cost > 1?"}
      D -- No --> E[Discard]
      D -- Proceed --> F["Prioritise Mitigation Projects by Economic Benefit/Cost (not by magnitude of risk)"]
    
```




### Four Basic Steps In Managing Asset Risk



```

    graph TD
      A[Identify Potential Failures] --> B[Determine Risks]
      B --> C[Identify Available Mitigation Strategies]
      C --> D[Combine Strategies for Greatest Benefit / Cost]
    
```

### Three Risk Management Case Studies

- ◆ Major sewer collapse
- ◆ Residential CCTV scheduling
- ◆ Equipment replacement decision










Guam Waterworks Authority  
January 27, 2006

### Asset Management Learning Session 5: Community Costs and Benefits





### Overview of the Learning Sessions

1. What IS Asset Management?
  - ♦ What are its basic elements? What does it mean for us? For our customers?
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  - ♦ How do we account for community and social costs in our asset decisions?





### Outline of Session 5

- ♦ What IS Asset Management?
- ♦ Aligning Service Levels and Cost: Risk
- ♦ Community Benefits and Costs
- ♦ Comments on the Case Studies





### What IS Asset Management?



### What IS Asset Management?

- ♦ A computer system?
- ♦ A set of tools and techniques?
- ♦ Procedures for improved planning?
- ♦ A way to make better asset decisions?
- ♦ New business processes?



Well, maybe all of the above, but mostly...



### Asset Management is...

...a way of doing business!

Specifically, it is a way of doing business suitable to agencies whose main mission is the delivery of service using large networks of expensive, long-lived assets.



**A Definition of AM**

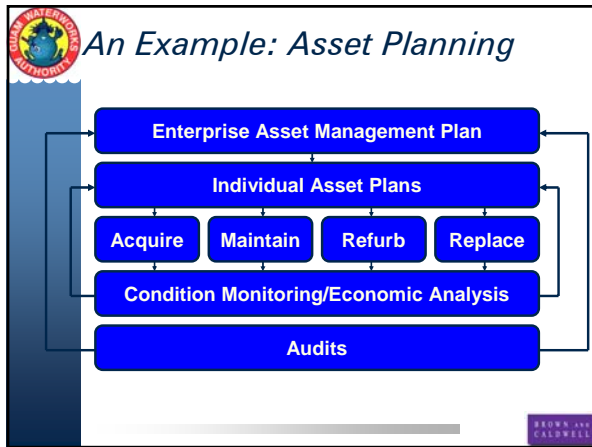
“Asset management is a structured program to deliver the service levels your customers require while minimizing the whole-life costs of asset ownership.”

*Let's look at this definition closely...*

**Element 1: A Structured Program**

“Asset management is a **structured program** to deliver the service levels your customers require while minimizing the whole-life costs of asset ownership.”

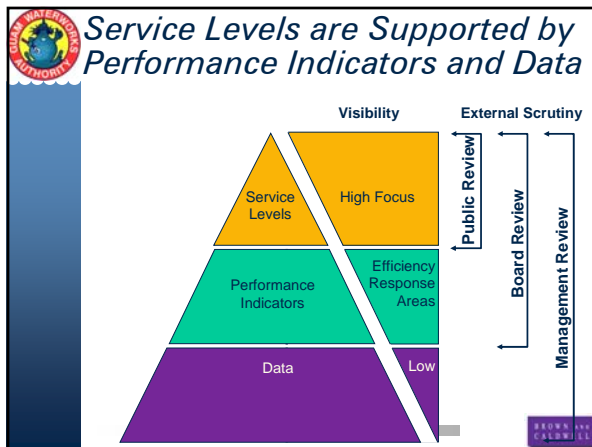
- AM is highly structured
- Asset decisions are made in repeatable and supportable ways, based on good data!
- AM's structure always includes continuous improvement cycles



**Element 2: Specified Service Levels**

“Asset management is a structured program to deliver the **service levels your customers require** while minimizing the whole-life costs of asset ownership.”

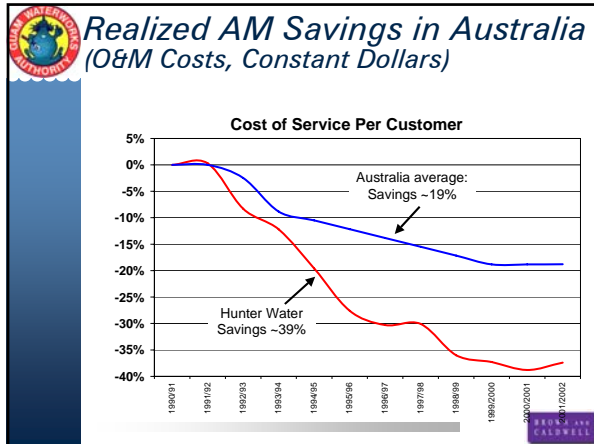
- AM doesn't want to deliver the *best* service—it wants to deliver *specified levels* of service
- These levels are selected based on service level/cost tradeoffs
- Ideally, service levels are “agreed” with customers in full knowledge of those tradeoffs



**Element 3: Minimizing the Costs of Asset Ownership**

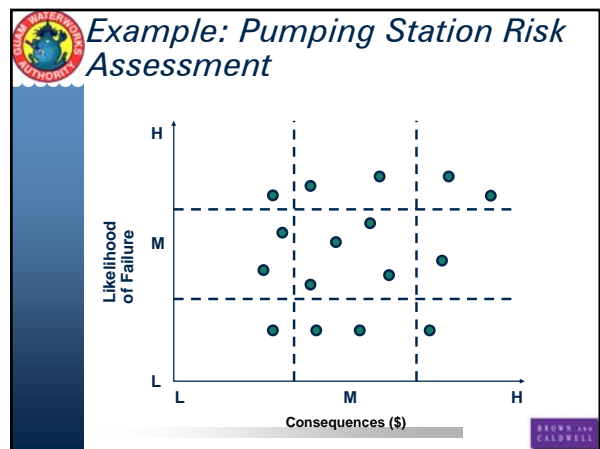
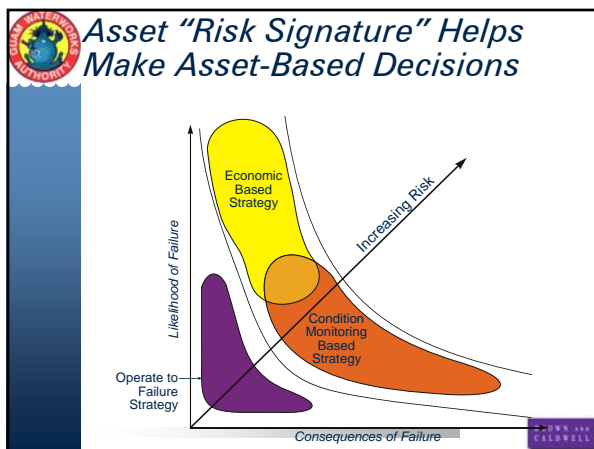
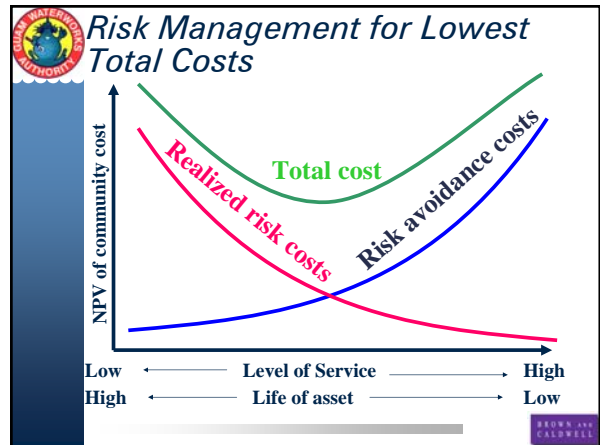
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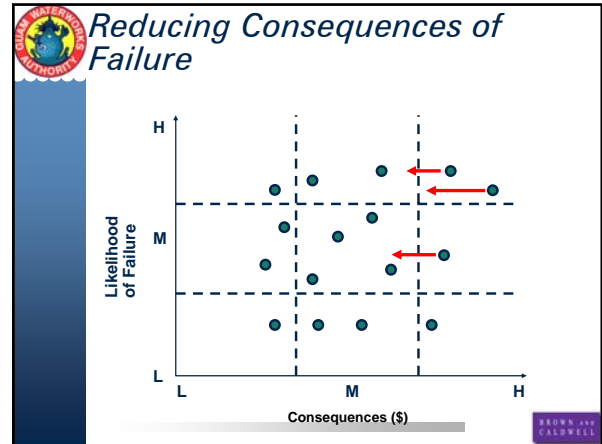
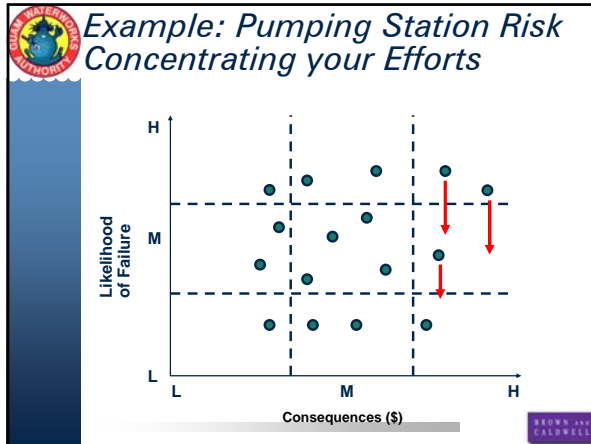
- ALL asset decisions (acquire, maintain, refurbish, replace) are made on a *life cycle basis*
- Each decision minimizes the *present value* of all future ownership costs
- Costs must include the *risk cost of ownership*



- ### Asset Management: A Summary
- ♦ AM is intensely *customer-focused*
  - ♦ What levels of service do our customers need?
  - ♦ How can we deliver these services at the lowest cost?
  - ♦ In a mature AM organization, this is a reflexive way of thinking!

### Aligning Costs and Service Levels: Risk





- ### Risk Cost: A Rational Approach
- ♦ Risk cost is an inherent cost of asset ownership
  - ♦ It is measured in dollars per year
  - ♦ It is the product of the likelihood of an event and the dollar consequence of that event
  - ♦ Once we know the risk cost, we can make *rational decisions* on reducing risk
  - ♦ We're now *managing* risk!


### Risk Quantification

$$\text{RISK COST} = \text{Frequency of Failure (Projected events per year)} \times \text{Consequence of Failure (Dollar cost of each event)}$$

**MEASURE: \$/YEAR**


## Community Benefits and Costs


- ### What's a Benefit?
- ♦ Reduction in cost compared with current practice or a "base case" alternative
    - May be capital, O&M, or community cost
  - ♦ Needed increase in service levels
    - General consists of a reduction in probability or impact of a "bad thing" occurring



### *Failures (and Preventing Them) may Include both Direct and Community Costs*



- ♦ Direct repair costs and loss of revenue
- ♦ Disruption costs (traffic, residence and business access, noise and dust, etc.)
- ♦ Environmental costs (public health, river/beach closures, quality of life)
- ♦ Image repair costs
- ♦ Legal costs
- ♦ Fines, penalties






### *Examples of Spill Costs*

- ♦ San Diego water/wastewater team evaluated alternatives for dealing with WW pump station problems
- ♦ Risk of spills if nothing done, also if various modifications were made
- ♦ Team priced spills at \$1/gallon
- ♦ Given estimates of spill probabilities and likely volumes, team was able to quantify risk cost of spills for all alternatives
- ♦ Also see Harlow's survey – found typical costs of \$1 to \$10 per gallon for smaller spills





### *Examples of Traffic Disruption Costs*

- ♦ Published estimates for private vehicles range from \$10 to \$22 per hour delayed
- ♦ May vary by community
- ♦ Commercial vehicles have higher costs of delay
- ♦ Large commercial trucks estimated at \$70 per hour delayed in one study






## *Comments on the Case Studies*


### *Key Concepts in Case Studies*

1. Long division is your friend (benefits and costs per customer, per failure, etc. – a valuable “smoke test”)
2. Wherever possible, quantify benefits and costs on an annual basis
3. When you can't quantify a cost or benefit, quantify everything else and see if a “reasonable person” would consider the remaining price worth paying

### *Introduction to the Case Studies*

1. What's a Spill Worth?
  - Analyzing the costs and benefits of a sewer spill reduction program
2. Trench or Tunnel?
  - Is tunneling worth it to reduce traffic disruption?
3. The Value of Reliability
  - Using a “reasonable person” test with regard to water line replacement impacts on homeowners





*Discussion/Exercises*

