

Tacoma Water's **Approach to Asset Management**



PNWS-AWWA PRE-CONFERENCE 2015



HISTORY AND CURRENT STRUCTURE

WORK LEADING TO CURRENT EFFORT

- 2007- HDR TAILORED ASSET MANAGEMENT READINESS REVIEW AND PUBLIC UTILITY BOARD PRESENTATION
- 2008 - INTERNATIONAL WATER ASSOCIATION (IWA) – WATER SERVICES ASSOCIATION OF AUSTRALIA (WSAA) ASSET MANAGEMENT PROCESS BENCHMARKING PROJECT
- 2009 - CONTRACT WITH CH2MHILL TO DEVELOP AN ASSET MANAGEMENT FRAMEWORK AND IMPLEMENTATION PLAN
- 2010 – BEGAN IMPLEMENTATION WITH STEERING TEAM AND DEDICATED STAFF





HISTORY AND CURRENT STRUCTURE

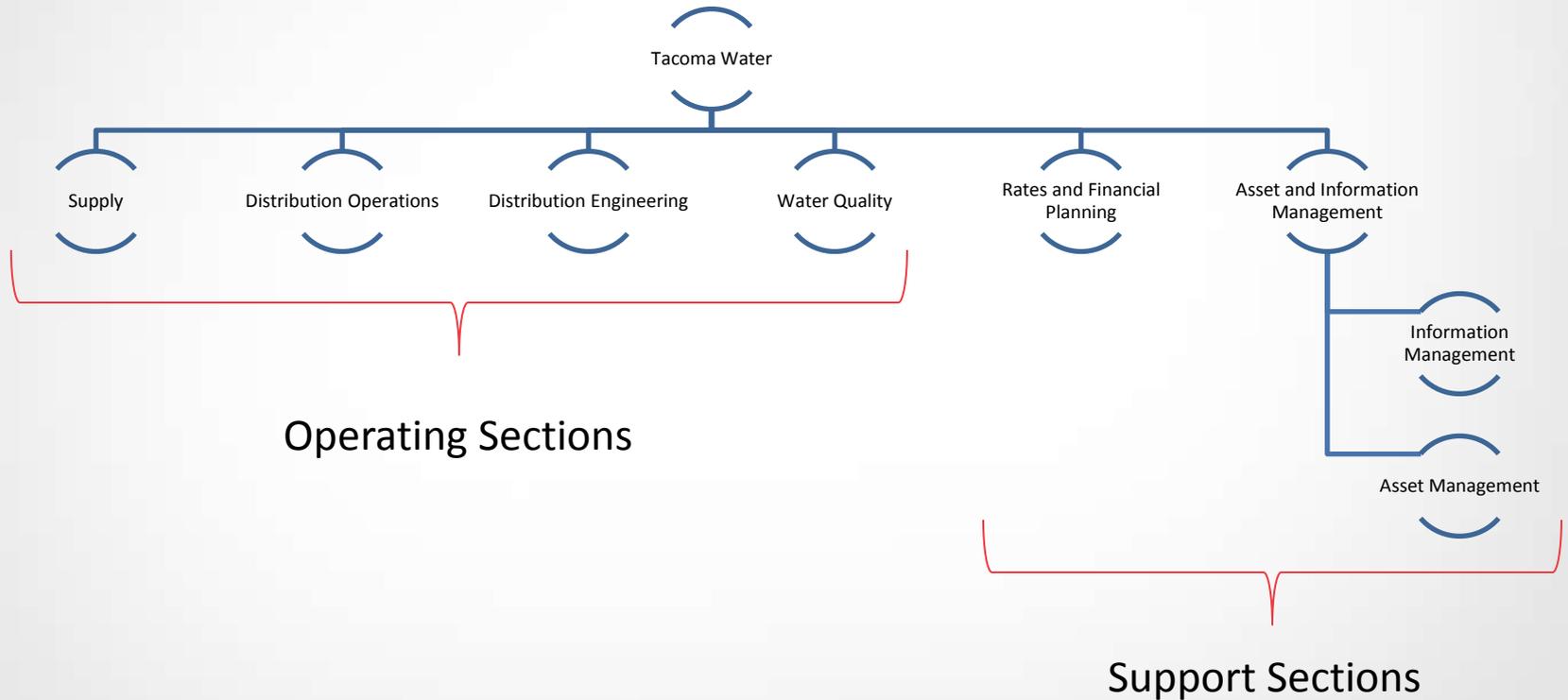
A JOURNEY OF CONTINUOUS IMPROVEMENT

- DECIDE TO START - BE OPEN TO DISCOVERY
- OBTAIN SUPPORT AT HIGHEST LEVELS
- INCLUDE IN PLANNING (STRATEGIC PLANS, BUSINESS PLANS, BALANCED SCORECARD)
- CHANGE IS HARD, BE PREPARED FOR THAT AND STAY COMMITTED – FIND YOUR CHAMPIONS
- MEASURE AND REPORT ON PROGRESS



HISTORY AND CURRENT STRUCTURE

ORGANIZATION STRUCTURE





TACOMA WATER DEMOGRAPHICS

~1,200 MILES OF DISTRIBUTION MAIN

~150 MILES OF TRANSMISSION MAIN

~100,000 METERS AND SERVICES

~25,000 VALVES

~10,000 HYDRANTS

~75 PRVS

31 WELLS

27 PUMP STATIONS

24 RESERVOIRS/TANKS/STANDPIPES

2 TREATMENT FACILITIES

1 FILTRATION FACILITY

JUST OVER \$1 BILLION IN ASSETS TO MANAGE

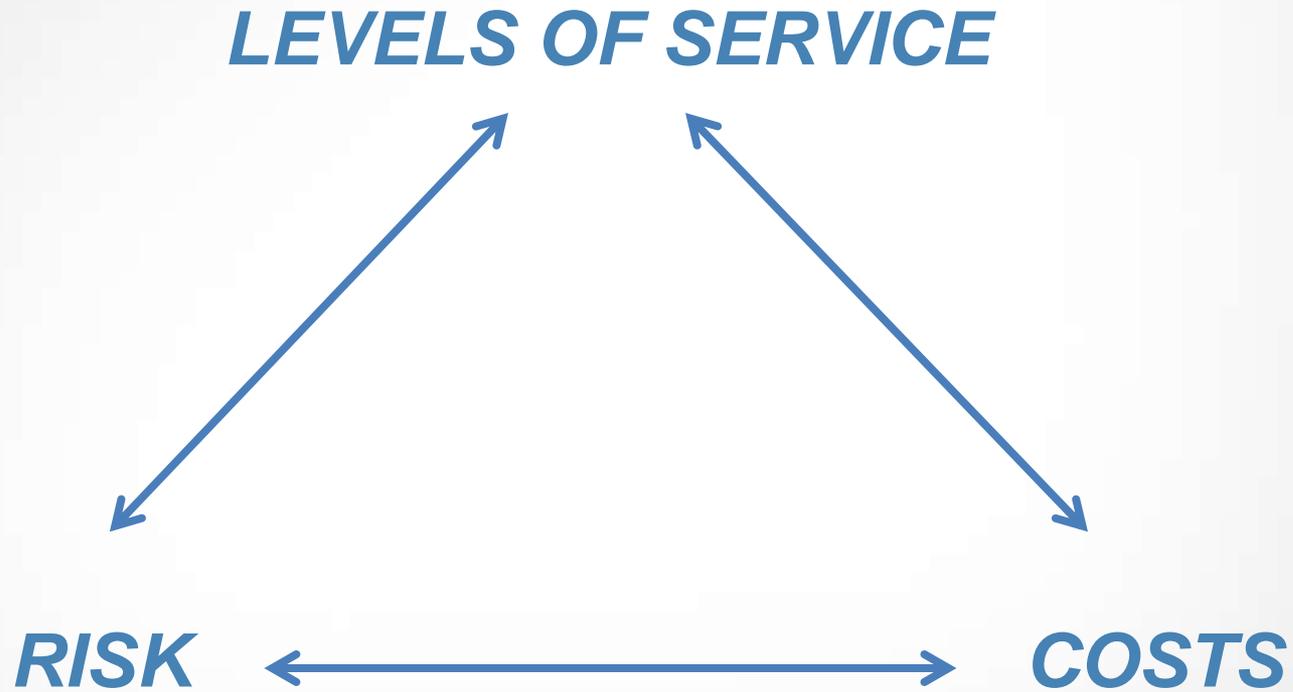


OVERVIEW OF CURRENT PROGRAM

“ASSET MANAGEMENT IS AN INTEGRATED SET OF PROCESSES TO MINIMIZE THE LIFECYCLE COSTS OF OWNING, OPERATING AND MAINTAINING ASSETS, AT AN ACCEPTABLE LEVEL OF RISK, WHILE CONTINUOUSLY DELIVERING ESTABLISHED LEVELS OF SERVICE.”



OVERVIEW OF CURRENT PROGRAM





WHAT SHOULD THE PROGRAM LOOK LIKE?

“REPLACE THE RIGHT ASSETS AT THE RIGHT TIME”

“BREAK DOWN SILOS”

“TOP DOWN, BOTTOM UP”

“TRIPLE BOTTOM LINE”

“PROACTIVE PLANNING”

“RISK BASED DECISION MAKING”

“DATA DRIVEN DECISION MAKING”

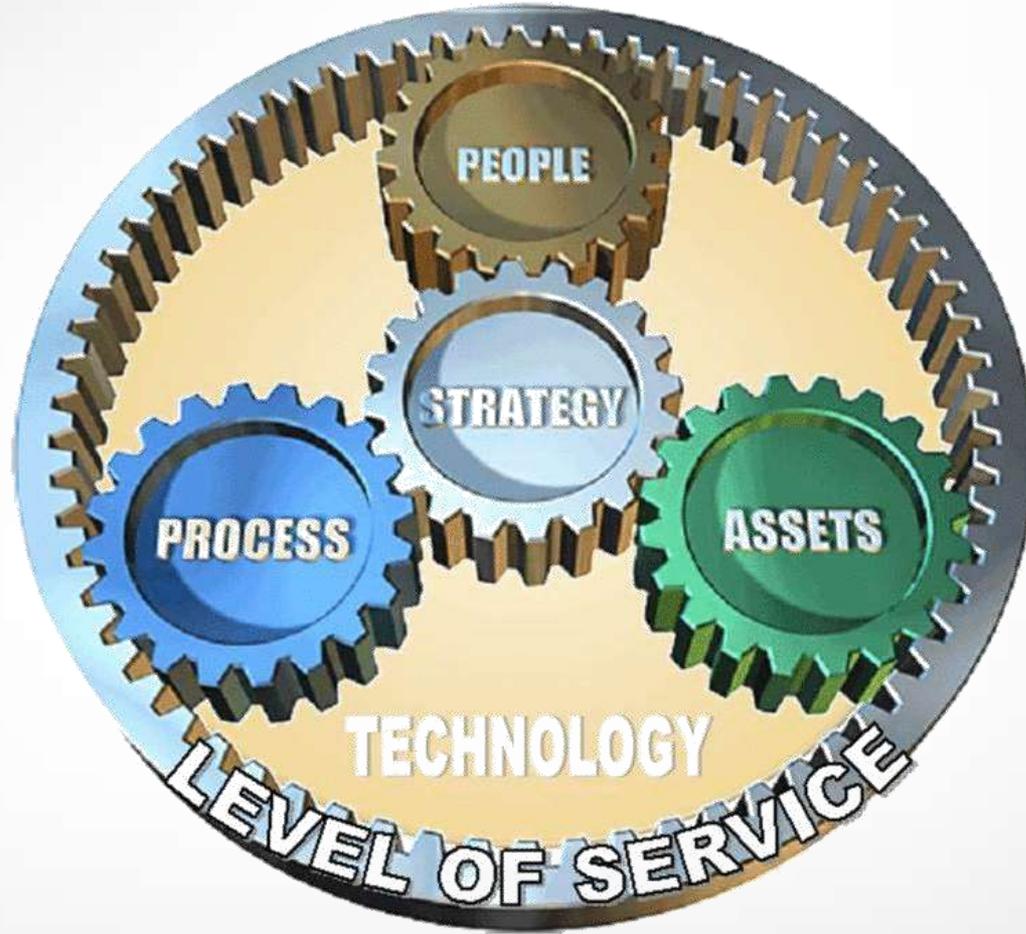
“BEST PRACTICES”

“CONTINUOUS IMPROVEMENT”

“RELIABILITY”



ASSET MANAGEMENT PHILOSOPHY





WHAT ARE THE KEYS TO OUR SUCCESS?

PEOPLE

PROCESSES

TECHNOLOGY

(AND HOW WELL THEY WORK TOGETHER)



A LITTLE BACKGROUND

*ADOPTED SAP AS OUR CMMS (& ERP) IN 2003
INCONSISTENT USE ACROSS ORGANIZATION*

UPGRADED TO ARCGIS IN 2014 (HOORAY!)

LONG STANDING CULTURE OF GOOD DECISION MAKING

PRIDE IN OUR WORK

DECENT LEGACY RECORD KEEPING

MANY AM 'LITE' PROGRAMS IN PLACE



RISK

CONSEQUENCE X LIKELIHOOD

**DEVELOPED OBJECTIVE SCORING (1 THROUGH 5)
FOR BOTH CONSEQUENCE AND LIKELIHOOD**

APPLIED CONSISTENCY TO EACH ASSET CLASS

COMPARE APPLES TO APPLES



CONSEQUENCE

5 CATEGORIES FOR CONSEQUENCES:

FINANCIAL

PUBLIC/ CUSTOMERS

SAFETY

SERVICE/SUPPLY

WATER QUALITY/REGULATORY

EACH CATEGORY SCORES 1 TO 5



LIKELIHOOD

4 CATEGORIES FOR LIKELIHOOD:

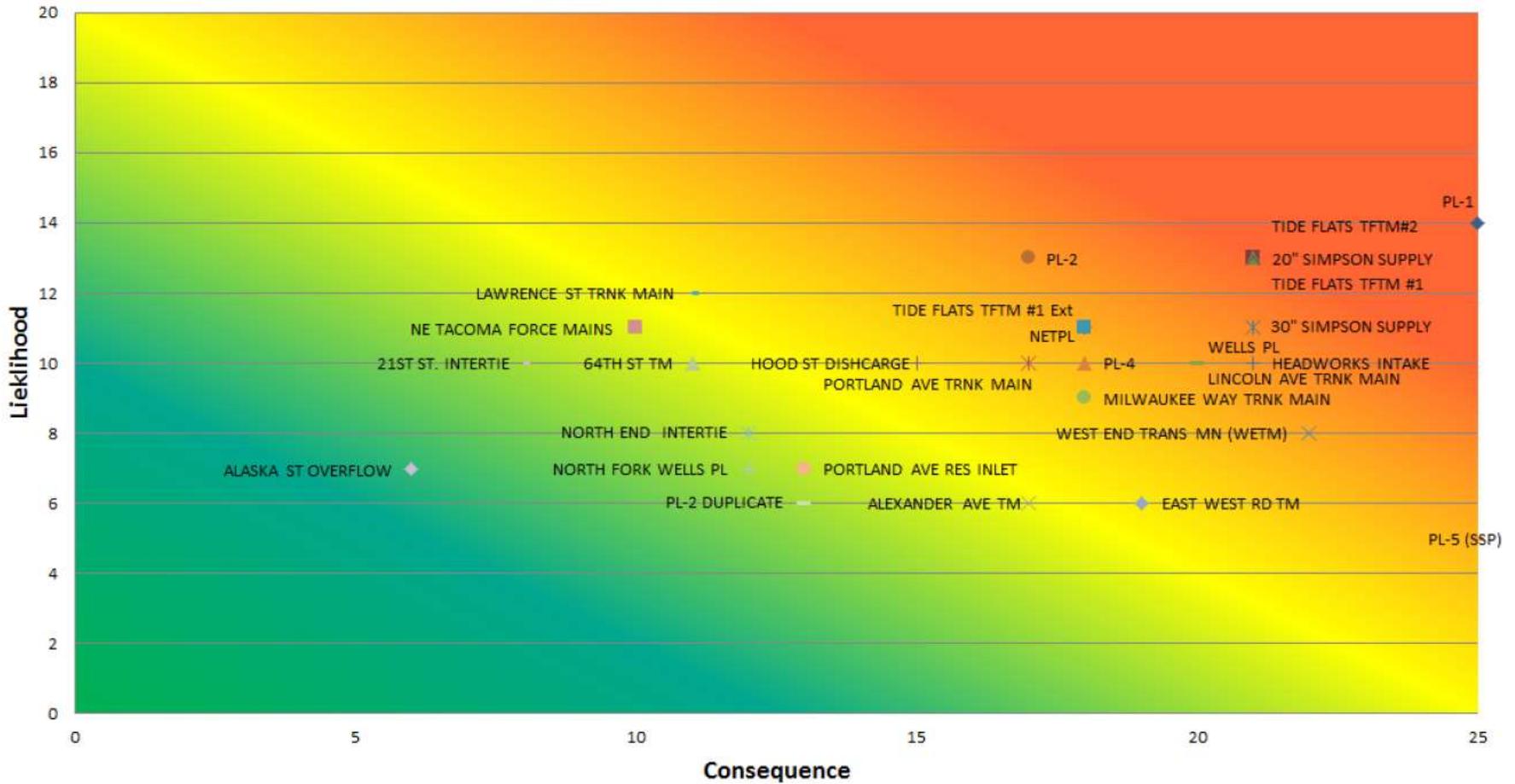
AGE/REMAINING USEFUL LIFE
CONDITION
MAINTENANCE (STATE)
PERFORMANCE

EACH CATEGORY SCORES 1 TO 5



RISK SCORING

Transmission Mains Risk Analysis





STRATEGIC ASSET MANAGEMENT PLANS (SAMPS)

18 ASSET CLASSES WERE DEFINED

**TEAMS OF SME'S CREATED FOR EACH ASSET
CLASS**

**TEAMS HAVE ~8 MEMBERS FROM ALL LEVELS OF
THE ORGANIZATION**

**FIRST TEAMS WERE: PRVS, DISTRIBUTION MAINS,
METERS, CATHODIC PROTECTION AND HYDRANTS**



STRATEGIC ASSET MANAGEMENT PLANS (SAMPS)

POPULATE SAMP REPORT WITH THE FOLLOWING:

**ASSET REGISTRY
LEVELS OF SERVICE
CONDITION ASSESSMENT
RISK
OPERATION & MAINTENANCE STRATEGY
RENEWAL & REPLACEMENT STRATEGY
FINANCES
DATA & ANALYSIS
RECOMMENDATIONS**



SAMP REPORT MISSION

DOCUMENT STRATEGIES FOR ASSETS

**DOCUMENT HISTORICAL INFORMATION
HISTORICAL MATERIALS AND PRACTICES**

CONSOLIDATE DATA

DEVELOP ANALYTICAL AND PLANNING TOOLS

IDENTIFY LOW HANGING FRUIT



STRATEGIC ASSET MANAGEMENT PLANS (SAMPS)

THEN WE ADDED:

FLEET & EQUIPMENT
WATER SERVICES
PUMP STATIONS
WELLS

QUICKLY REALIZED WE COULDN'T MANAGE AND
DRIVE THE DEVELOPMENT FOR ALL OF THESE



CHANGING FOCUS

IMPLEMENTED “SAMP LEADS” AND AM FORUM

NEED TO DECENTRALIZE SAMP DEVELOPMENT

CREATED THE CONCEPT OF “PHASE 1” FOR SAMPS

FOCUS ON HIGH LEVEL PASS THROUGH

ID DATA

ASSET REGISTRY

RISK

OTHER EASILY COLLECTABLE INFO/DATA

DEVELOP RECOMMENDATIONS FOR PHASE 2



PILE IT ON!

THEN WE ADDED:

**TREATMENT & MONITORING
TRANSMISSION MAINS
ELECTRICAL
RESERVOIRS
VALVES**

NOW THERE ARE 14 SAMPS IN FLIGHT

BY 2016 WE HOPE TO BE JUGGLING 18 OF THEM



STRATEGIC ASSET MANAGEMENT PLANS (SAMPS)

FOCUS ON ALIGNING RECOMMENDATIONS WITH

**STRATEGIC PLAN
ANNUAL GOALS
SECTION PLANS**

BUILD RELATIONSHIPS WITH SECTION MANAGERS

USE SAMPS AS A HUB/NEXUS FOR COMMUNICATION

BE CLEAR WITH EXPECTATIONS!

PLAN! PLAN! PLAN!



DATA & DECISION MAKING

PUTTING RIGOR INTO OUR ANALYSIS

**TRANSITION FROM CONSEQUENCE BASED ANALYSIS
TO RISK BASED**

**BREAK DOWN INFORMATION SILOS (USE CONSISTENT
ASSUMPTIONS)**

COMPARE APPLES TO APPLES

TAKE EMOTION OUT OF THE PROCESS

RESULTS SHOULD STAND ON THEIR OWN



BUSINESS CASE EVALUATIONS (BCES)

ALTERNATIVES ANALYSIS

**CALCULATE LIFECYCLE COSTS FROM A TRIPLE
BOTTOM LINE PERSPECTIVE**

PERFORM BENEFIT COST ANALYSIS

**DEVELOP STANDARD TEMPLATES, SUPPORT &
STANDARDS**

PROVIDE HIGH LEVEL TRAINING



BIG CHANGES

BASED ON RISK, NOT CONSEQUENCES

**NET PRESENT VALUE METHOD DISCOUNTS
FUTURE COSTS**

**BENEFITS AND COSTS ARE QUANTIFIED
OBJECTIVELY**

**ALTERNATIVES ANALYSIS, INCLUDING “DO
NOTHING” ARE REQUIRED**



FIRST BCE'S

DONE IN HOUSE BY AM & SME'S AS A PILOT

TEST OUT AND DEVELOP GOVERNANCE

FOR DISCRETE WORK EFFORTS

NOT ALL PROJECTS WERE EVALUATED USING BCE

MINOR FRUSTRATION BY THOSE PARTICIPATING



15/16 BUDGET DEVELOPMENT

ALL CAPITAL PROJECTS REQUIRED A BCE

BIG STRETCH TO IMPLEMENT

MAJOR FRUSTRATIONS

MANY PROJECTS DID NOT PENCIL OUT

PROCESS WAS NOT PERFECT

RESULTS AND DISCUSSIONS WERE WELL RECEIVED

RESULTED IN ~50% REDUCTION IN CAPITAL SPENDING



17/18 BUDGET PLANNING

IMPROVEMENT TEAM MADE UP OF BCE
PARTICIPANTS CREATED

OVERHAUL BCE EXCEL TEMPLATE

DESIGNING TRAINING BASED ON FEEDBACK

BIGGER FOCUS ON TRIPLE BOTTOM LINE

GETTING BUY IN

NEXT TIME WILL BE SMOOTHER & BETTER



DATA IMPROVEMENTS

LARGE EFFORT TO MAKE EXISTING DATA MORE ACCESSIBLE

STAND UP REPEATABLE ANALYSIS

DISTRIBUTION MAIN FAILURES AND METER TEST BENCH DATA WERE FIRST



DISTRIBUTION MAIN FAILURE DATABASE



**ASSEMBLED 30 YEARS OF
BREAK DATA**

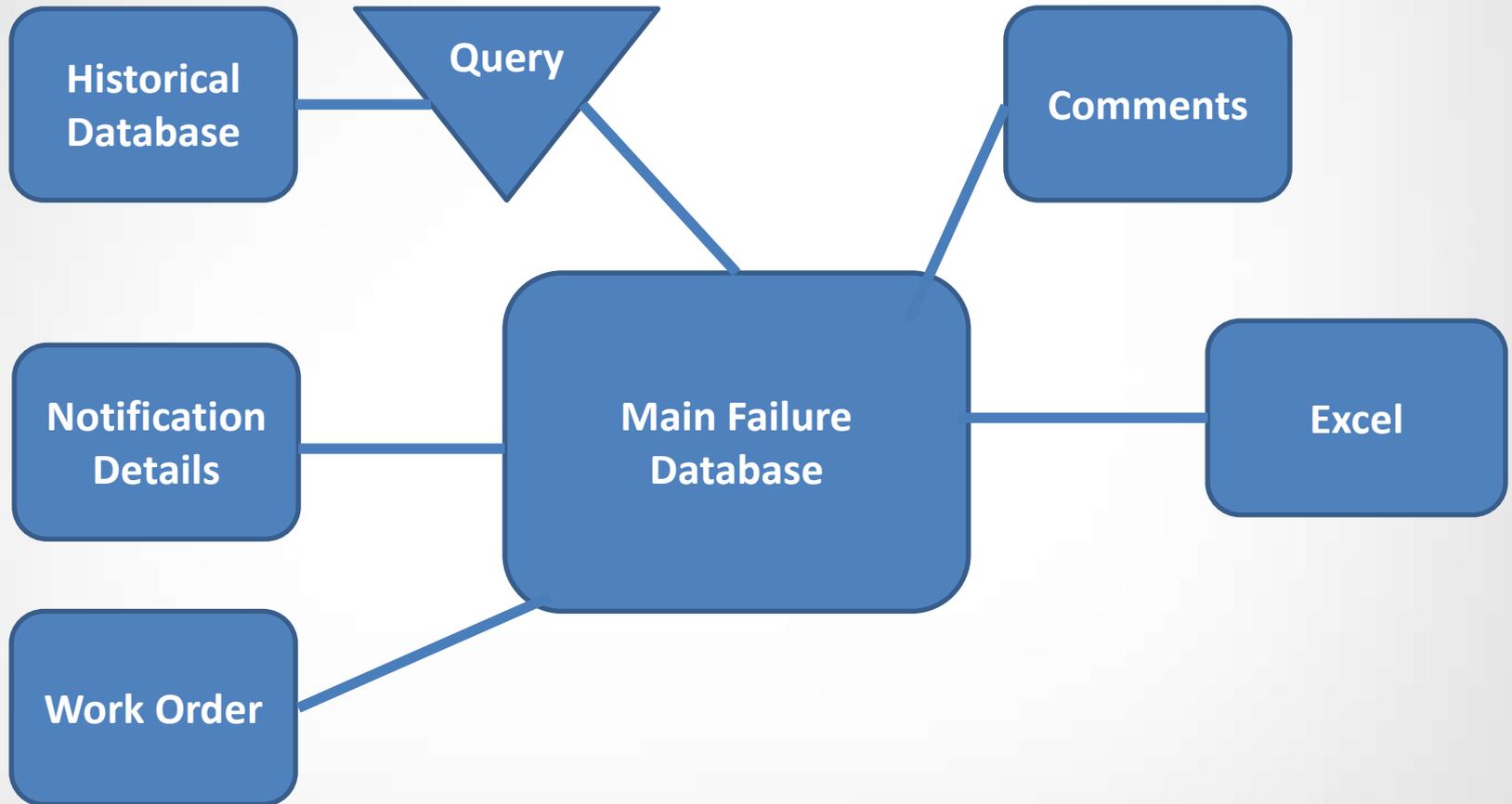
EASILY UPDATEABLE

SEARCHABLE

REPORTABLE



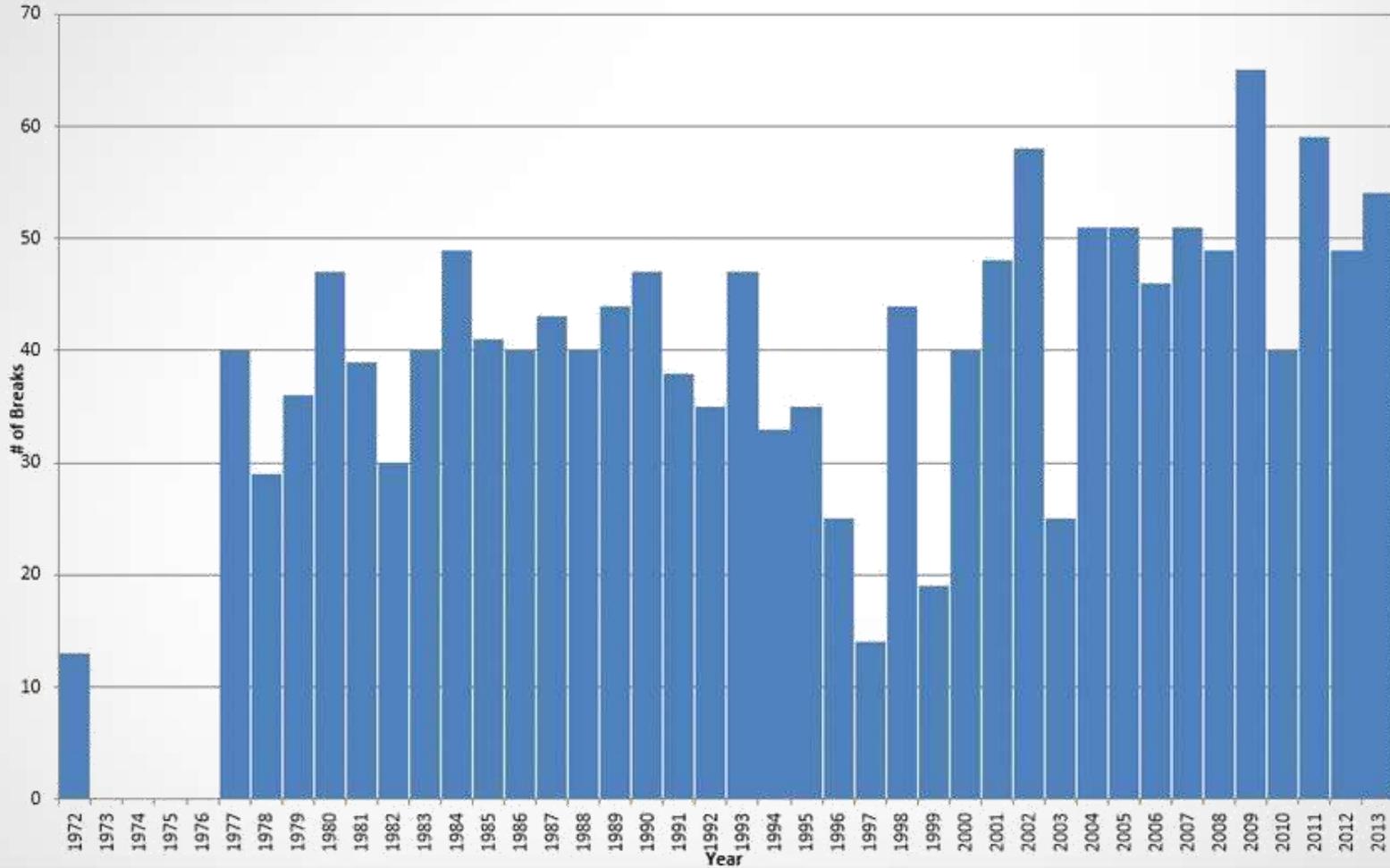
DATABASE DIAGRAM





BREAKS BY YEAR

of Breaks per Year

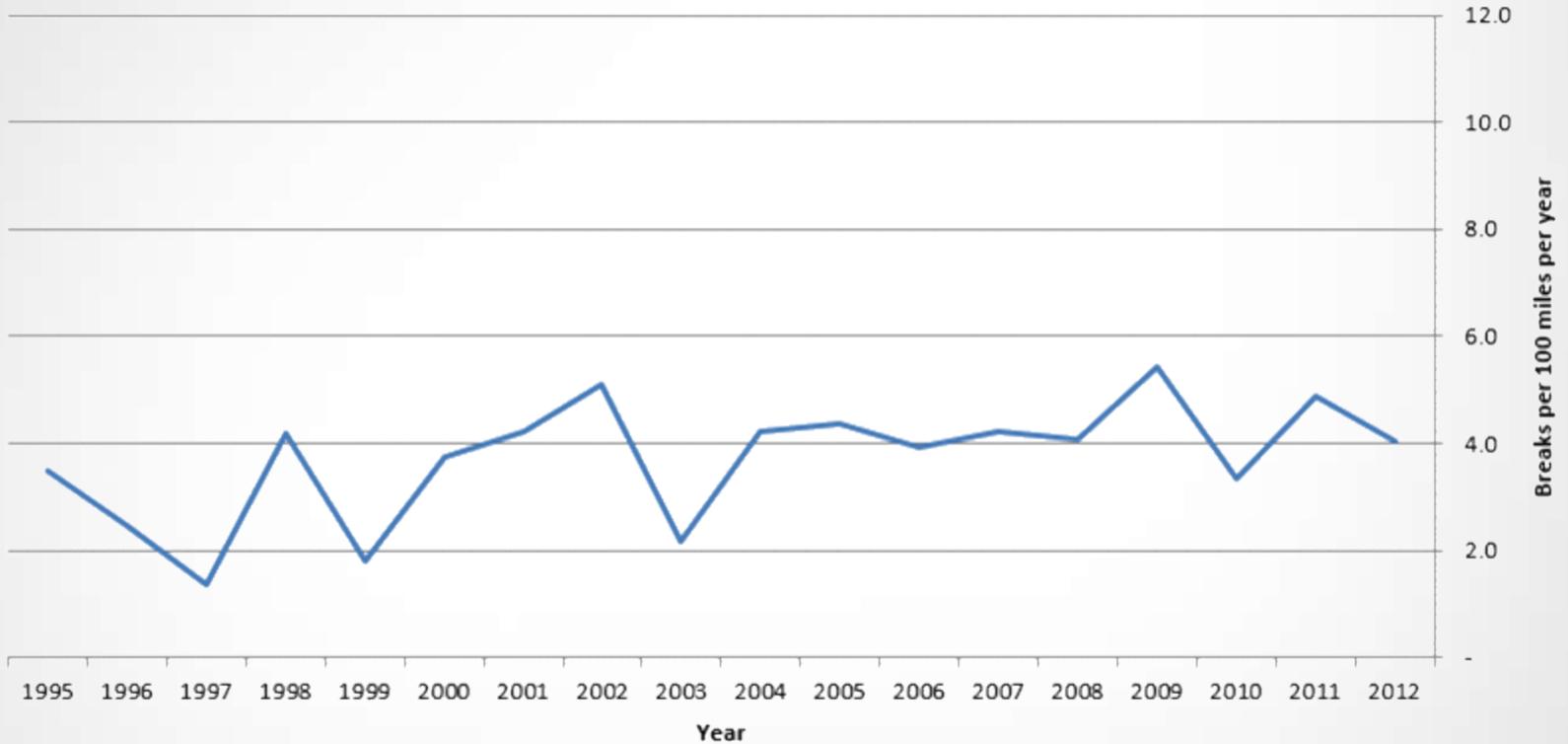




BREAK RATES

Chart Area

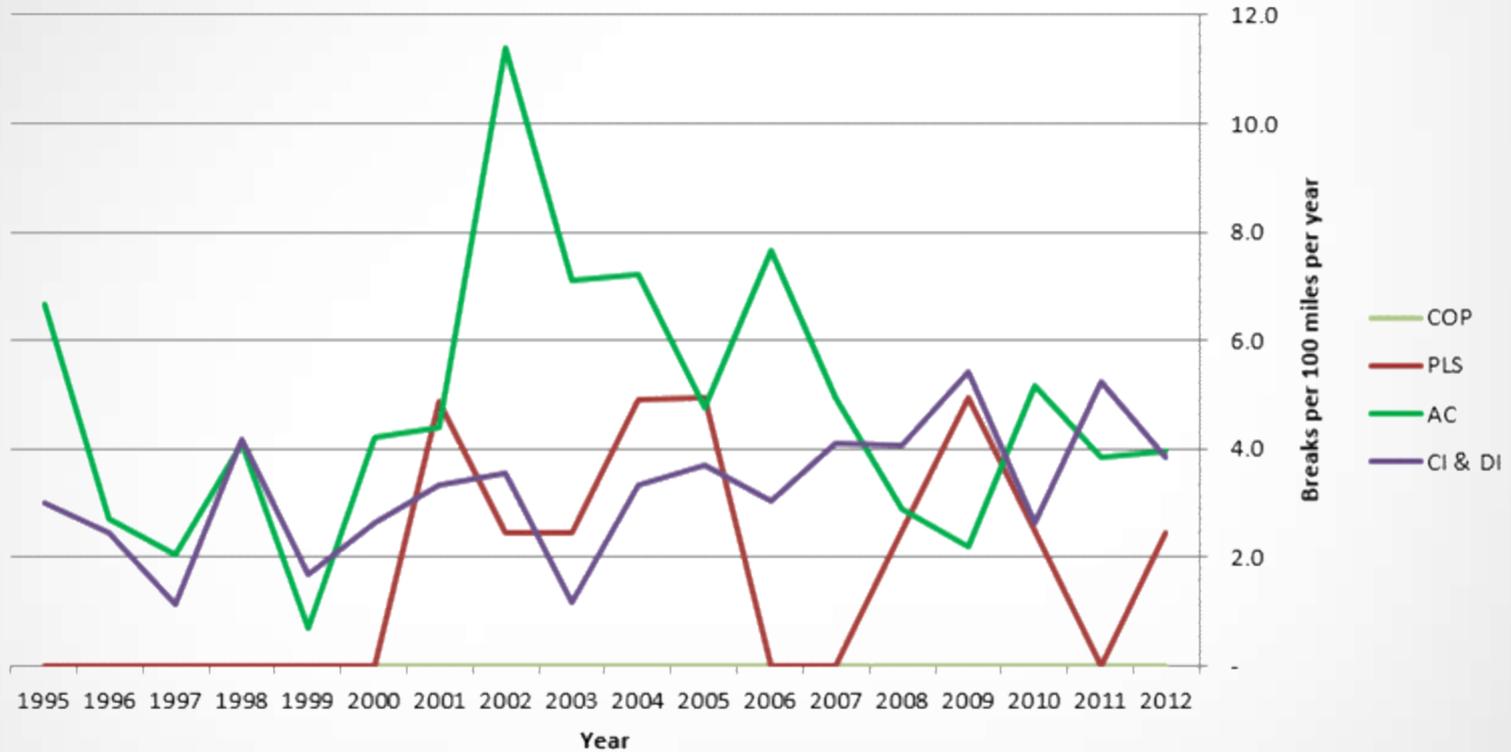
Breaks Per 100 Miles Per Year (Entire System)





BREAK RATES

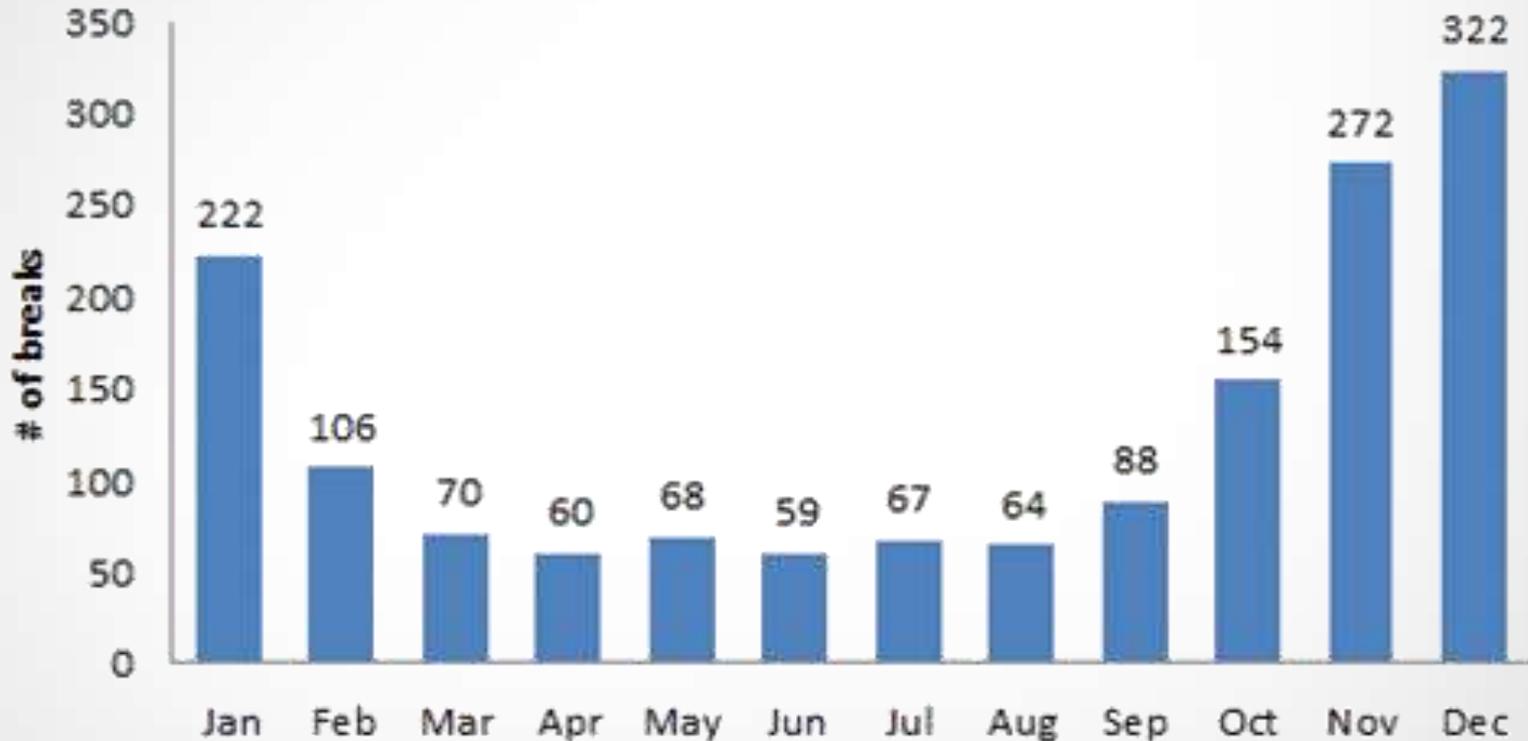
Breaks Per 100 Miles Per Year (by Material Type)





BREAKS BY MONTH

Distribution of Breaks By Month





BREAKS BY MATERIAL BY MONTH

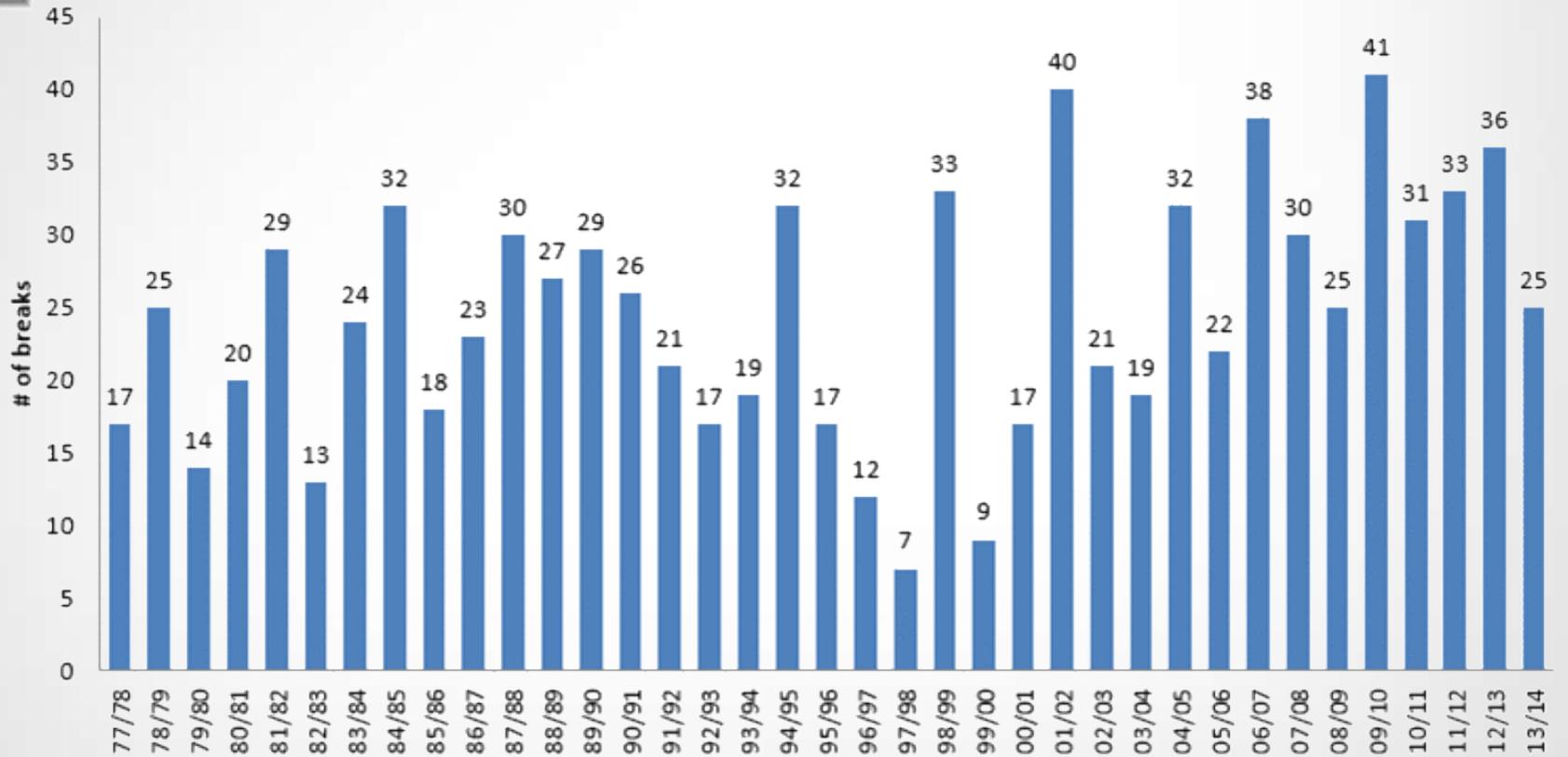
Month	Count	CI	CI WW2	CI OLD	AC	GLV	STL	DI	PLS	Unknown
1 Jan	222	14	130	39	27	4	0	5	2	1
2 Feb	106	8	58	13	22	2	0	3	0	0
3 Mar	70	3	20	7	31	4	2	2	1	0
4 Apr	60	3	16	6	20	9	1	3	2	0
5 May	68	3	21	13	28	2	0	0	1	0
6 Jun	59	3	14	14	19	4	0	1	3	1
7 Jul	67	4	20	10	22	7	1	2	1	0
8 Aug	64	5	12	8	22	10	1	1	3	2
9 Sep	88	6	23	9	38	5	2	3	1	1
10 Oct	154	9	79	12	41	6	2	0	3	1
11 Nov	272	18	179	30	37	5	1	1	1	0
12 Dec	322	22	208	63	16	8	0	5	0	0



WINTERTIME BREAK RATES

Chart Area

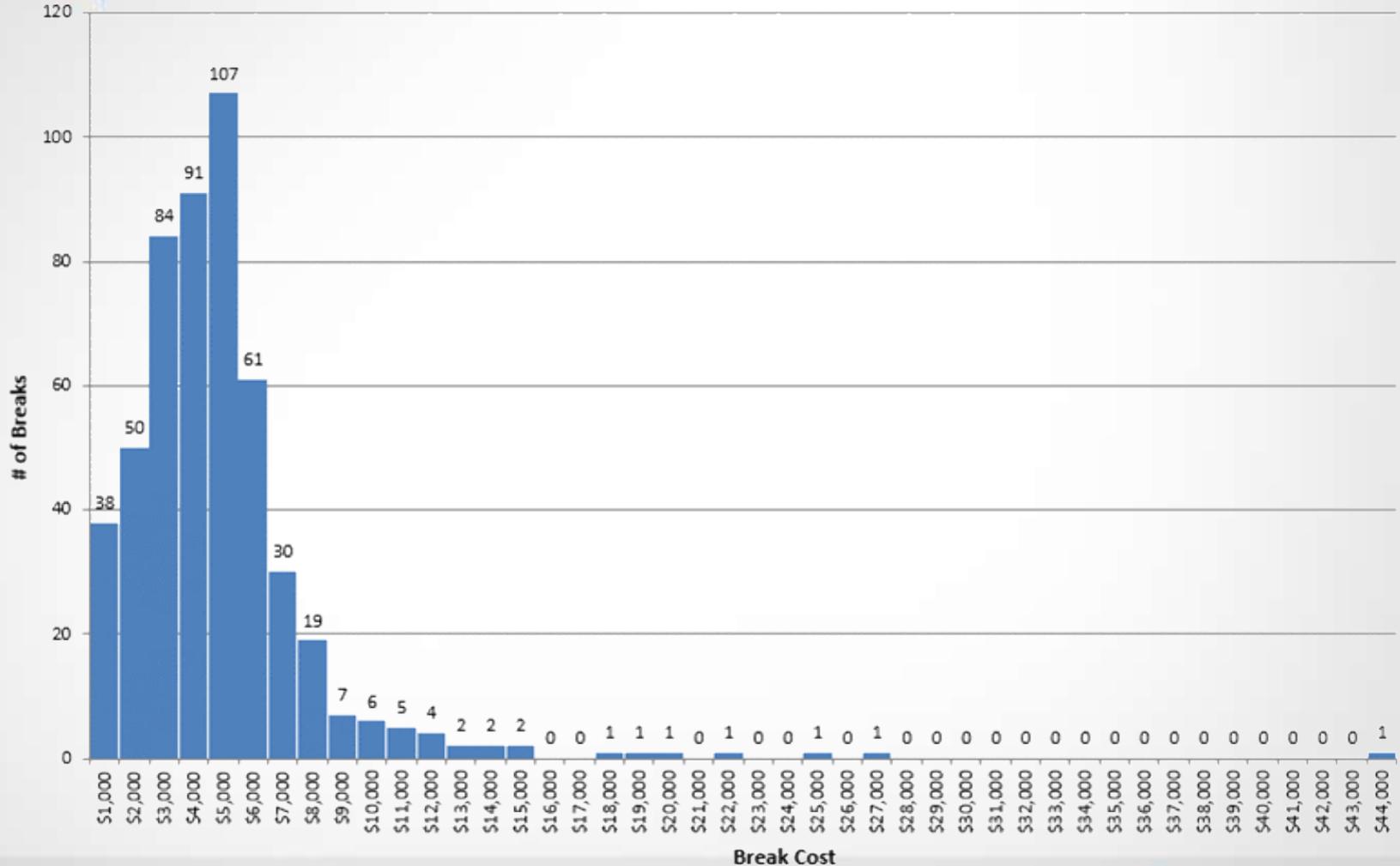
Winter Breaks By Year (Nov-Dec-Jan-Feb)





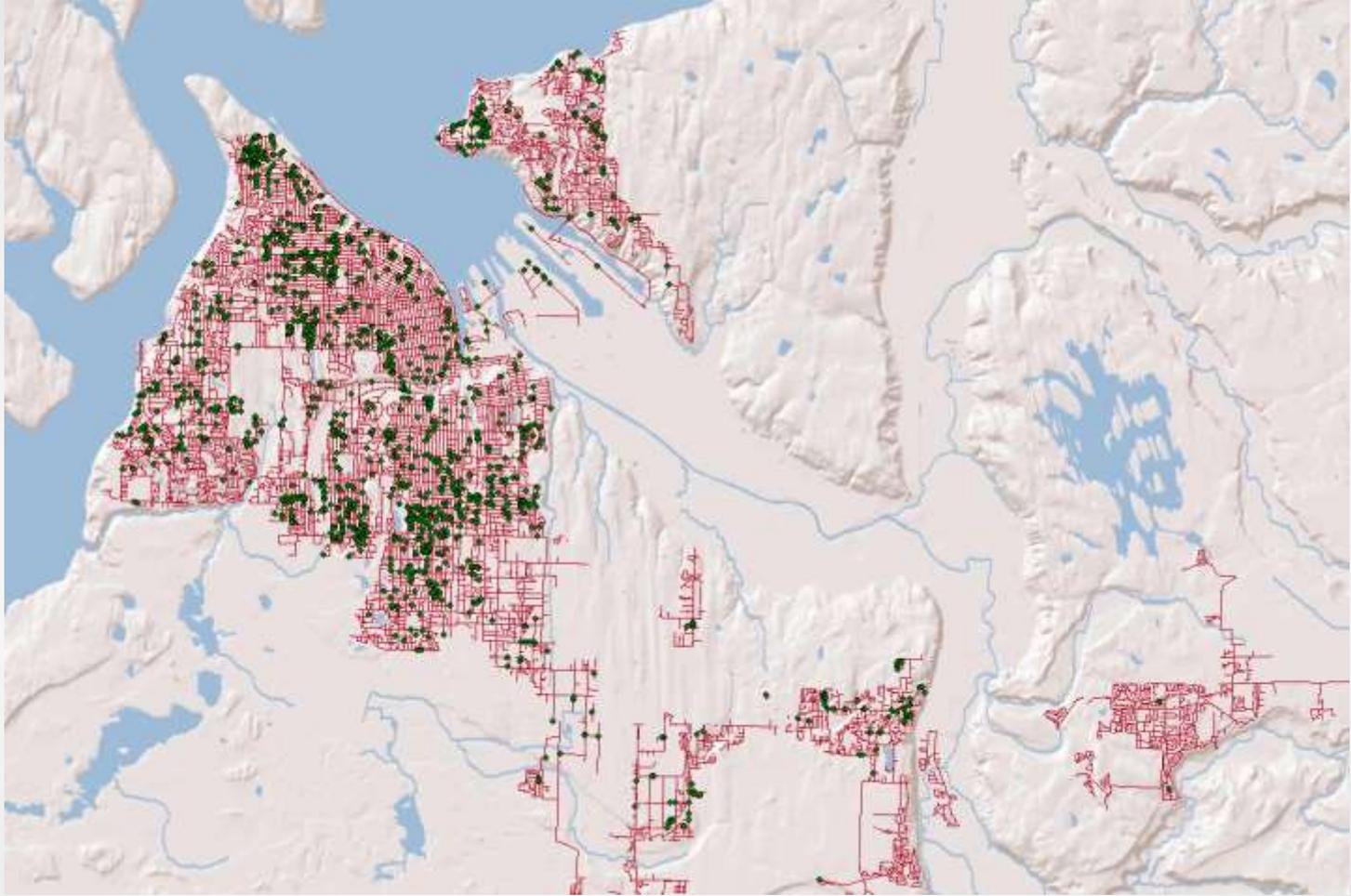
COST DISTRIBUTION OF FAILURES

Break Cost Distribution





INTEGRATION WITH GIS





DISTRIBUTION SYSTEM SUMMARY

- **OVERALL LOW BREAK RATE**
- **FAIRLY NON-CORROSIVE SOILS**
- **STABLE SOILS**
- **MAINS ARE IN OVERALL GOOD HEALTH**
- **CONCERN ABOUT AC AND CI MAINS; NEED TO MANAGE THESE EFFECTIVELY**



ECONOMIC MODELS

BUILT USING MS EXCEL AND MS ACCESS

HIGHLY CUSTOMIZABLE

WHAT IS THE RISK OF NOT REPLACING AN ASSET?

**WHAT IS THE HIDDEN COST OF EARLY
REPLACEMENT?**

DETERMINE ECONOMIC END OF LIFE



ECONOMIC MODEL – SINGLE ASSET

DISTRIBUTION MAINS
RELOAD ASSET
SAVE ASSET

DEMOGRAPHICS	
Asset ID	Main-3822
C FID	3822
Pipe diameter	6
Project id	Unk Unk
Installation year	9999
Pipe length	109
Pipe class	Unk
Location	
Pavement type	
Road type	
Effective age	52

INTERVENTIONS	
Existing material code	ACP
Existing material	AC
Replacement type	DI
Replacement cost, base	\$15,260
Replacement cost, total	\$23,435

ADDITIONAL DEMOGRAPHICS	
Joint type	Unk
Sap id	
Zoning code	
Zoning description	

CRITICAL AREAS	
Bridge crossing	No
Highway crossing	Yes
Railroad crossing	No
Contaminated soils	Yes
Environmental issues	No
Erosion	No
Property damage	Yes

RESULTS	
Age at replacement	76
Years To replacement	24
Year of replacement	2036
Benefit/cost ratio	
Lifecycle cost of new asset	\$1,065
Net benefit of replacement	-\$20,036
Assumed data?	YES
Lifecycle of new asset	200

PROBABILITY OF FAILURE	
Breaks by project mile	0.4
Abnormal breaks per mile	No
Existing multiplier	1.1
Replacement multiplier	1.1
Probability of failure	2.1%

CONSEQUENCE OF FAILURE EXISTING	
ERUs affected	
ERUs assumed	4.36
Minor leak or break	\$10,480
Major leak or break	\$9,674
Catastrophic break	\$3,329
Consequence of failure	\$23,484

RISK COST	
Near-term Risk	\$492

DATA FROM GIS & SAP (PM SYSTEM)

EVALUATE EACH SEGMENT INDIVIDUALLY

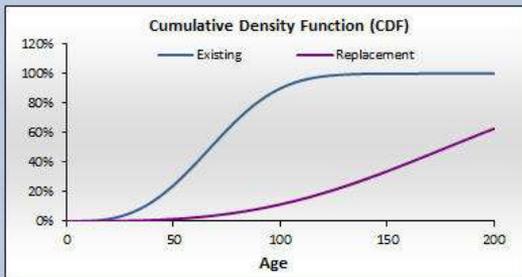
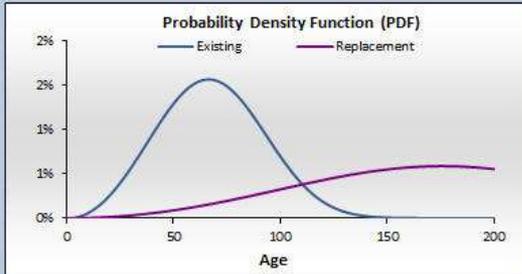
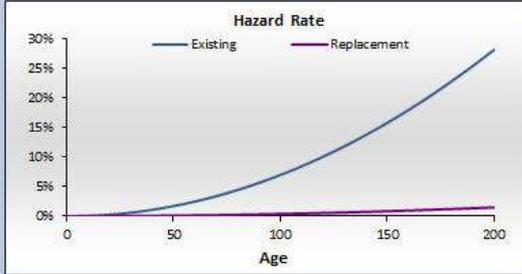
COMPARE ANNUAL RISK TO REPLACEMENT COST



LIKELIHOOD

PROBABILITY OF FAILURE

Age	EXISTING	REPLACEMENT
	AC	DI
Shape	3.00	3.00
Scale	75.00	200.00
0	0.00%	0.00%
1	0.00%	0.00%
2	0.00%	0.00%
3	0.01%	0.00%
4	0.01%	0.00%
5	0.02%	0.00%
6	0.03%	0.00%
7	0.03%	0.00%
8	0.05%	0.00%
9	0.06%	0.00%
10	0.07%	0.00%
11	0.09%	0.00%
12	0.10%	0.01%
13	0.12%	0.01%
14	0.14%	0.01%
15	0.16%	0.01%
16	0.18%	0.01%
17	0.21%	0.01%
18	0.23%	0.01%
19	0.26%	0.01%
20	0.28%	0.02%
21	0.31%	0.02%
22	0.34%	0.02%
23	0.38%	0.02%
24	0.41%	0.02%
25	0.44%	0.02%
26	0.48%	0.03%
27	0.52%	0.03%
28	0.56%	0.03%
29	0.60%	0.03%
30	0.64%	0.03%
31	0.68%	0.04%
32	0.73%	0.04%
33	0.77%	0.04%
34	0.82%	0.04%



EXISTING TYPE	SHAPE	SCALE
AC	3.0	75.0
BRS	3.0	75.0
CI OLD	3.0	200.0
CI WW2	3.0	75.0
CO	3.0	100.0
DI	3.0	200.0
GLV	3.0	50.0
PLS	3.0	100.0
PLY	3.0	100.0
STL	3.0	100.0

**WEIBULL
DISTRIBUTION
CURVES**

**BASED ON
INDUSTRY
STANDARDS AND
HISTORICAL DATA**

**THESE CURVES
OVERESTIMATE
OUR ACTUAL
NUMBER OF
FAILURES**



CONSEQUENCE

CONSEQUENCES OF FAILURE

Existing Failure Scenario Tree

EXISTING CONSEQUENCE COST BREAKDOWN

Direct consequence cost	\$5,412
Indirect consequence cost	\$18,072
Total consequence cost	\$23,484

Scenario 1: Minor leak or break

Pipe develops a minor leak.

Requires replacement	No	ERUs affected	4.36
Repair cost	\$5,000	Outage duration	4.0
Percent rejuvenation	0%	Outage cost	\$436
Direct associated cost	\$0	Weighted total cost	\$10,480
Indirect cost	\$8,000		

Scenario 2: Major leak or break

Pipe has a major leak. Duration of service interruption is extended and there are possible flooding impacts.

Requires replacement	No	ERUs affected	4.36
Repair cost	\$5,000	Outage duration	8.0
Percent rejuvenation	0%	Outage cost	\$872
Direct associated cost	\$0	Weighted total cost	\$9,674
Indirect cost	\$42,500		

Scenario 3: Catastrophic break

Requires replacement	No	ERUs affected	4.36
Repair cost	\$5,000	Outage duration	8.0
Percent rejuvenation	0%	Outage cost	\$872
Direct associated cost	\$20,600	Weighted total cost	\$3,329
Indirect cost	\$140,000		

WEIGHTED AVERAGE
FOR FAILURE COSTS



CUSTOMIZE

CRITICAL AREA ADDITIONAL COSTS				
MINOR SCENARIO				
CRITICAL AREA	REPAIR	ASSOCIATED	INDIRECT	TOTAL
Bridge crossing	\$1,500	\$0	\$0	\$1,500
Highway crossing	\$1,000	\$0	\$0	\$1,000
Railroad crossing	\$0	\$0	\$0	\$0
Contaminated soils	\$7,000	\$0	\$0	\$7,000
Environmental issues	\$5,000	\$0	\$0	\$5,000
Erosion	\$1,000	\$0	\$0	\$1,000
Property damage	\$0	\$0	\$0	\$0
MAJOR SCENARIO				
CRITICAL AREA	REPAIR	ASSOCIATED	INDIRECT	TOTAL
Bridge crossing	\$20,000	\$0	\$0	\$20,000
Highway crossing	\$5,000	\$0	\$0	\$5,000
Railroad crossing	\$0	\$0	\$0	\$0
Contaminated soils	\$30,000	\$0	\$0	\$30,000
Environmental issues	\$10,000	\$0	\$0	\$10,000
Erosion	\$10,000	\$0	\$0	\$10,000
Property damage	\$7,500	\$0	\$0	\$7,500
CATASTROPHIC SCENARIO				
CRITICAL AREA	REPAIR	ASSOCIATED	INDIRECT	TOTAL
Bridge crossing	\$130,000	\$0	\$0	\$130,000
Highway crossing	\$30,000	\$0	\$0	\$30,000
Railroad crossing	\$0	\$0	\$0	\$0
Contaminated soils	\$30,000	\$0	\$0	\$30,000
Environmental issues	\$20,000	\$0	\$0	\$20,000
Erosion	\$80,000	\$0	\$0	\$80,000
Property damage	\$80,000	\$0	\$0	\$80,000

ACCOUNT FOR AREAS OF HIGHER CONSEQUENCE

CUSTOMIZE DEPENDING ON TYPE OF CONSEQUENCE



CUSTOMIZE

**CUSTOMIZE
TABLES TO
PROVIDE
GRANULAR
ANALYSIS BASED
ON AVAILABLE
DATA**

Lookups

ZONING CODE	ERU's per 100'	ZONING DESCRIPTION
C1	40	COMMERCIAL DISTRICT
C1	40	COMMERCIAL DISTRICT
C2	40	COMMERCIAL DISTRICT
CCX	40	COMMUNITY COMMERCIAL MIXED USE DISTRICT
CIX	40	COMMERCIAL INDUSTRIAL MIXED USE DISTRICT
DCC	40	DOWNTOWN COMMERCIAL CORE
DMU	4	DOWNTOWN MIXED USE
DR	4	DOWNTOWN RESIDENTIAL
HM	4	
HMR-SRD	4	
HMX	4	
M1	40	LIGHT INDUSTRIAL DISTRICT
M2	40	HEAVY INDUSTRIAL DISTRICT
NCX	40	NEIGHBORHOOD COMMERCIAL MIXED USE DISTRICT
NRX	4	
PDB	40	PLANNED BUSINESS DEVELOPMENT DISTRICT
PMI	40	PORT MARITIME AND INDUSTRIAL
R1	4	ONE FAMILY DWELLING DISTRICT
R2	4	ONE FAMILY DWELLING DISTRICT
R2-SRD	4	
R3	4	TWO FAMILY DWELLING DISTRICT
R4	8	MULTIPLE-FAMILY DWELLING DISTRICT
R4L	4	LOW DENSITY MULTIPLE-FAMILY DWELLING DIST.
R5	4	MULTIPLE-FAMILY DWELLING DISTRICT
RCX	4	RESIDENTIAL COMMERCIAL MIXED USE DISTRICT
RUS	4	RUSTON
S1	4	WATER
S10	4	WATER
S11	4	WATER
S12	4	WATER
S14	4	WATER
S2	4	WATER
S6	4	WATER
S7	4	WATER
S8	4	WATER
S9	4	WATER
T	4	RESIDENTIAL COMMERCIAL TRANSITIONAL DISTRICT
UCX	15	URBAN CENTER MIXED USE DISTRICT
UCX-TD	4	
URX	4	
WR	4	WAREHOUSE/RESIDENTIAL

PIPE DESCRIPTIONS	
CODE	DESCRIPTION
ACP	AC
BRS	BRS
CIP	CI
COP	CO
DIP	DI
GLV	GLV
PLS	PLS
PLY	PLY
STL	STL

ROAD TYPE MULTIPLIERS	
ROAD TYPE	MULTIPLIER
Highway	200%
Arterial	120%
Unknown	100%
Residential	100%

ASSUMED INSTALLATION	
EXISTING TYPE	YEAR
ACP	1960
BRS	1990
CIP	1945
COP	1990
DIP	1995
GLV	1960
PLS	1970
PLY	1970
STL	1965

CI TYPE		
CAST IRON TYPE	YEAR RANGE	
CI OLD	1890	1944
WW2	1945	1959
CI	1960	1975



WHEN TO REPLACE?

DISTRIBUTION MAINS		RELOAD ASSET	SAVE ASSET
DEMOGRAPHICS			
Asset ID	Main-3822		
C FID	3822		
Pipe diameter	6		
Project id	Unk Unk		
Installation year	9999		
Pipe length	109		
Pipe class	Unk		
Location			
Pavement type			
Road type			
Effective age	52		
INTERVENTIONS			
Existing material code	ACP		
Existing material	AC		
Replacement type	DI		
Replacement cost, base	\$15,260		
Replacement cost, total	\$23,435		
ADDITIONAL DEMOGRAPHICS			
Joint type	Unk		
Sap id			
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Zoning description			
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RISK COST			
Near-term Risk	\$492		

**DETERMINE
REPLACEMENT TIMING
AND COST**

**UNDERSTAND
ECONOMIC DRIVERS
FOR REPLACEMENT**



CUSTOMIZE

INTERVENTIONS

PLANNED INTERVENTION: REPLACEMENT	
Existing type code	ACP
Existing type material	AC
Replacement type	DI
Replacement cost	\$23,435

REACTIVE INTERVENTION	
Emergency premium increase	10%
Emergency premium cost	\$2,344

REPLACEMENT SIZE	
EXISTING SIZE	REPLACE SIZE
1	4
2	4
3	4
4	6
6	8
8	8
10	10
12	12
14	16
16	16
18	20
20	20
22	24
24	24
30	30
36	30

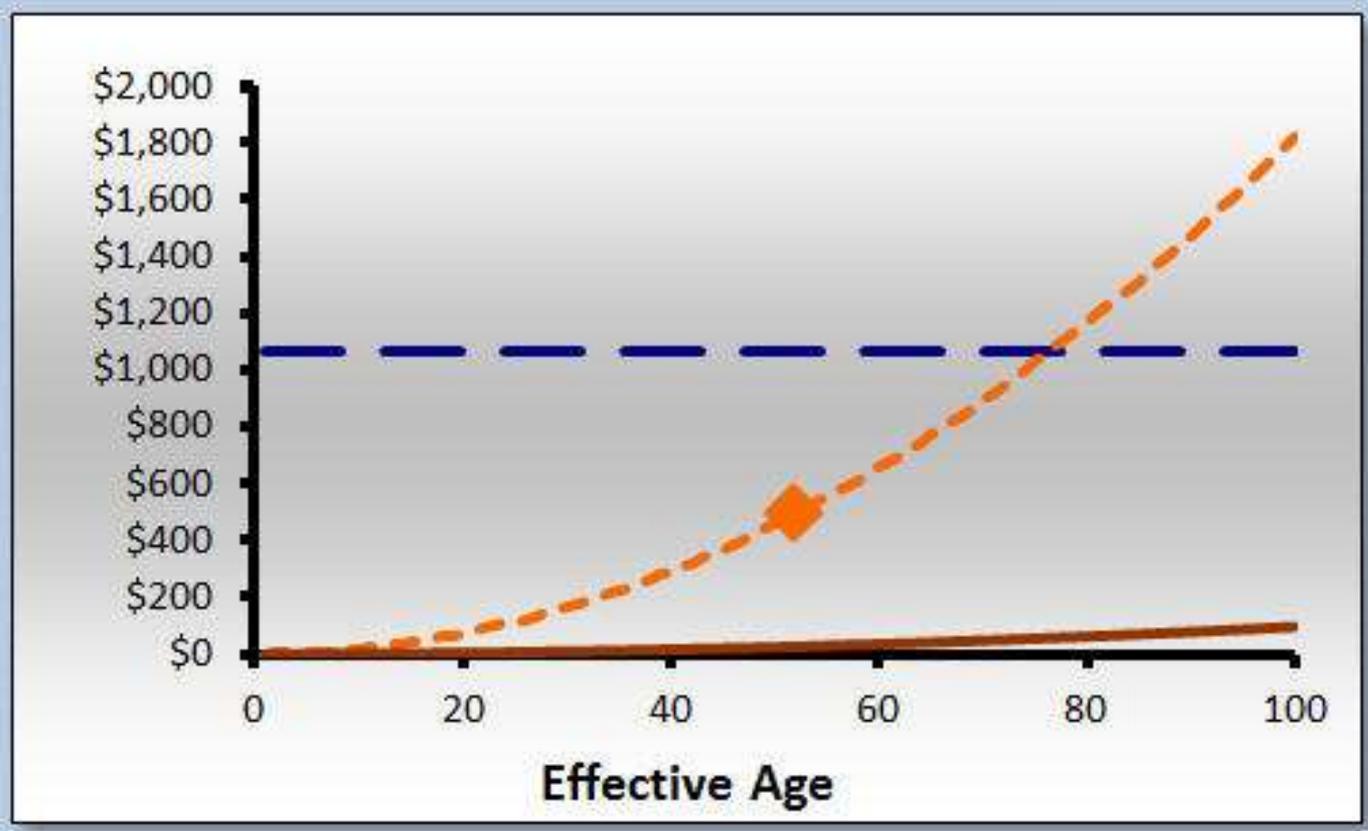
REPLACEMENT COST		PAVEMENT RESTORATION COST						
SIZE	Materials and Labor	Asphalt Concrete Pavement	Asphalt Over Portland Cement	Bituminous Surface Oilmat	Brick	Cobble Stone	Gravel	Portland Cement Concrete
4	\$80	\$75	\$115	\$65	\$120	\$175	\$25	\$150
6	\$130	\$75	\$115	\$65	\$120	\$175	\$25	\$150
8	\$140	\$75	\$115	\$65	\$120	\$175	\$25	\$150
10	\$205	\$75	\$115	\$65	\$120	\$175	\$25	\$150
12	\$200	\$75	\$115	\$65	\$140	\$220	\$30	\$150
16	\$315	\$75	\$115	\$65	\$140	\$220	\$30	\$150
20	\$415	\$75	\$115	\$65	\$140	\$220	\$40	\$150
24	\$450	\$75	\$115	\$65	\$165	\$265	\$40	\$150
30	\$700	\$75	\$115	\$65	\$165	\$265	\$40	\$150

INTERVENTION MATRIX				
EXISTING TYPE	REPLACE TYPE	REFURB TYPE	REFURB COST	REFURB EFFECT
AC	DI			
BRS	DI			
CI	DI			
CI OLD	DI			
CI WW2	DI			
CO	DI			
DI	DI			
GLV	DI			
PLS	DI			
PLY	DI			
STL	DI			
UNKNOWN	DI			



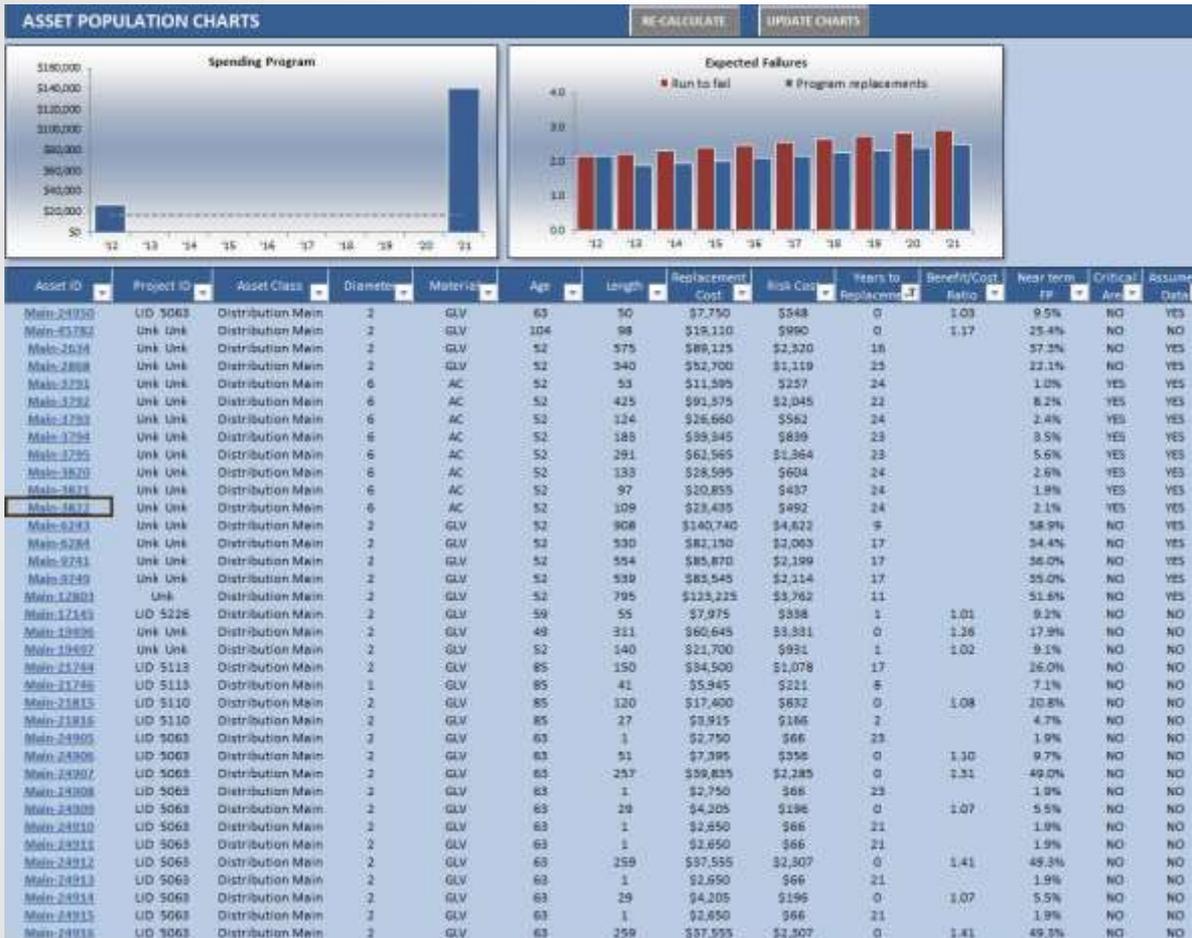


OPTIMAL REPLACEMENT TIMING





RESULTS – ENTIRE POPULATION



DISPLAY RESULTS

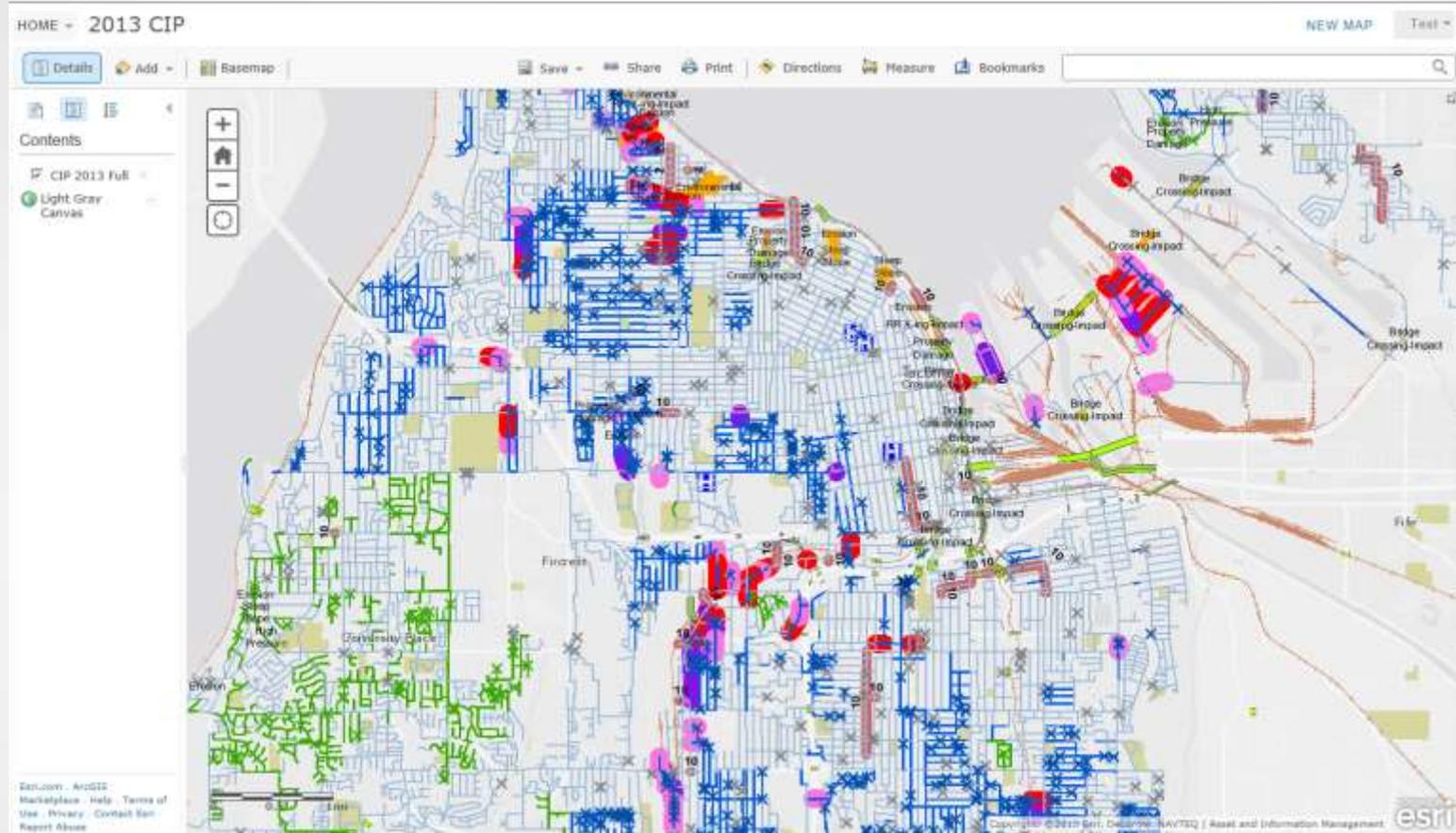
QC OUTPUTS WITH SME'S

ADJUSTMENT

RINSE AND REPEAT



DYNAMIC MAPPING VIA GIS





NEXT ITERATION

IMPROVED FUNCTIONALITY WITH GIS

IMPROVED DATA

DECENTRALIZE CAPABILITY

MOVE EASILY BETWEEN GIS AND MODEL

MODEL FOR TRANSMISSION MAINS



BIG TAKEAWAYS

**NEVER UNDERESTIMATE THE POWER OF
ITERATING YOUR WAY TO PERFECTION**

PLAN, PLAN, PLAN!

BUILD AND INVEST IN RELATIONSHIPS

PATIENCE!



ALMOST BREAK TIME!

QUESTIONS?



HOW DO WE MAINTAIN THE STUFF WE CAN SEE?





CHANGING OUR PHILOSOPHY

SHIFT MAINTENANCE FOCUS FROM

KEEPING EQUIPMENT RUNNING/OPERATING

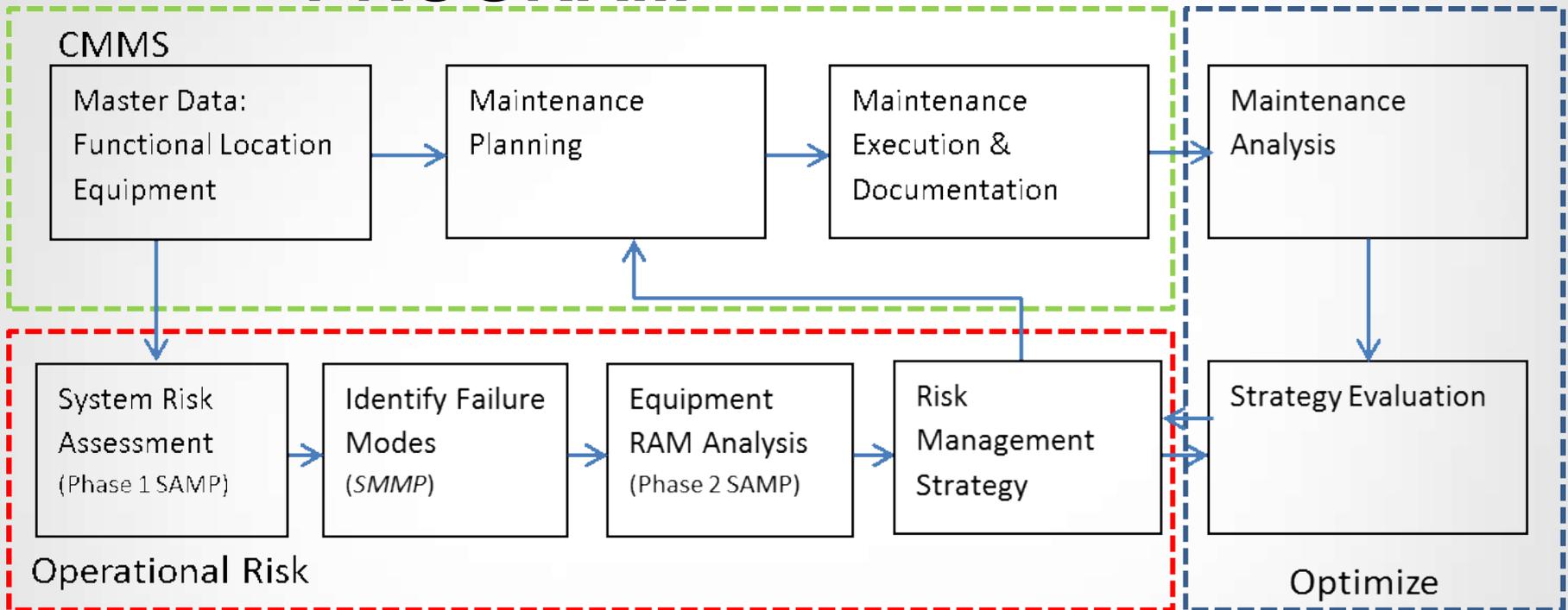
TO

**PRESERVING SYSTEM
FUNCTIONALITY/RELIABILITY**

MORE PLANNING & SCHEDULING OF WORK



TACOMA WATER'S STRATEGIC MAINTENANCE MANAGEMENT PROGRAM



SAMP: Strategic Asset Management Plan

SMMP: Strategic Maintenance Management Program

RAM: Reliability, Availability, Maintainability



EQUIPMENT TAXONOMY

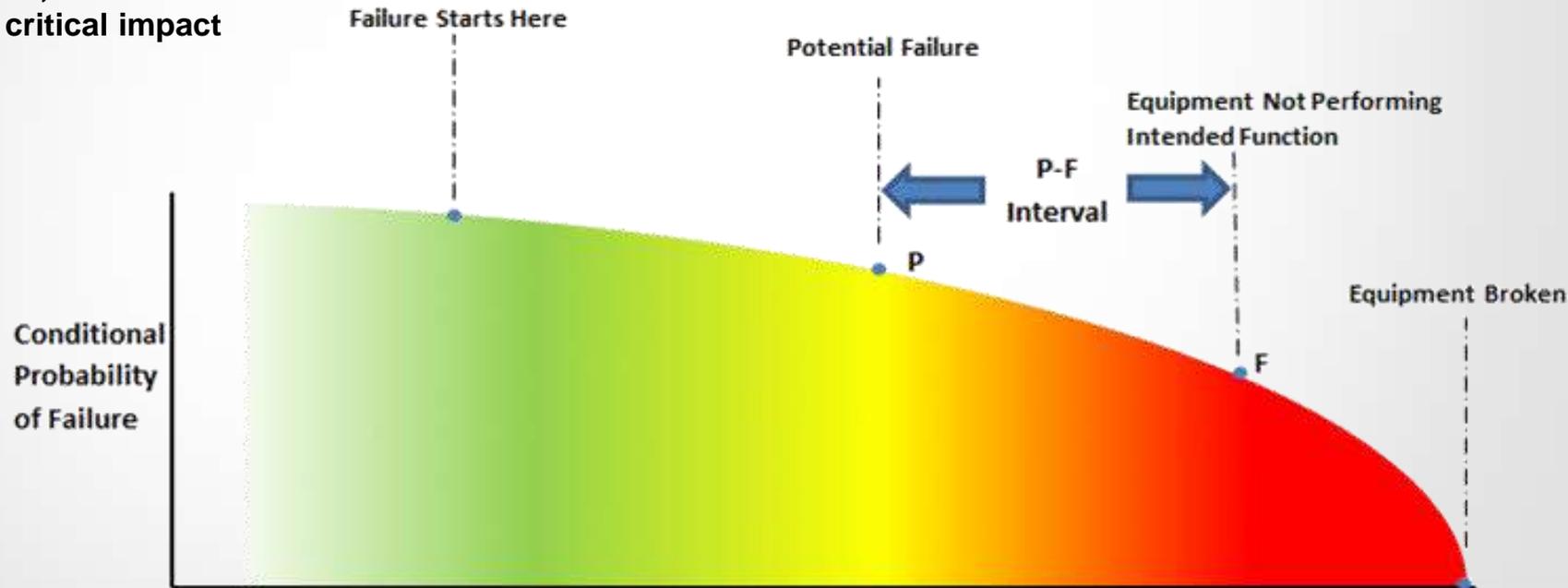
Main Category	Taxonomy Level	Taxonomy Hierarchy	Example
Use/Location Data	1	Industry	Water
	2	Process	Source, Distribution, Treatment, Pumping, Transmission
	3	Facility	Booster Pump Station, Well, Treatment Facility, Solids Handling, Intake
	4	Plant/Unit Category	Chemical Building, Filter Gallery, Pump Station, PRV Station
	5	Section/System	Chemical Injection,
Equipment Subdivision	6	Equipment (Class/Unit)	Pump, Piping, Motor, PRV
	7	Sub-Unit (Necessary for the equipment unit to function)	Lubrication, Cooling, Heating, Control and Monitoring
	8	Component/ Maintainable Item	Coupling, Gearbox, Lubrication Pump, Pressure Sensor, Filter
	9	Part	Impeller, Gasket, Filter, Seal, Nut, Bolt



DEFINING FAILURE

THREE TYPES OF FAILURES

- 1) Desired function not obtained
- 2) Function outside acceptable operational limits
- 3) Failure indication is observed, but no immediate and/or critical impact





EXAMPLE OF FAILURE MODES

- ▷ TW70 Malfunction Report: Blowers/Fans
- ▷ TW71 Malfunction Report: Combustion Engine
- ▷ TW72 Malfunction Report: Compressor
- ▷ TW73 Malfunction Report: Electrical Motor
- ▷ TW74 Malfunction Report: Electrical Generator
- ▷ TW75 Malfunction Report: Pump
- ▷ TW76 Malfunction Report: Crane
- ▷ TW77 Malfunction Report: Filter/Strainer
- ▷ TW78 Malfunction Report: Heat Exchanger
- ▷ TW79 Malfunction Report: Hydraulics
- ▷ TW80 Malfunction Report: Nozzle
- ▷ TW81 Malfunction Report: Piping
- ▷ TW82 Malfunction Report: Storage Tank
- ▷ TW83 Malfunction Report: Valve
- ▷ TW84 Malfunction Report: Load Panel
- ▷ TW85 Malfunction Report: UPS
- ▷ TW86 Malfunction Report: Analyzers
- ▷ TW87 Malfunction Report: Control Logic
- ▷ TW88 Malfunction Report: Instrumentation
- ▷ TW89 Malfunction Report: Rectifier
- ▷ TW90 Malfunction Report: Transformer

The screenshot shows a 'Catalog Selection' window with a tree view. The root node is 'TW73 Malfunction Report: Electrical Motor'. It has 12 sub-items: 101 Fail to Start on Demand, 102 Fail to Stop on Demand, 103 Breakdown, 201 False Stop, 202 High Output, 203 Low Output, 204 Erratic Output, 305 Vibration, 306 Noise, 307 Overheating, 309 Parameter Deviation, 310 Abnormal Instrument Reading, 311 Structural Deficiency, and 312 Minor In-Service Problem. Below this are two more main categories: 'TW74 Malfunction Report: Electrical Generator' and 'TW75 Malfunction Report: Pump'. The 'TW75' category has 8 sub-items: 101 Fail to Start on Demand, 103 Breakdown, 201 False Stop, 202 High Output, 203 Low Output, 204 Erratic Output, 301 External Leakage - Process Medium, 302 External Leakage - Utility Medium, and 304 Internal Leakage. At the bottom of the window are three buttons: 'Choose' (with a checkmark), a folder icon, and a close icon (X).



REACTIVE VS. PROACTIVE

Maintenance Planning

Before Failure

After Failure

Pro-active Maintenance

All activities done to Prevent or Find Failures

Reactive Maintenance

All activities done to correct a failure

Preventive - Time Based

Predictive - Condition Based

Corrective Maintenance

Can be executed in four different ways

Planned & Scheduled

What, How, How Long, Who & When

Planned Only

What, How & How Long

Scheduled Only

Who & When

Break-in Work

Know nothing

- Lubrication
- Alignment
- Filtration
- Balancing
- Cleaning
- Operating Practices
- Programmed Replacements
- Overhauls

Basic Inspection

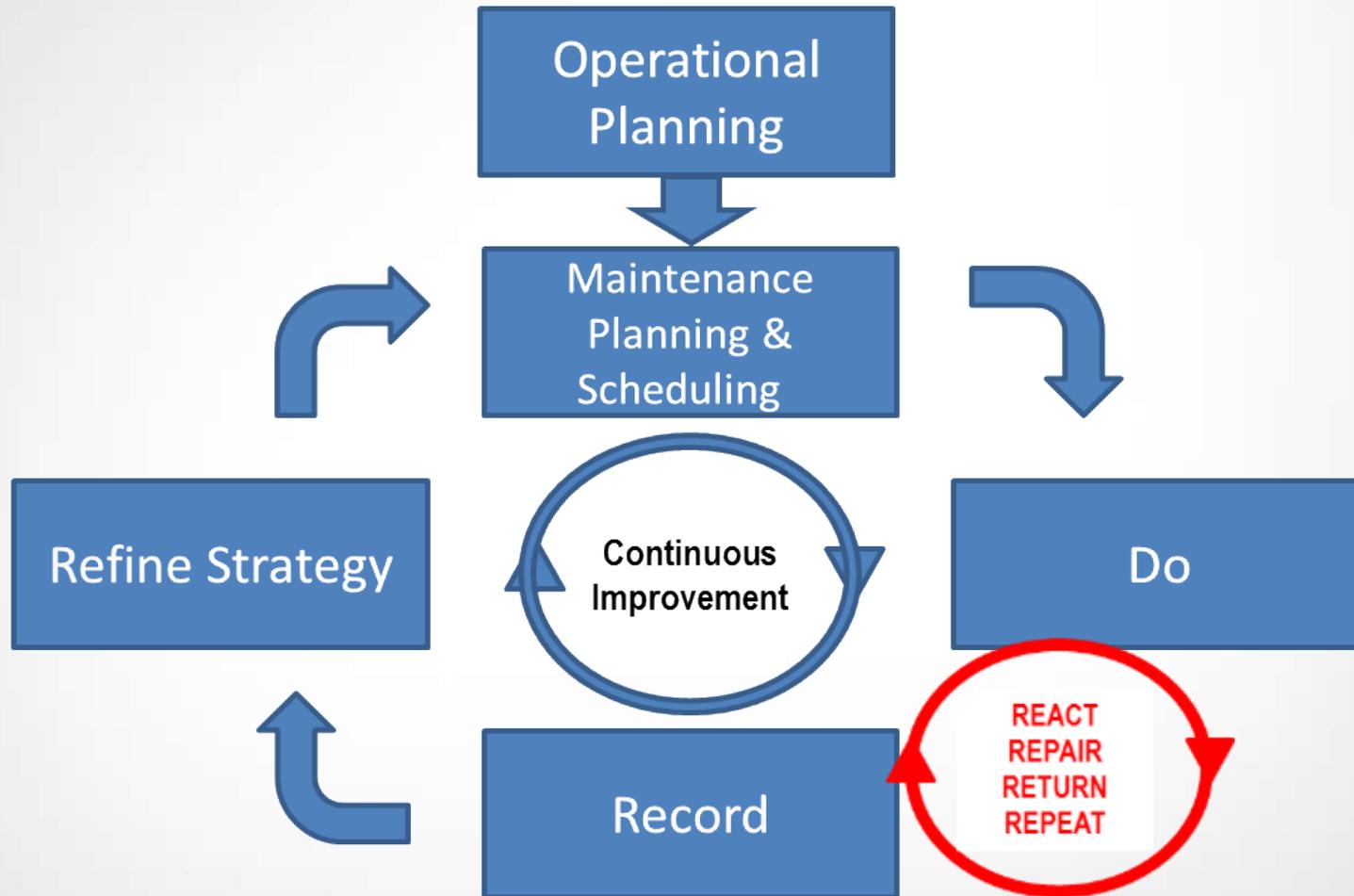
- Look
- Listen
- Smell
- Touch
- Don't Taste

Technologies

- IR analysis
- Vibration analysis
- Oil analysis



CONTINUOUS IMPROVEMENT





PLANNING vs. SCHEDULING

PLANNING IS:

WHAT: TOOLS, CLASSIFICATIONS NEEDED, MATERIALS, PPE, EQUIPMENT NEEDED, TRAFFIC CONTROL, PERMITS, LOCKOUT/ TAGOUT PROCEDURE, ETC.

HOW: PROCEDURES, CHECK LIST, SEQUENTIAL STEPS

HOW LONG: ESTIMATED TIME OF COMPLETION

SCHEDULING IS:

WHO: SPECIFIC PERSONNEL

WHEN: START DATES/ END DATES



EXAMPLE OF INSPECTION PLAN



Figure 6

6. Left side of engine.
 - a. Check oil and log on Weekly Genset Chart.
 - i. Service if needed
 - b. Check belts.
 - i. For looseness.
 - ii. Condition.
 - c. Check condition of hoses.
 - i. Indication of rubbing against other object.
 - ii. Soft/squeezable, this is an indication of impending failure.
 - d. Condition of ignition/all wiring.
 - e. Battery and battery heater condition.
 - f. Check for signs of leaks.
 - g. Remove any signs of rodent habitation.



REPORTING

PLANNED COST VS ACTUAL COST (TOP 10)

Top 10: TotalPlnndCosts

Functional Location	NotifCreat	BrkdnReptd	OrdsCrtd	TotalPlnndCosts	Total act.costs	Int. wage costs	Int. mat. costs	Miscell. costs
Total	189	0	192	69,799.92 USD	56,202.11 USD	47,638.61 USD	7,722.12 USD	841.38 USD
Wright Park	5	0	5	2,739.44 USD	1,925.34 USD	1,925.34 USD	0.00 USD	0.00 USD
50th PL SW & SW 327t	5	0	5	2,678.24 USD	199.06 USD	199.06 USD	0.00 USD	0.00 USD
Harbor View Dr & Sla	4	0	4	2,654.00 USD	530.80 USD	530.80 USD	0.00 USD	0.00 USD
S 17th and Adams	2	0	2	2,123.20 USD	850.51 USD	554.90 USD	254.83 USD	40.78 USD
NE 44th Ave and 33rd	2	0	2	2,123.20 USD	1,025.02 USD	665.88 USD	309.60 USD	49.54 USD
UP Tanks 5 & 6	4	0	4	2,123.20 USD	2,364.95 USD	2,130.60 USD	202.03 USD	32.32 USD
Pointe Woodworth Dr	2	0	2	2,123.20 USD	1,024.34 USD	727.32 USD	256.05 USD	40.97 USD
51st St. N. & Mildre	2	0	2	2,123.20 USD	961.46 USD	665.88 USD	254.81 USD	40.77 USD
6th & Mountain View	4	0	4	2,123.20 USD	2,887.40 USD	2,678.12 USD	180.41 USD	28.87 USD
SR 162 & 128th St. E	4	0	4	2,123.20 USD	682.40 USD	682.40 USD	0.00 USD	0.00 USD
Rest	155	0	158	46,865.84 USD	43,750.83 USD	36,878.31 USD	6,264.39 USD	608.13 USD



METRICS AND BENCHMARKS

Metric	Variables and Equations	Benchmark
Equipment Availability	$\% = \frac{\text{Hours available at capacity}}{\text{Total hours in report period}}$	>95%
Schedule Compliance	$\% = \frac{\text{Total hours worked on scheduled jobs}}{\text{Total hours worked}}$	>90%
Emergency Maintenance Percentage	$\% = \frac{\text{Total hours worked on emergency jobs}}{\text{Total hours worked}}$	<10%
Preventive Maintenance Completion Percentage	$\% = \frac{\text{Preventive maintenance jobs completed}}{\text{Preventive maintenance jobs scheduled}}$	>90%
Preventive Maintenance Budget Cost	$\% = \frac{\text{Preventive maintenance cost}}{\text{Total maintenance cost}}$	15% - 18%
Predictive Maintenance Budget Cost	$\% = \frac{\text{Predictive maintenance cost}}{\text{Total maintenance cost}}$	10% - 12%



LESSONS LEARNED

**NEVER UNDERESTIMATE THE POWER OF
ITERATING YOUR WAY TO PERFECTION**

PLAN, PLAN, PLAN!

UNDERSTANDING EMERGENCY vs URGENT WORK

BUILD AND INVEST IN RELATIONSHIPS

PATIENCE!



TECHNOLOGY'S ROLE IN ASSET MANAGEMENT

MAKE TECHNOLOGY YOUR FRIEND

- WHAT QUESTIONS DO I NEED TO ANSWER
- LEVERAGE DATA & INFORMATION COLLECTIVELY
- ITS ALL ABOUT THE DATA
- KNOW YOUR BUSINESS REQUIRMENTS
- ESRI, SAP AND SHAREPOINT – INFORMATION PYRAMID
- ENABLES ENHANCED DATA MANAGEMENT, ANALYTICS & REPORTING
- DEVELOP BASED ON BUSINESS REQUIREMENTS
- SIMPLIFIES IMPLEMENTATION
- ALLOWS YOU TO BE AGILE
- OPPORTUNITY TO RE-ENGINEER BUSINESS PROCESSES
- IT'S A PARTNERSHIP



CHANGE DRIVERS

BUSINESS

- ACCURATE MAPS
- ASSET MANAGEMENT
- LEVERAGE TECHNOLOGY
- MASTER DATA MANAGEMENT(SINGLE SOURCE OF TRUTH)
- NEAR REAL TIME OPERATIONAL INFORMATION

TECHNICAL

- END OF APPLICATION LIFECYCLE & OBSOLETE HARDWARE
- NON SUPPORTED (CUSTOM CODE)
- KNOWLEDGE SILO



CAUTIONARY TALES

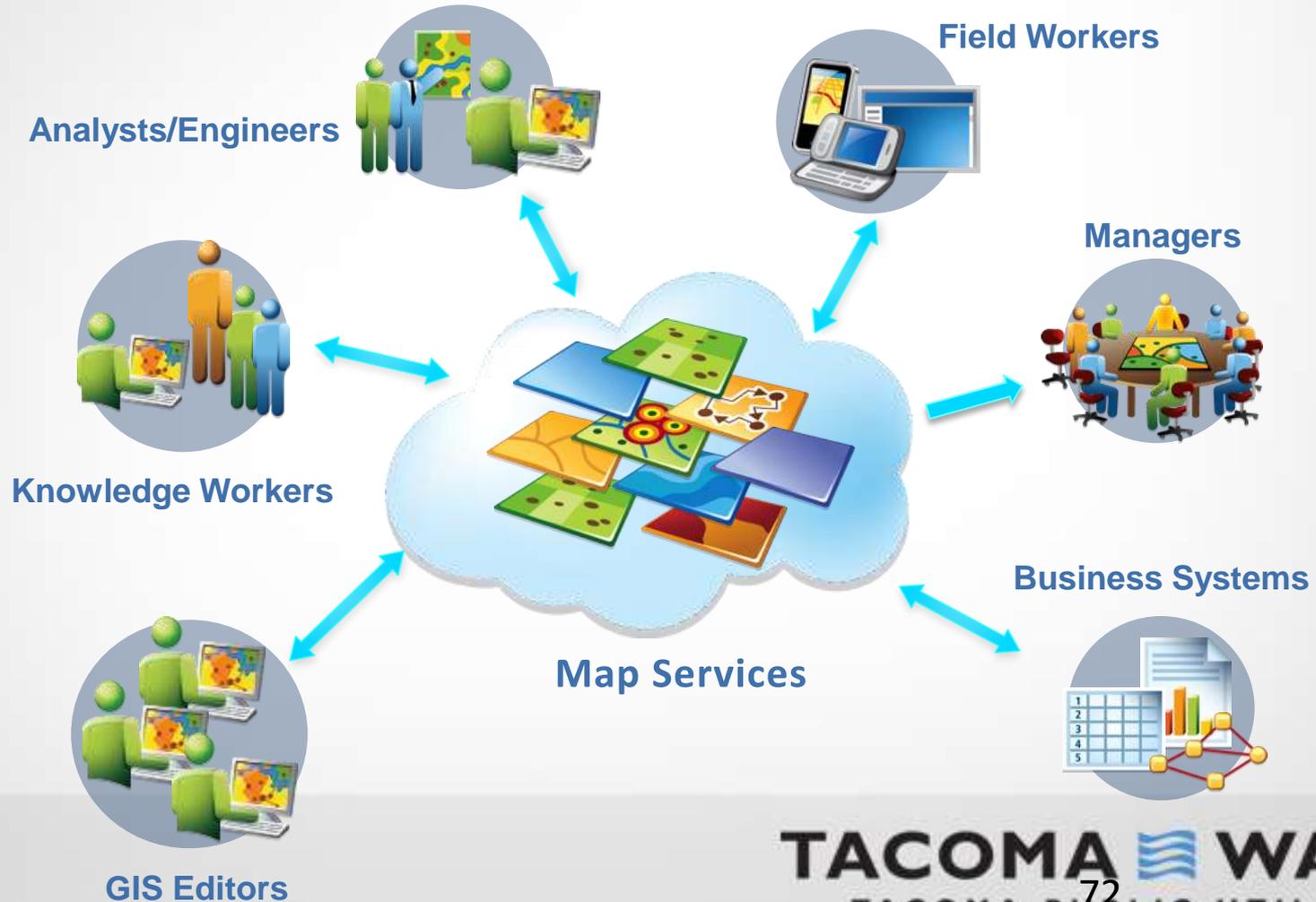
YOU'RE NOT SPECIAL (WELL KINDA)

- WHAT VALUE DOES THE TECHNOLOGY ADD
- FAIL SMALL - PILOT & PROVE
- CONFIGURE VS. CUSTOMIZE
- DO NOT RECREATE YOUR OLD SYSTEM/S
- DO NOT TRY TO “FIX” OR “BUILD” EVERYTHING AT ONCE
- DO NOT TRY TO BE ALL THINGS TO ALL PEOPLE
- GIVE YOURSELF A BREAK
- THIS IS A DISCOVERY PROCESS
- TECHNOLOGY IS ALWAYS AHEAD OF AN ORGANIZATIONS ABILITY TO ADOPT
- FOCUS ON HIGH VALUE RETURN



BLUEWAVE CURRENT STATE

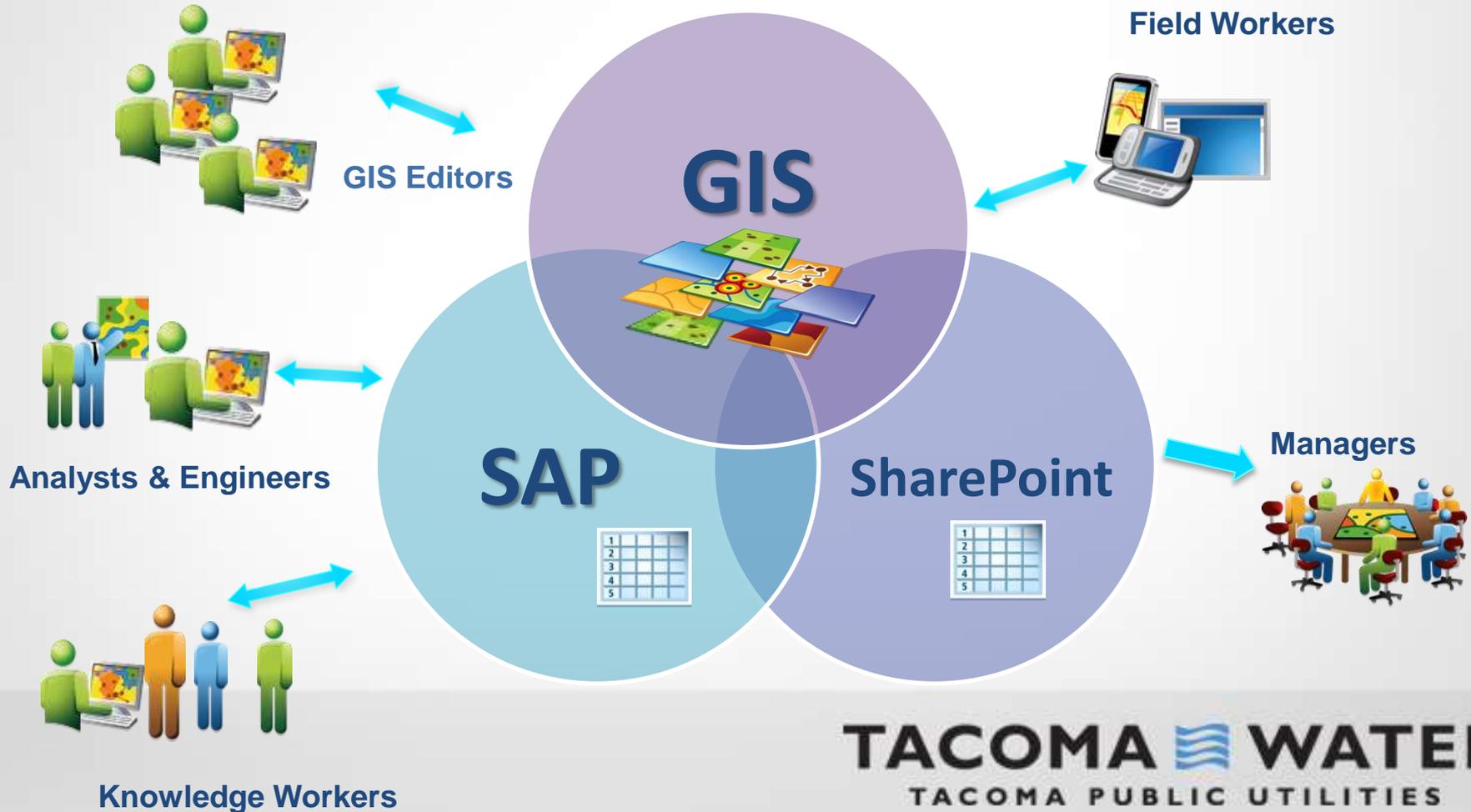
ENTERPRISE GIS





BLUEWAVE FUTURE STATE

ENTERPRISE GIS INTEGRATED MASTER DATA:
“ONE SOURCE OF THE TRUTH” FOR DECISION MAKING





MAP QUEUE ONLINE

SharePoint
Tacoma Water
Map Edits Tracking Log

new item or edit this list

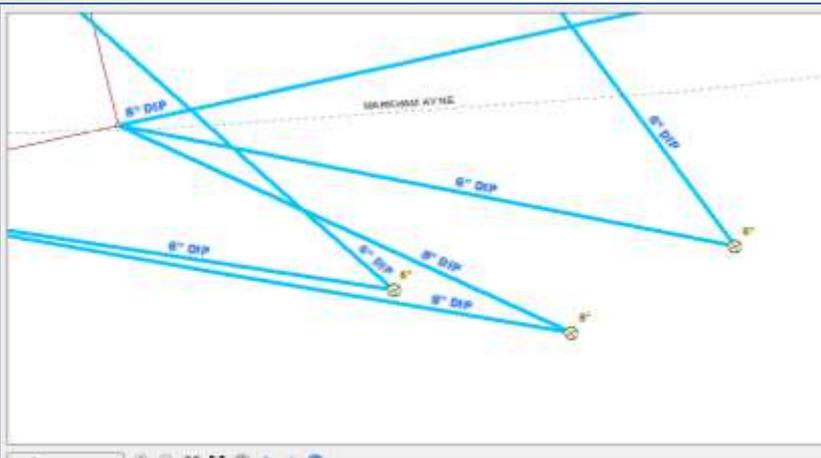
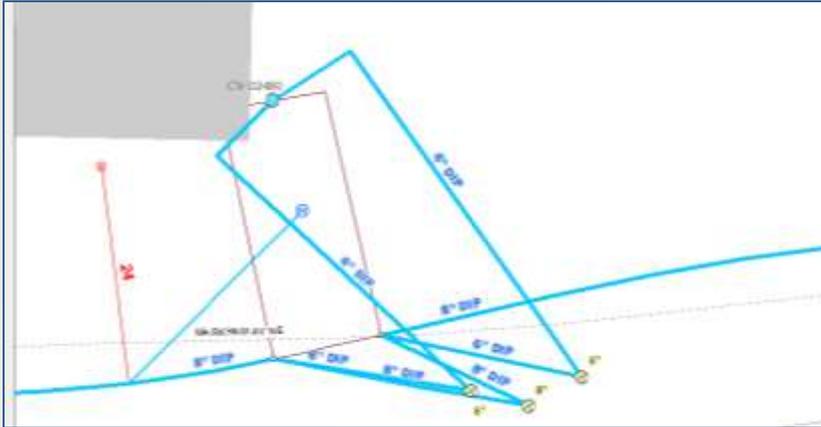
Queue All items Completed items Find on items

Item Title	Category	Project Type	Project Number	Submitted By	Status	Priority	Assigned To	Start Date
128th St E, PL2 Distribution Main	New-Project	WDP	2011-14	Kurt	Rec & Post	1 - High	Mary	3/8/2015
Yacht Club Rd.	New-Project	PC	2013-23	Kurt	Rec & Post	1 - High	Steve	3/9/2015
Sunset Estates	New-Project	PC	2012-22	Kurt	Rec & Post	1 - High	Steve	3/10/2015
Bonney Lake Estates Phase I	New-Project	PC	2012-20	Kurt	Rec & Post	1 - High	Mary	3/3/2015
Headworks Intake	New-Project	Supply/Water Quality	N/A	Seth	Rec & Post	1 - High	Eric	3/18/2015
Area 10 GPS Facility-Adjustment Project	Map Adjustments	N/A		Andy	Waiting on Someone	1 - High	Steve	3/3/2015
Pipeline No. 1 Replacement-Phase BA	New-Project	Supply/Water Quality	13-1-81	Kurt	In Work	2 - Medium	Steve	3/24/2015
Falling Water Div.3 Ph.2	New-Project	PC	2013-34	Kurt	On hold	2 - Medium	Pending	
Dreamscape	New-Project	PC	2013-37	Kurt	Rec & Post	2 - Medium	Steve	3/12/2015
Columbia Vista Phase II	New-Project	PC	2013-4	Kurt	Rec & Post	2 - Medium	Eric	3/11/2015
Farwest Fabrication Phase II	New-Project	PC	2013-29	Kurt	Rec & Post	2 - Medium	Eric	3/11/2015
FORT INEQUALITY MAIN EXTENSION	New-Project	PC	2013-30	Kurt	Rec & Post	2 - Medium	Steve	3/18/2015
HOOBIE CREEK	New-Project	PC	2013-28	Kim	Rec & Post	2 - Medium	Eric	2/25/2015
H Waterview St	New-Project	PC	2014-11	Kim	Rec & Post	2 - Medium	Mary	3/19/2015
Summer Canyon	New-Project	PC	2013-19	Kim	Rec & Post	2 - Medium	Steve	3/12/2015
PHEASANT RUN	New-Project	PC	2013-63	Kim	Rec & Post	2 - Medium	Steve	3/14/2015

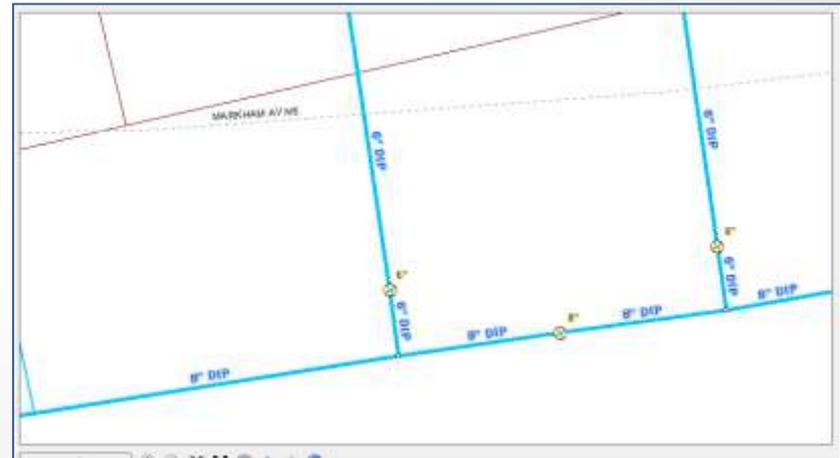


WHERE ARE MY ASSETS?

BEFORE



AFTER





THEN & NOW



MAPGUIDE

- OLD BASEMAP (2006)
- BACKLOG MYSTERIES
- HAPHAZARD ERROR REPORTING
- NO SLA
- SINGLE SHEET EDITS
- QUARTERLY PUBLISHING
- 2 WEEK MANUAL EFFORT TO PUBLISH
- ONLY DRAWING STANDARDS
- STANDARDS BY HONOR SYSTEM
- BROKEN SAP INTERFACE

BLUEWAVE

- BASEMAP UPDATED WEEKLY
- ONLINE MAP EDIT QUEUE
- MAP MARK-UPS STORED IN DATABASE
- 60 DAY SLA BY SUMMER
- EDITS IN ENTERPRISE GEODATABASE
- WEEKLY PUBLISHING
- AUTOMATED PROCESS TO PUBLISH
- DRAWING & ATTRIBUTE STANDARDS
- STANDARDS ENFORCED BY SYSTEM
- AUTOMATING SAP INTERFACE



WHAT'S NEXT?

IMPROVED USER EXPERIENCE

- NEW 3RD PARTY SOFTWARE THAT IS DEVICE AGNOSTIC

MOBILE APPS

- PROVIDE LOCATION SERVICES NOT AVAILABLE VIA LAPTOP
- MOST VENDOR SOLUTIONS ARE TARGETING THIS PLATFORM

MANAGEMENT DASHBOARD

- SUMMARY REPORTS WITH MAPS

CUSTOMER APPS

- WEB & MOBILE SOLUTIONS FOR CUSTOMER COMMUNICATION



EMPLOYEE ENGAGEMENT

2015 TACOMA WATER STRATEGY MAP

Vision: Engaged and Informed

Outcome Perspective

CUSTOMER EXPECTATIONS

C01. Work with our customers' best interests in mind
 Objective champion: Gen George
 Objective coordinator: Prabhu/Kama

FINANCIAL STRENGTH

F01. Ensure financial stability and effectively manage costs
 Objective champion: Sean Sorensen
 Objective coordinator: Marc Powell

CUSTOMER FOCUS

IP01. Understand and support retail customer needs
 Objective champion: Tony Lindgren
 Objective coordinator: Jesse Angel

IP02. Understand and support wholesale customer needs
 Objective champion: Chris McKeen
 Objective coordinator: Kim Corbin

EFFECTIVE DECISION MAKING

IP03. Successfully manage the implementation of operational and strategic plans
 Objective champion: Linda McCrea
 Objective coordinator: Heather Pennington

IP04. Manage assets at lowest lifecycle cost with an acceptable level of risk
 Objective champion: Heather Pennington
 Objective coordinator: Todd Steinhilber

IP05. Leverage technology
 Objective champion: Heather Pennington
 Objective coordinator: Todd Steinhilber

Internal Process Perspective

- si33. Ordinance Revision
- si71. Enhance Customer Service Offerings and Communications
- si75. Permit Counter Move & IVR
- si79. Water Conservation
- si61. Wholesale Customers – Sales and Services – Ph II

- si36. Balanced Scorecard Transition
- si53. Budget Development Decision-making Framework
- si69. Water Emergency Management
- si70. High Level system planning
- si16. Testing of New and Other Brands of Meters
- si59. Electrical SAMP Development (GenSet subset)
- si60. Valve SAMP Phase I
- si72. Planning & Scheduling Training
- si73. Electrical SAMP Phase I
- si68. Planner Scheduler Implementation in Supply
- si67. Supply Maintenance Plans
- si80. Economic Model Framework
- si81. Transmission Mains Economic Model
- si82. Distribution Mains Economic Model
- si63. Linear Assets
- si64. Hydraulic Model
- si78. Meter Replacements and Automation

Employee Perspective

ENGAGEMENT

E01. Improve relationships between employees and their direct supervisor
 Objective champion: Heather Pennington
 Objective coordinator: Jennifer Wiley

E02. All employees understand what is expected of them at work
 Objective champion: Ray West
 Objective coordinator: Jennifer Wiley

- si62. Supervisor-Employee Relationships ph II
- si76. Foundational Plan for Employee Development Initiative

- si48. Employee Expectations

REQUIRED COMMITMENTS

- si01. All Hazards Vulnerability Assessment
- si05. Green River Filtration Facility
- si52. Howard Hanson BA/BI/Op
- si66. Resiliency Effort with Water Supplier's Forum
- si77. RockTenn Renegotiation

- On Track
- Attention Required
- new
- At Risk
- Completed in 2015



EMPLOYEE ENGAGEMENT

TWO EMPLOYEE OBJECTIVES ON 2015 BALANCED SCORECARD

E01. Improve relationships between employees and their direct supervisor

*Objective champion: Heather Pennington
Objective coordinator: Jennifer Airey*

si62. Supervisor-Employee Relationships ph II

si76. Foundational Plan for Employee Development Initiative

E02. All employees understand what is expected of them at work

*Objective champion: Ray West
Objective coordinator: Jennifer Airey*

si48. Employee Expectations

MEASURED BY SURVEY PATTERNED AFTER GALLUP
EMPLOYEE ENGAGEMENT 12 QUESTIONS



EMPLOYEE ENGAGEMENT

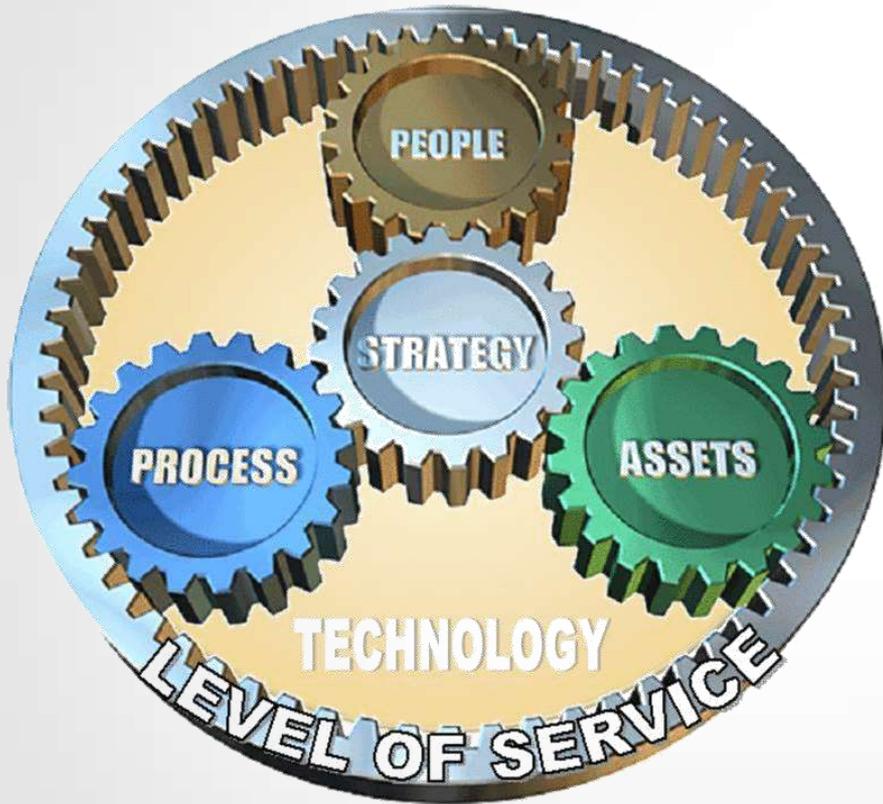
THINGS WE'VE LEARNED

- MEANINGFUL COMMUNICATION IS KEY
- REPEAT MESSAGES IN MANY WAYS, MAKE CONNECTIONS AND STRIVE FOR UNDERSTANDING
- MODEL PLANNING AND SCHEDULING, AND DON'T FORGET TO MEASURE IMPLEMENTATION – GO ALL THE WAY TO A NEW BUSINESS AS USUAL
- FIND YOUR CHAMPIONS AT ALL LEVELS
- CELEBRATE SUCCESSES



SUMMARY

DELIVERY OF COST-EFFECTIVE SERVICES TO CUSTOMERS



Strategy – Sets the vision, mission, framework and road map.

Assets – Minimize total cost of ownership, maximize reliability and meet performance standards.

People – Make the right choices in organization design and people resources.

Process – Design and implement process that are streamlined and effective.



QUESTIONS?

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LINK TO PREZI

[HTTP://PREZI.COM/ILD TNHTM JMH8/?UTM_CAMPAIGN=SHARE&UTM_MEDIUM=COPY&RC=EX0SHARE](http://PREZI.COM/ILD TNHTM JMH8/?UTM_CAMPAIGN=SHARE&UTM_MEDIUM=COPY&RC=EX0SHARE)