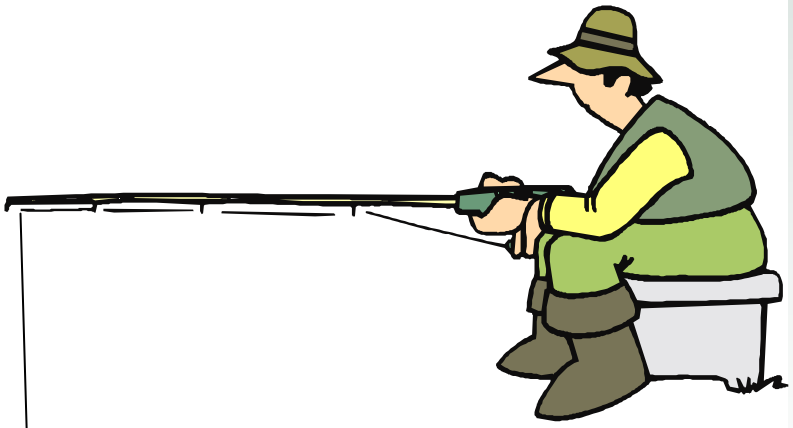
Life Cycle Management of Asset Portfolios Redwood National & State Parks

Rich Schneider
National Park Service

Doug Kincaid
Applied Management Engineering

Life Cycle Asset Management at Bering Land Bridge National Preserve

NPS Facility Manager decides to try ice fishing!



Facility Management Program

Life Cycle Management of Asset Portfolios
Redwood National & State Parks

Facility Condition Assessment Survey (FCAS) Results

Conducted thorough inventory & comprehensive assessment of park facilities including digital photo's, floor plans, GPS coordinates & detailed information for each asset/feature

Calculated Current Replacement Value (CRV) for each asset & summarized by Asset Code

Calculated Deferred Maintenance Cost for each asset & summarized by Asset Code

Buildings	124 EA	$ 27,574,903	$ 8,457,682	A/E
Housing	9 EA	$ 4,657,006	$ 718,116	A/E
Utilities	22 EA	$ 3,782,385	$ 467,835	A/E
Paved Roads	17 MI	$ 5,668,090	$ 4,208,892	FHWA
Unpaved Roads	129 MI	$ 56,472,668	$18,929,210	Park
Paved Parking	24 EA	$ 2,785,440	$ 832,060	FHWA
Road Bridges	5 EA	$ 1,115,300	$ 14,500	FHWA
Trails	108 MI	$ 9,237,275	$ 1,018,301	Park
Campsites/picnic	24 EA	$ 173,137	$ 25,725	Park
		$111,466,204 Total	$34,672,321	Total

Determined Asset Condition based on Facility Condition Index (FCI) = Total Repair Cost */CRV

* RS Means

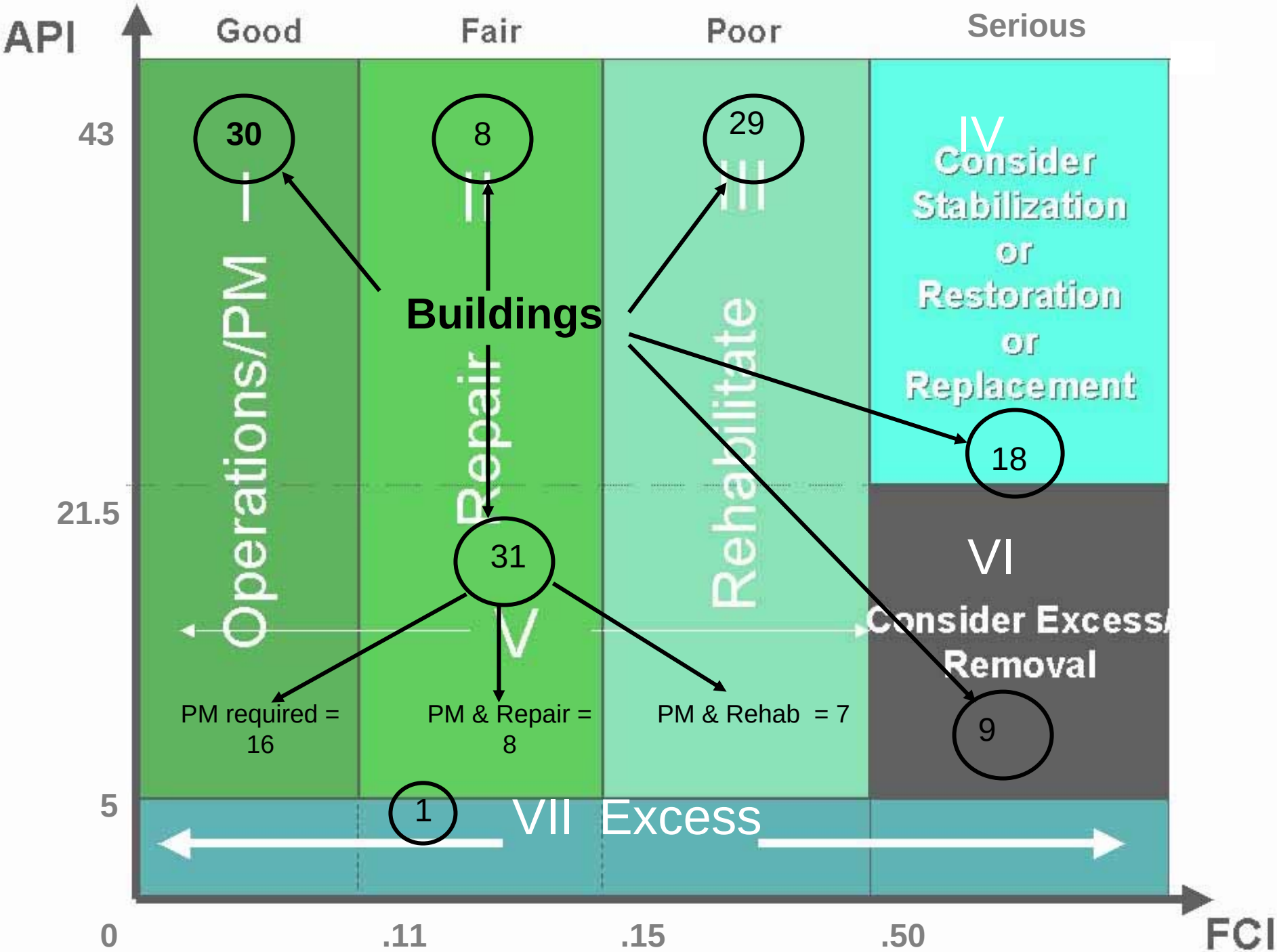
Good	Fair	Poor	Replace
(0 – .10)	(.11-.15)	(above .15)	(.50 or above)

Determined Asset Status and Asset Priority Index (API) for each asset to assist in work prioritization (summarized below)

Good	Fair	Poor	Serious	Asset Type
55	11	33	25	Buildings
4	3	1	1	Housing
21	0	0	1	Utilities
0	0	12	2	Paved Roads
8	2	40	19	Unpaved Roads
6	1	9	6	Paved Parking
5	0	0	0	Road Bridges
12	2	13	2	Trails
14	10	0	0	Campsites/ Picnic

Status	Quantity
Operational	282
Operational/Obsolete	61
Replacement	3
Excess	68
Planned	3

	API Rating
High	*40 - 21*
Medium	*20 - 6*
Low	*5 - 0*


API
Good
Fair
Poor
Serious
43
21.5
5
0
.11
.15
.50
FCI
30
8
29
18
31
9
1
Buildings
I
Operations/PM
II
Repair
III
Rehabilitate
IV
Consider Stabilization or Restoration or Replacement
V
VI
Consider Excess/ Removal
VII Excess
PM required = 16
PM & Repair = 8
PM & Rehab = 7

Capital Asset Planning

Systematic approach to scheduling and budgeting current and anticipated deficiencies that maximizes the ROI, meets mission goals and preserves the value of the physical assets

- The condition assessment and capital asset planning processes assist facility managers identify, prioritize and manage the overall condition of their asset portfolios to provide a sound, defensible tool for articulating the “business case” for investing resources in infrastructure.
- The basis for making repair-versus-replace decisions, identifying maintenance and repairs that can be deferred without loss of investment, and projecting long-range capital renewal requirements.

Stewardship of Federal Facilities ~ National Research Council

Objectives

- Arrest and reduce the existing maintenance backlog through targeted investment strategies.
- Create a backlog reduction strategy that provides funding opportunities for all Redwood National & State Park facilities, including cultural and historic assets.
- Implement a strategy that balances backlog reduction with capital improvement, preventive maintenance, and recapitalization needs.
- Implement a capital asset management program with mature, repeatable processes for assessing, sustaining, and recapitalizing the asset portfolio.
- Incorporate tools and metrics for measuring performance, prioritizing investment decisions, and managing an asset portfolio that is based on Redwood National & State Park mission needs.
- Focus attention on managing the asset life-cycle through implementation of leading asset management information technology.
- Commit to the total cost of asset ownership through integrated partnerships in the planning, design, construction, operations, maintenance, recapitalization, and disposal of Park assets.

Capital Asset Planning

By Equipment

Deferred Maintenance

Operating Status, Facility Condition Index, Asset Priority Index, Deferred Cost and Current Replacement Value used in "bundling" of Deferred Maintenance into Project Proposals

Location Number	Location Description	Operating Status	FCI	API	Deferred Cost	CRV
Asset Code: 1100						
3454	Davison Road, Paved - Rte 115	OPERATING	0.46	33.00	105,455.00	229,498.45
15618	Requa Housing/CCC Complex Rd ., Paved - Rte 407	OPER/OBSO	0.29	29.00	74,666.00	261,373.23
3443	Alder Camp Road Rte 102	OPERATING	1.00	28.00	3,290,231.80	3,290,231.00
3456	Enderts Beach Rd , Paved - Rte 100	OPERATING	0.37	28.00	527,201.03	1,427,990.35
28331	Requa Water Treatment Plant RD	OPER/OBSO	0.00	26.00	0.00	367,500.00
15653	Lost Man Creek Rd ., Paved - Rte 205	OPERATING	0.00	26.00	0.00	573,746.12
11049	Redwood Information Center Rd., Paved - Rte 215	OPERATING	0.52	24.00	86,321.39	165,748.88
11047	Redwood Creek Trailhead Rd ., Paved - Rte 210	OPERATING	0.46	24.00	125,017.19	274,123.15
3447	Red Alder Rd., Paved - Rte 110	OPERATING	0.00	19.00	0.00	796,869.61
11024	Schach House/Jed Smith Service Rd , Paved (Shared)	OPERATING	0.00	14.00	0.00	159,373.92
15655	Redwood Information Center Service Rd., Rte 415	OPERATING	0.00	10.00	0.00	44,624.70
3470	Rudisill Road	OPER/OBSO	0.00	5.00	0.00	223,123.49
		Location Count	**12**	**12**	**12**	**12**

Deferred Maintenance for 3 Buildings in the same geographic area

Presentation was interactive -- linked to Excel files.

Loc No.	Location Description	Asset Status	FCI	API	Deferred Cost	CRV	Comments
3385	2101 Park Headquarters (Crescent City)	OPERATING	0.33	32.00	$681,392.37	$2,084,128.00	Access and fire alarm are critical; electrical & windows are serious deficiencies
3391	1197 Hiouchi RV Multipurpose Building	OPERATING	0.33	15.00	$81,248.57	$244,858.00	Exterior door is critical; exterior window, electrical are serious deficiencies
4093	2901 Howland Hill Outdoor School Lodge	OPERATING	0.46	22.00	$49,896.97	$109,753	Exterior door is critical; exterior window, exterior finish are serious deficiencies
					Exterior Windows for Buildings 2101, 1197 & 2901		
11093	6500 Redwood Information Center	OPERATING	0.08	32.00	$74,711.07	$971,104.00	
4159	2302 Pumphouse Crescent Beach Env. Ed. Ctr.	OPERATING	0.15	29.00	$3,324.95	$22,638.00	
3991	3191 South WWII Radar Site Generator Building	OPERATING	0.01	28.00	$451.02	$75,611.00	
11118	6713 Coyote Creek Cabin Outbuilding	OPERATING	0.05	28.00	$210.50	$4,010.00	
11117	6712 Elk Camp Outhouse	OPERATING	0.00	28.00	$0.00	$3,813.00	
11116	6711 Elk Camp Garage	OPERATING	0.18	28.00	$5,934.80	$32,523.00	
11115	6708 Dooleyville Cabin	OPERATING	0.16	28.00	$3,185.00	$20,000.00	
11114	6707 Longridge Sheep Shed	OPERATING	0.00	28.00	$0.00	$172,751.00	
11113	6706 Coyote Creek Barn	OPERATING	0.00	28.00	$0.00	$122,150.00	
11112	6705 Coyote Creek Cabin	OPERATING	0.21	28.00	$4,432.70	$21,562.00	

Distribution of Repair Costs by Priority

Critical = High priority repairs that must be implemented within the next five years in order to keep the building in an operational state.
Serious = Longer term repairs or upgrades that should be programmed for accomplishment in more than five years. Items classed as modernization or requiring prospectus authority.
Minor = Repairs or upgrades that would improve facilities or support of functions but are not required or do not fall into Category 1 or 2.

						Critical	Serious	Minor
1	4140	1	Exterior Window Unit	77	EA	-	18,811	-
2	4140	2	Exterior Window Unit	31	EA	-	51,528	-
3	4150	1	Exterior Door Unit	18	EA	-	-	2,058
4	4150	2	Exterior Door Unit	1	EA	-	1,872	-
5	4210	1	Interior Wall Surface/Cover	200	SF	-	-	1,904
6	4210	2	Interior Wall Surface/Cover	4	EA	-	-	3,414
7	4210	3	Interior Wall Surface/Cover	945	SF	-	-	1,495
8	4310	1	Roof Surface/Cover	12,100	SF	-	-	100,998
9	4350	1	Roof Drainage	1	EA	-	-	794
10	4716	1	Fire Escape	1	EA	1,474	-	-
11	4716	2	Fire Escape	1	EA	6,094	-	-
12	4730	1	Electrical System - Fire Alarm	1	EA	19,375	-	-
13	4770	1	Handicap Access	1	EA	247,542	-	-
14	4770	2	Handicap Access	1	EA	57,770	-	-
15	5810	1	Replace Water Heater	1	EA	-	1,009	-
16	5830	1	Electrical System - Lighting	1	EA	-	-	80,730
17	5830	2	Electrical System - Emergency Egress Lighting & Exit Signs	1	EA	13,999	-	-
18	5830	2	Electrical System Distribution	1	EA	-	138,726	-
19	5830	4	Electrical System Workspace Clearance	1	EA	-	73	-
20	5840	1	Add Fresh Air Intakes to Furnaces.	1	EA	-	2,009	-
25	0	0	0	-	0	-	-	-
				Category Sub-Totals:		346,254	214,028	191,394
	Page Totals:		$751,676			Critical	Serious	Minor

Deferred cost for windows at Park Headquarters

Building Name: Headquarters — Property Number: 2101

DEFICIENCY TITLE: Exterior Window Unit

Detailed Deficiency Description & Photographs: Discipline: Arch No. 4140 1

The exterior window units on the first and second story window finishes are in poor condition and should be replaced. Scrape, sand and prepare existing paint and provide new paint finishes.

	Action Item	Quantity	Units	Lbr Hr	Hours	Equip	Mtrl Cost	Lbr Cost	Total Cost
1	Prepare Window Units for Finishes	3045	SF	0.023	70.5	0.08	0.05	0.81	$ 2,862
2	Scaffolding/Lift for Windows	1	EA	80.714	80.7	2356.00		2825.00	$ 5,181
3	Exterior Window Finish	77	EA	1.250	96.3		3.10	43.75	$ 3,607

Deficiency Category:			Feature Code:		Direct Construction Cost:		$ 11,651
0%	$ -	Critical	77	Quantity	General Conditions	8%	932
100%	$ 18,811	Serious	EA	Unit	Overhead and Profit	20%	2,330
0%	$ -	Minor	$ 244.30	Cost/Unit	Design Contingency	10%	1,165

Distribution of Upgrade Costs:			Gross Construction Cost		$ 16,078
Critical Health or Safety-Deferred Maintenance	0%	-	Design Costs:		
Critical Health or Safety-Capital Improvement	0%	-	Testing & Inspection	5%	804
Critical Mission-Deferred Maintenance	0%	-	Design Costs:	10%	1,608
Critical Resource Protection-Deferred Maint.	100%	18,811	Supplementary Services	2%	322
Critical Resource Protection-Capital Improve	0%	-	GROSS Design Cost		$ 2,733
Compliance and Other Deferred Maint.	0%	-			
Other Capital Improvements	0%	-	TOTAL COST:		$ 18,811

Closer look at costs by Labor, Equipment and Material

Deferred cost for Windows in all 3 Park Buildings

Building Name: **Park Headquarters** Building Number: **2101**

Distribution of Repair Costs by Priority

Critical = High priority repairs that must be implemented within the next five years in order to keep the building in an operational state.

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Minor = Repairs or upgrades that would improve facilities or support of functions but are not required or do not fall into Category 1 or 2.

						Critical	Serious	Minor
1	4140	1	Exterior Window Unit (2101)	77	EA	-	$ 18,811.30	-
2	4140	2	Exterior Window Unit (2101)	31	EA	-	$ 51,528.35	-
2	4140	1	Exterior Window Unit (1197)	7	EA	-	$ 10,777.46	-
3	4140	1	Exterior Window Unit (2901)	5	EA	-	$ 8,726.91	-
						-		-
					Category Sub-Totals:		$ 89,844.02	

Capital Asset Planning

By Asset

Deferred Maintenance

"Bundling" Deferred Maintenance by Asset – Park Headquarters

Building Name: Park Headquarters — Building Number: 2101

Distribution of Repair Costs by Priority

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4	4150	2	Exterior Door Unit	1	EA	-	1,872	-
5	4210	1	Interior Wall Surface/Cover	200	SF	-	-	1,904
6	4210	2	Interior Wall Surface/Cover	4	EA	-	-	3,414
7	4210	3	Interior Wall Surface/Cover	945	SF	-	-	1,495
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9	4350	1	Roof Drainage	1	EA	-	-	794
10	4716	1	Fire Escape	1	EA	1,474	-	-
11	4716	2	Fire Escape	1	EA	6,094	-	-
12	4730	1	Electrical System - Fire Alarm	1	EA	19,375	-	-
13	4770	1	Handicap Access	1	EA	247,542	-	-
14	4770	2	Handicap Access	1	EA	57,770	-	-
15	5810	1	Replace Water Heater	1	EA	-	1,009	-
16	5830	1	Electrical System - Lighting	1	EA	-	-	80,730
17	5830	2	Electrical System - Emergency Egress Lighting & Exit Signs	1	EA	13,999	-	-
18	5830	2	Electrical System Distribution	1	EA	-	138,726	-
19	5830	4	Electrical System Workspace Clearance	1	EA	-	73	-
20	5840	1	Add Fresh Air Intakes to Furnaces.	1	EA	-	2,009	-
25	0	0	0	-	0	-	-	-
				Category Sub-Totals:		346,254	214,028	191,394
	Page Totals:		$751,676			Critical	Serious	Minor

Capital Asset Planning

By Asset Type

Deferred Maintenance

"Bundling" Deferred Maintenance by Asset Type – Paved Roads / Parking

Facility Management Software System

Condition Assessment Evaluation Report - Detail

Park Alpha Code: REDW - Redwood National & State Parks

Location	Description	Replacement Cost	FCI	API	Deferred Cost	
Assessment Ranking: GOOD						
Asset Code - 1100 - Paved Roads						
3463	L-1 Road on the Orick Horse Trail Overnight Loop	1,311,455	0.000	24.00	180	
14004	C-6-2 Road	702,565	0.000	12.00	180	
14542	N. Fork Streelow Road	374,702	0.000	12.00	70	
15563	Coyote Peak Road	749,403	0.025	24.00	18,466	
3459	Howland Hill Outdoor School Road	327,864	0.026	26.00	8,594	
13170	Mill Creek Horse Trail Road	2,107,696	0.063	26.00	133,716	
14514	Schoolhouse Pasture/Peak Road	248,240	0.091	24.00	22,612	
					183,817	
Asset Code - 1300 - Paved Parking Area						
15613	Parking Crescent Beach Env. Ed. Cntr Paved Rte 911	157,490	0.058	12.00	9,117	
15657	Parking CCC Complex Paved Rte 909	141,050	0.072	21.00	10,169	
					19,286	
Asset Code - 1350 - Unpaved Parking Area						203,103

Backlog/Funding Projection Model

Deferred Maintenance

Backlog/Funding Projection Model

Backlog Work Types: DM,SF

Backlog Years: 0- 5

Plant Deterioration: CI,CR,CY,DX,EC,FR,GR,IX,MX,PA,PM,PR,PX,RR,ST

Asset Location: ALL LOCATIONS

Actual Current Backlog: $10,196,688

Actual Current Repl Value: $81,771,233

Number of Years: 10 Year 1: 2005

Select Years

Backlog Projection

Current Funding: $0 (000's)

Annual Funding Increase: Dollars

$0 (000's) 0.00%

Funding Projection

Target: Backlog FCI

Backlog: $0 (000's)

Years: 0 FCI: .00

Inflation Rate: 0.0 %

Backlog Deterioration Rate: 0.0 %

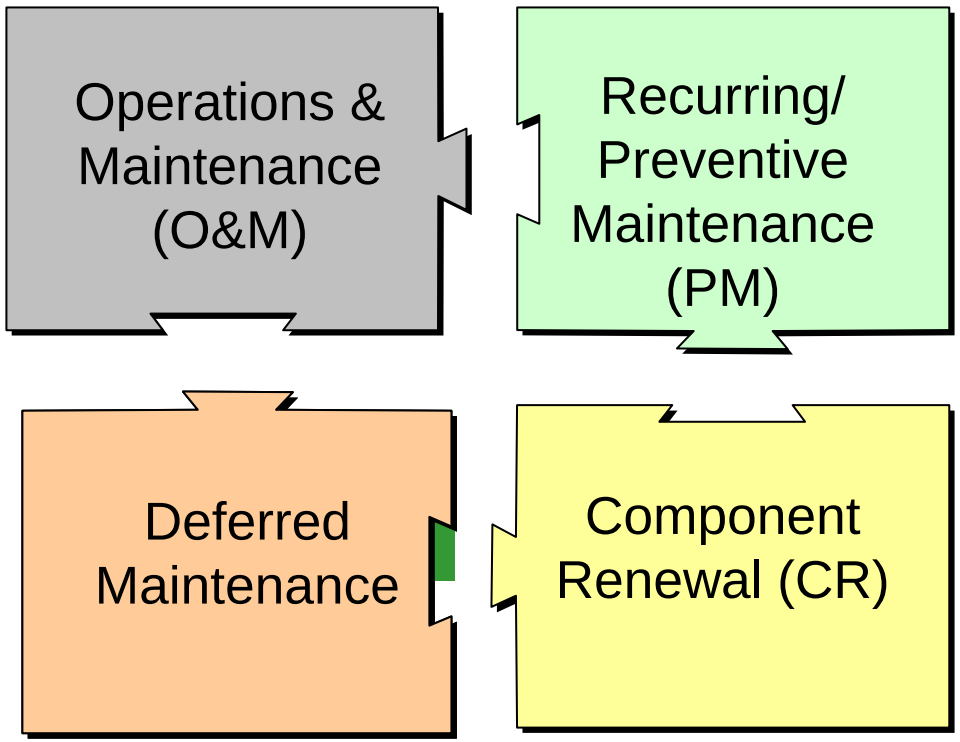
Plant Deterioration Rate: 0.0 %

CRV Growth Rate: 0.0 %

Year	Infl Rate	Det Rate Bklg	Det Rate Plant	CRV Growth	Plant Growth (millions)	Extra Funds (000's)	CRV (millions)	Plant det (000's)	Funding (000's)	Backlog (000's)	FCI
2005							$81.8			$10,197	0.12
2006							$81.8	$44		$10,241	0.13
2007							$81.8	$1,088		$11,329	0.14
2008							$81.8	$192		$11,521	0.14
2009							$81.8	$141		$11,663	0.14
2010							$81.8	$124		$11,786	0.14
2011							$81.8	$767		$12,553	0.15
2012							$81.8	$39		$12,592	0.15
2013							$81.8	$193		$12,786	0.16
2014							$81.8	$58		$12,843	0.16

More | Report | Export | Graph | Save | Restore | Exit

A Schedule & Budget for Deferred Maintenance work has been established… What is Next?



The Life Cycle approach to facility management requires that managers plan & schedule maintenance work across the entire life of an asset.

REDWOOD INFORMATION CENTER				3825 SF FCI 0.08		CRV $971,104		
Function / System / Component	Work Type	Feature / Location	RS Means Section	Quantity	Cost / UM	Frequency	Total Cost/Cycle	Total Cost /50 Years
	Operational Maintenance (Facility							
Custodial	OM	Vacuum Carpet	1837-900-0070	1948 SF	9.25/MSF	$18 Daily	$6,570.00	$328,500.00
	OM	Dust Walls	1937-925-0020	5400 SF	2.43/MSF	$14 Daily	$5,110.00	$255,500.00
	OM	Wash Windows	1835-900-0400	693 SF	84.5/MSF	$59 Monthly	$708.00	$35,400.00
	OM	Clean Restrooms	1837-200-0110+	3 EA	$48.66	$49 Daily	$17,885.00	$894,250.00
						SUBTOTAL	**$30,273.00**	**$1,513,650.00**
Utilities	OM	Electrical		36040KWH	$5,074.00	1 year	$5,074.00	$253,700.00
	OM	Propane (heating)		862 GAL	$912.00	1 year	$912.00	$45,600.00
	OM	Water		40600 GAL	$739.00	1 year	$739.00	$36,950.00
						SUBTOTAL	**$6,725.00**	**$336,250.00**
Other	OM	Service Sprinkler System	PM8.2-170-1950	1 EA	$745.00	1 year	$745.00	$37,250.00
	OM	Service Fire/Intrusion Alarms	PM8.2-270-1950	1 EA	$720.00	1 year	$720.00	$36,000.00
	OM	Service HVAC/AirHandlers	PM8.3-410-1950	2 EA	$430.00	1year	$860.00	$43,000.00
	OM	Service Water Heater	PM8.3-910-1950	2 EA	$144.00	1 year	$288.00	$14,400.00
	OM	Service Lift Station	PM8.4-050-1950	2 EA	$91.00	1 year	$182.00	$9,100.00
	OM	Service Urinals	PM8.5-050-1950	2 EA	$13.00	1 year	$26.00	$1,300.00
	OM	Service Flush Toilets	PM8.5-050-3950	7 EA	$21.00	1 year	$147.00	$7,350.00
	OM	Service Lavatories	PM8.5-050-4950	7 EA	$24.00	1 year	$168.00	$8,400.00
	OM	ServiceShower	PM8.5-050-5950	1 EA	$18.00	1 year	[illegible]	[illegible]

50-Year Life Cycle of a Facility

Operations & Maintenance (O&M)

REDWOOD INFORMATION CENTER

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	OM	Service Lavatories	PM8.5-050-4950	7 EA	$24.00	1 year	$168.00	$8,400.00
	OM	ServiceShower	PM8.5-050-5950	1 EA	$18.00	1 year	$18.00	$900.00
	OM	Service BackFlow Preventer	PM8.5-110-2950	1 EA	$26.50	1 year	$26.50	$1,325.00
	OM	Service Refrigerator	PM11.2-160-1950	1 EA	$26.00	1 year	$26.00	$1,300.00
	OM	Service Gate Valves	PM12.2-200-3950	1 EA	$64.00	1 year	$64.00	$3,200.00
						SUBTOTAL	**$3,270.50**	**$163,525.00**
				OPERATIONAL TOTALS			$40,268.50	$2,013,425.00

50-Year Life Cycle of a Facility

Recurring/ Preventive Maintenance (PM)

Facility Management Program

REDWOOD INFORMATION CENTER				3825 SF	FCI 0.08	CRV $971,104		
Function / System / Component	Work Type	Feature / Location	RS Means Section	Quantity	Cost / UM	Frequency	Total Cost/Cycle	Total Cost /50 Years
	Planned / Scheduled Maintenance (FM)							
	Painting	Interior						
Wall Covering	PM/SM	Int Doors	6.4-420-1020	9 EA	$46.00	4 years	$414.00	$5,175.00
	PM/SM	Int Trim	6.2-110-0030	500 LF	$1.40	7 years	$700.00	$4,999.00
	PM/SM	Int Drywall (Walls)	6.5-230-0050	5150 SF	$1.00	5 years	$5,150.00	$51,500.00
	PM/SM	Int Paneling	6.5-590-0020	210 LF	$1.00	5 years	$210.00	$2,100.00
	PM/SM	Int Drywall (Ceiling)	6.7-120-0020	3600 SF	$1.37	6 years	$4,932.00	$41,099.00
	PM/SM	Int Paneling	6.7-510-0030	490 SF	$1.05	6 years	$515.00	$4,291.00
							SUBTOTAL	$109,164.00
	Painting	Exterior						
	PM/SM	Deck	4.1-558-1030	3736 SF	$1.25	3 years	$4,670.00	$77,833.00
	PM/SM	Handrail	4.1-558-1030	441 LF	$2.04	3 years	$900.00	$14,999.00
	PM/SM	Siding/trim	4.1-534-1030	5124 SF	$2.67	7 years	$13,681.00	$97,721.00
	PM/SM	Ext Doors	4.6-320-1050	9 EA	$180.00	4 years	$1,620.00	$20,250.00
	PM/SM	Fascia	4.1-558-1030	598 LF	$1.57	7 years	$938.00	$6,699.00
	PM/SM	Soffit	4.1-558-1030	492 SF	$1.67	7 years	$822.00	$5,871.00
	PM/SM	Fencing/Screen	4.1-558-1030	100 LF	$1.57	7 years	$1,570.00	$11,214.00
							SUBTOTAL	$234,587.00
Roofing	PM/SM	Inspection/cleaning	5.1-345-0100	6600 SF	$20.00	1 year	$132.00	$6,600.00
							SUBTOTAL	$6,600.00
Plumbing	PM/SM	Rebuild Backflow Prev	8.1-299-3020	1 EA	$486.00	10 years	$486.00	$2,430.00
	PM/SM	Drain/Flush Hotwater Heater	8.8-187-0010	2 EA	$215.00	7 years	$430.00	$3,071.00
							SUBTOTAL	$5,501.00
				PM / SM TOTALS			$7,117.00	$355,852.00

50-Year Life Cycle of a Facility

Component Renewal (CR)

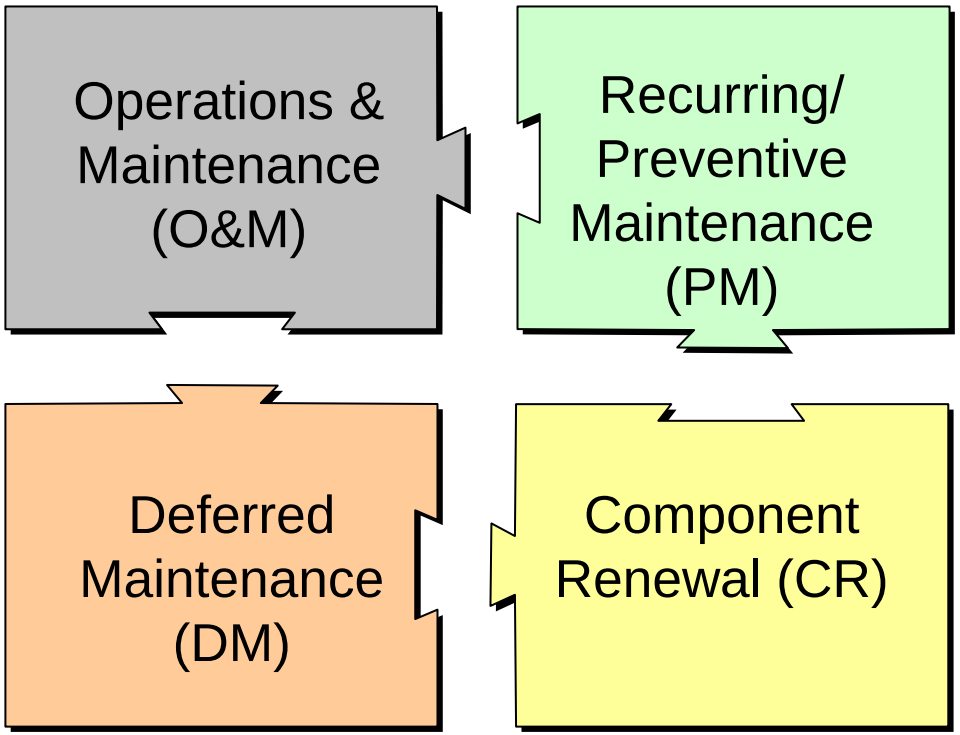
Facility Management Program

REDWOOD INFORMATION CENTER				3825 SF	FCI 0.08	CRV $971,104		
Function / System / Component	Work Type	Feature / Location	RS Means Section	Quantity	Cost / UM	Frequency	Total Cost/Cycle	Total Cost /50 Years
	Recapitalization (FM)							
Flooring	CR	Vinyl	6.6-240-0020	74 SY	$78.00	18 years	$5,772.00	$16,033.00
	CR	Carpet	6.6-910-0020	217 SY	$35.00	8 years	$7,595.00	$47,468.00
	CR	Base	6.2-160-0010	300 LF	$2.75	8 years	$825.00	$5,156.00
Roofing	CR	Composition	5.1-345-0700	6600 SF	$258.00	20 years	$17,028.00	$42,570.00
Windows	CR	Vinyl Clad	4.7-240-3030	41 EA	$548.00	40 years	$22,468.00	$28,085.00
Doors	CR	Ext. Door Hardware	4.9-110/310/410	9 EA	$769.00	15 years	$6,921.00	$23,069.00
	CR	Ext Door	4.6-320	9 EA	$1,114.00	30 years	$10,026.00	$16,709.00
	CR	Int Door Hardware	6.4-710/720/740	9 EA	$711.00	20 years	$6,399.00	$15,997.00
Plumbing	CR	Urinal	8.1-213-0300	2 EA	$783.00	35 years	$1,566.00	$2,237.00
	CR	Lavatory	8.1-214-0060	7 EA	$569.00	40 years	$3,983.00	$4,978.00
	CR	Electric Water Heater	8.1-287-0030	2 EA	$1,257.00	15 years	$2,514.00	$8,379.00
HVAC	CR	LPG Furnace	8.3-424-3030	2 EA	$2,418.00	15 years	$4,836.00	$16,120.00
						REPLACEMENT TOTAL		**$226,801.00**
						TOTAL		**$2,596,078.00**

50-Year Life Cycle of a Facility
Summary

REDWOOD INFORMATION CENTER		
CRV for Asset (note: bldg only)		$ 971,104
	Annual	50 years
Facility Operations	$ 40,269	$ 2,013,425
Facility Maintenance	$ 7,117	$ 355,852
Recapitalizations		$ 226,801
Grand Total	$ 47,386	$ 2,596,078
	5%	267%

Modeling is another way to determine the Total Cost of Ownership required to operate and maintain a facility over its useful life.



Overview – O&M Modeling

- Annual Maintenance Budget Development
  - Represents methodologies for developing annual maintenance costs on fixed assets
  - Typically represent re-occurring costs associated with the achievement of the assets design life or intended function
- A wide range of methodologies is currently in use within the public and private sectors

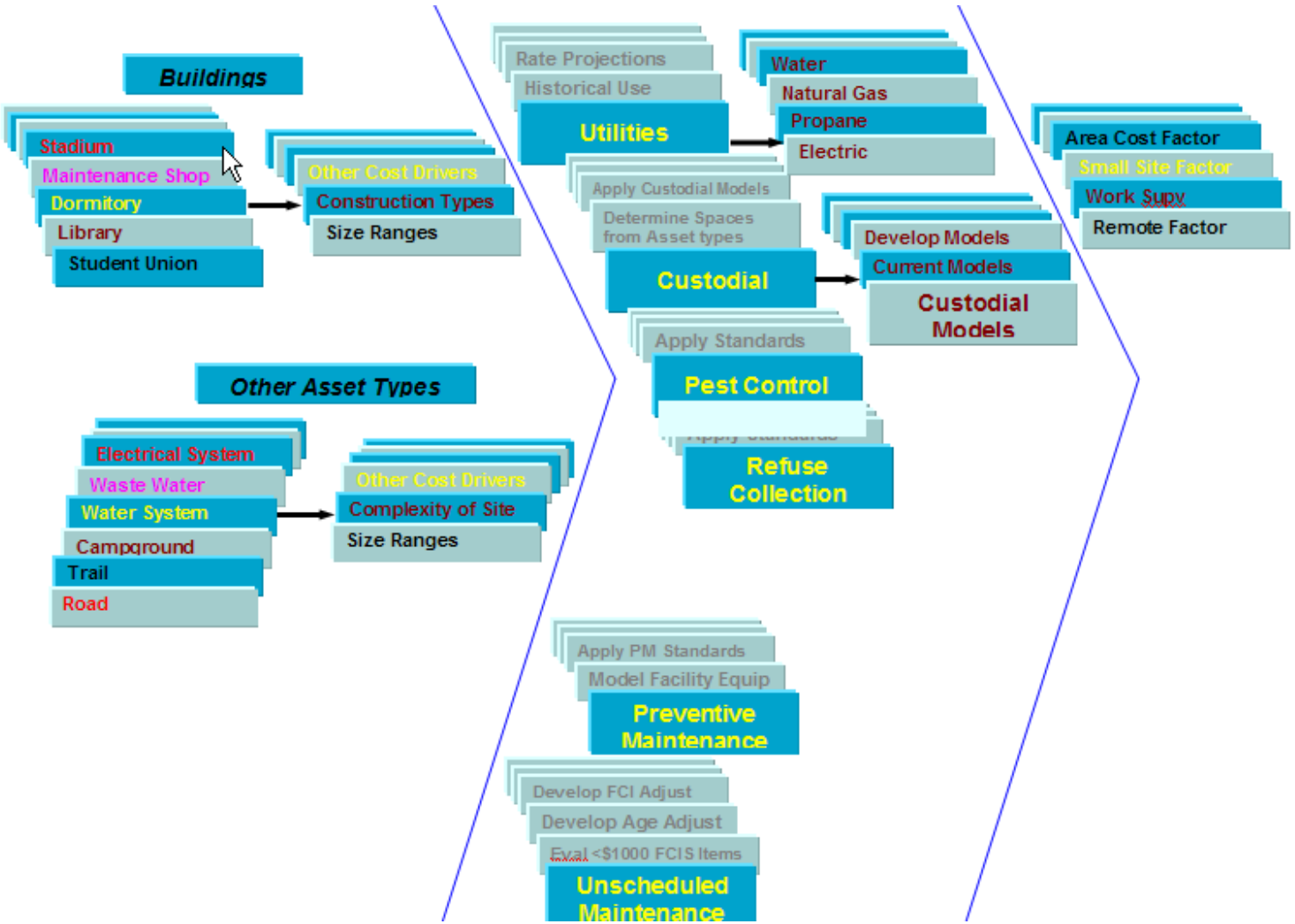
What is Modeling

- Modeling is the use of a representative amount of data to predict the outcome for a large amount of data.
- Used the O&M requirements generated by facility models to predict the overall O&M requirements of all facilities.

Why Models

- ❑ Less costly to maintain
- ❑ More consistent site to site
- ❑ Repeatable and documented
- ❑ Defines the O&M funding need more clearly
- ❑ Easier to generate the numbers
- ❑ Can be applied to new and projected construction

OPERATIONS & MAINTENANCE SQUARE FOOT MODELING



Building Types

Animal Shelter
Auditorium
Boiler, Heating Plant
Cafeteria
Chemical-Paint Storage
Communications Equipment
Courthouse
Day Care
Dining Hall
Facility Management Shop
Fire Dormitory
Fire Station
Fire Tower
Fire Tower w/Apartment
Forestry Building
Forestry Shop

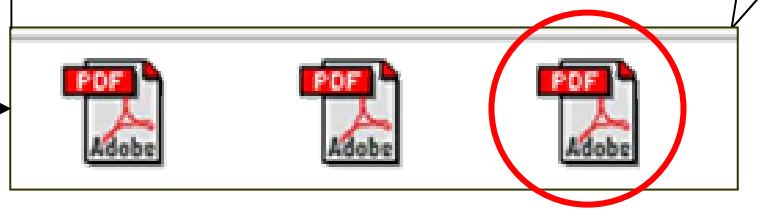
Garage
Green House
Gymnasium
Irrigation Shop
Kitchen
Laboratory
Laboratory-Dark Room
Law Enforcement Center
Library
Maintenance Shop
Medical Clinic
Multi-purpose
Multi-purpose Shop
Museum
Non-heat Storage
Office-General
Other

Building Types

Quarters Garage-detached
Quarters Apartment
Quarters Multi-Family
Quarters Single-Family
Restroom
Road Shop
School-Day
School-Elementary-Boarding Day
School-Elementary Boarding
School-Elementary Day
School-Middle Day

School-Other
School-Post Secondary Boarding
School-Pre-School Day
School-Secondary Boarding
School-Vocational Shop
Security
Shed
Shop
Stadium
Student Union
Swimming Pool
Trailer Housing
Utility Plant
Warehouse

3 Models



Up_2K 2001_5K Over_5K

Models were created for:

- ❑ Recurring Maintenance
- ❑ Preventive Maintenance
- ❑ Custodial
- ❑ Refuse
- ❑ Unscheduled
- ❑ Site
- ❑ Utilities

Recurring Maintenance

02/26/03 RECURRING MAINTENANCE MODEL Page: 1

USAGE CODE MT MAINTENANCE SHOP RANGE: Over 5000 SF

Model: A01-01 Facility Number: [illegible]

Reference	Description	Quantity	UOM	Hrs Per UOM	Recurring Hours	Cost Per UOM	Recurring Cost	Material Cost Per UOM	Material Cost	Total Cost	Occur-ance	Annualized Cost
08.01.011	PREP/PAINT INTERIOR WALLS	16338.0	SF	0.016	261.408	0.330	5391.54	0.141	2303.66	7695.20	0.20	1539.04
11.01.090	PREP/CAULK PERSONNEL DOORS	34.66	LF	0.040	1.386	0.640	22.18	0.195	6.76	28.94	0.20	5.79
11.01.040	PREP/PAINT PERSONNEL DOOR	2.00	EA	2.150	4.300	45.150	90.30	6.276	12.55	102.85	0.20	20.57
11.01.090	PREP/CAULK EQUIPMENT DOORS	112.00	LF	0.040	4.480	0.640	71.68	0.195	21.84	93.52	0.20	18.70
11.01.060	PREP/PAINT EQUIPMENT DOOR	360.00	SF	0.037	13.320	0.780	280.80	0.216	77.76	358.56	0.20	71.71
10.01.110	PREP/CAULK EXTERIOR WINDOWS	120.67	LF	0.040	4.827	0.640	77.23	0.195	23.53	100.76	0.20	20.15
10.01.020	PREP/PAINT EXTERIOR WINDOWS, ONE STORY	102.97	SF	0.110	11.327	2.310	237.86	0.151	15.55	253.41	0.20	50.68
9.6-130-0020	RELAMP FLUORESCENT FIXTURE	69.50	EA	0.310	21.545	10.990	763.81	5.850	406.58	1170.38	0.24	280.89
APPLY TO ALL FACILITIES IN RANGE			Totals:		322.59		6935.40		2868.23	9803.62		1960.724
			Per SF:		0.0434		0.9322		0.3855	1.3177		0.2635
02.01.010	PREP/PAINT OR SEAL EXTERIOR WALLS, ONE STORY	5809.00	SF	0.010	58.090	0.210	1219.89	0.141	819.07	2038.96	0.20	407.79
ADD ON FOR EXTERIOR PAINTED FACILITIES			Totals:		58.09		1219.89		819.07	2038.96		407.792
			Per SF:		0.0078		0.1640		0.1101	0.2741		0.0548

Preventive Maintenance

PREVENTIVE MAINTENANCE MODEL

MAINTENANCE SHOP - 5000 SQ FT (A01-01)

Equipment Type	Labor Hours	Labor Rate	Labor Cost	Material	Total Cost	Quantity	Annual Cost
EXTINGUISHING SYSTEM, WET PIPE	11.34	25.71	291.58	117.70	409.28	1	409.28
FIRE ALARM ANNUNCIATOR SYSTEM	11.05	25.71	284.10	107.00	391.10	1	391.10
OVERHEAD ROLL-UP, METAL, ELECTRIC	4.07	25.71	104.64	46.55	151.19	4	604.76
CONDENSING UNIT, AIR COOLED, 3 TO 25 TONS	2.56	25.71	65.79	64.20	129.99	1	129.99
FORCED AIR HEATER, OIL OR GAS FIRED, COMMERCIAL,UP TO 120 MBH	5.80	25.71	149.12	96.30	245.42	1	245.42
UNIT HEATER, GAS INFRARED	1.50	25.71	38.67	21.40	60.07	4	240.28
FAN, ROOF/ WALL, EXHAUST, 18" X 18" BASE AND ABOVE (5,000 CFM)	1.18	25.71	30.23	5.35	35.58	2	71.16
WATER HEATER, GAS, TO 120 GALLONS	1.72	25.71	44.20	42.80	87.00	1	87.00
SECURITY/INTRUSION ALARM SYSTEM	3.83	25.71	98.52	39.06	137.58	1	137.58
REFRIGERATOR, RESIDENTIAL	0.23	25.71	6.02	12.04	18.06	1	18.06
							2334.63
TOTAL							

Custodial Maintenance

02/[illegible]/03

Page: 1

USAGE CODE MT : MAINTENANCE SHOP **RANGE: Over 5000 SF**

Model: A01-01 Facility Number: 2009

Room	Area	Room Use	Custodial Standard	Hours Per SF	Custodial Hours	Cost Per SF	Custodial Cost	Material Cost Per SF	Material Cost	Total Cost
100	246	OFFICE, NON-CARPET	CM01	0.1270	31.242	2.1775	535.67	0.1100	27.06	562.73
101	1053	MAINTENANCE SHOP	CM18	0.0331	34.854	0.5671	597.16	0.0100	10.53	607.69
101Q	162	MAINTENANCE SHOP	CM18	0.0331	5.362	0.5671	91.87	0.0100	1.62	93.49
101Q	162	MAINTENANCE SHOP	CM18	0.0331	5.362	0.5671	91.87	0.0100	1.62	93.49
102	126	TOOL CRIB	CM18	0.0331	4.171	0.5671	71.45	0.0100	1.26	72.71
103	54	RESTROOM	CM03	0.8029	43.357	13.7689	743.52	0.1100	5.94	749.46
104	36	RESTROOM	CM03	0.8029	28.904	13.7689	495.68	0.1100	3.96	499.64
105	108	OFFICE, NON-CARPET	CM01	0.1270	13.716	2.1775	235.17	0.1100	11.88	247.05
106	234	OFFICE, NON-CARPET	CM01	0.1270	29.718	2.1775	509.54	0.1100	25.74	535.28
107	234	OFFICE, NON-CARPET	CM01	0.1270	29.718	2.1775	509.54	0.1100	25.74	535.28
108	972	STORAGE	CM18	0.0331	32.173	0.5671	551.22	0.0100	9.72	560.94
108Q	60	STORAGE	CM18	0.0331	1.986	0.5671	34.03	0.0100	0.60	34.63
108Q	66	STORAGE	CM18	0.0331	2.185	0.5671	37.43	0.0100	0.66	38.09
109	180	OFFICE, NON-CARPET	CM01	0.1270	22.860	2.1775	391.95	0.1100	19.80	411.75
110	729	STORAGE	CM18	0.0331	24.130	0.5671	413.42	0.0100	7.29	420.71
111	1080	STORAGE	CM18	0.0331	35.748	0.5671	612.47	0.0100	10.80	623.27
B001	216	CHEMICAL/PAINT STORAGE	CM18	0.0331	7.150	0.5671	122.49	0.0100	2.16	124.65
112	72	STAIRWELL, NON-CARPET	CM12	0.1145	8.244	1.9636	141.38	0.0100	0.72	142.10
EXT	5809	EXTERIOR WINDOWS	CM15	0.0007	4.066	0.0123	71.45	0.0000	0.00	71.45

se	Custodial Standard	Hours Per SF	Custodial Hours	Cost Per SF	Custodial Cost	Material Cost Per SF	Material Cost	Total Cost
	Totals:		364.95		6257.31		167.10	6424.41
	Per SF:		0.0491		0.8410		0.0225	0.8635

Facility Management Program

Refuse Collection

02/27/03 REFUSE COLLECTION MODEL Page: 1

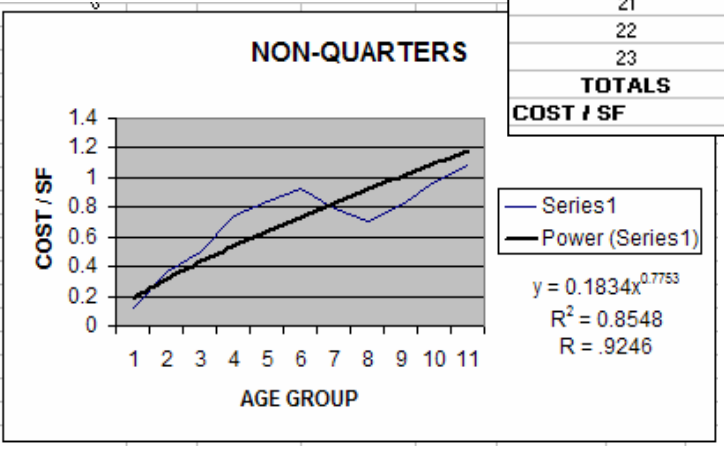
USAGE CODE MT : MAINTENANCE SHOP RANGE: Over 5000 SF

Model: A01-01 Facility Number: 2009

Reference	Description	HOURS	UOM	Quantity	Total Hours	Total Cost	Occurance	Annualized Cost
ST-048	EMPTY 25 CUBIC FOOT CONTAINER INTO 30 OR 40 CUBIC YARD CONTAINER.	0.075	CONTAINER	74.00	5.569	111.37	1.00	111.37
ST-008	PICK UP, UNLOAD AT DISPOSAL SITE, AND RETURN 30 OR 40 CUBIC YARD CONTAINER. FIVE MILE RADIUS.	0.317	CONTAINER	4.00	1.268	25.37	1.00	25.37
	APPLY TO ALL FACILITIES IN RANGE	Totals:			6.837	136.74		136.74
		Per SF:			0.0006	0.0184		0.0150

Unscheduled Maintenance

Age Group	Facility Age in Group	Total Fac Area For Age Group	% of Total Area	Running % Total	Total Unsch Maint ($) fo Age Group	Cost per SQ FT	Applying Chart Formula	Total Using Formula
1	0-5	272,669	1.42	1.42	33,565	**0.123**	0.1757	47,908
2	6-10	1,604,480	8.37	9.79	582,526	**0.363**	0.305763075	490,591
3	11-15	1,078,188	5.62	15.41	535,273	**0.496**	0.422799807	455,858
4	16-20	1,470,368	7.67	23.08	1,098,114	**0.747**	0.532106192	782,392
5	21-25	1,651,532	8.61	31.69	1,378,199	**0.834**	0.636002007	1,050,378
6	26-30	1,669,365	8.71	40.4	1,544,121	**0.925**	0.735780131	1,228,286
7	31-35	1,963,776	10.24	50.64	1,543,086	**0.786**	0.832259239	1,634,371
8	36-40	3,930,255	20.5	71.14	2,786,324	**0.709**	0.926001282	3,639,421
9	41-45	1,596,976	8.33	79.47	1,304,608	**0.817**	1.017414211	1,624,786
10	46-50	801,669	4.18	83.65	783,228	**0.977**	1.106806654	887,293
11	51-55	251,178	1.31	**84.96**	272,793	**1.086**	1.194419637	300,012
12	56-60	133,426	0.7	85.66	93,612	0.702	1.280446188	170,845
13	61-65	582,752	3.04	88.7	793,567	1.362	1.365044102	795,482
14	66-70	767,682	4	92.7	833,630	1.086	1.448344587	1,111,868
15	71-75	554,486	2.89	95.59	437,627	0.789	1.530458314	848,618
16	76-80	206,050	1.07	96.66	209,146	1.015	1.611479791	332,045
17	81-85	112,106	0.58	97.24	64,271	0.573	1.691490583	189,626
18	86-90	145,703	0.76	98	129,819	0.891	1.770561738	257,976
19	91-95	123,578	0.64	98.64	189,226	1.531	1.848755652	228,466
20	96-100	112,877	0.59	99.23	159,807	1.416	1.926127523	217,415
21	101-105	57,748	0.3	99.53	92,079	1.594	2.002726497	115,653
22	106-110	22,162	0.12	99.65	46,619	2.104	2.078596589	46,066
23	111-115	65,084	0.34	99.99	79,103	1.215	2.153777426	140,176
TOTALS		**19,174,110**			**14,990,343**			**16,595,531**
COST / SF					**0.782**			**0.866**



Site Maintenance

Facility Management Program

02/26/03

Page: 1

LOCATION CODE: A01-01 SITE: CHEYENNE RIVER AGENCY/EAGLE BUTTE

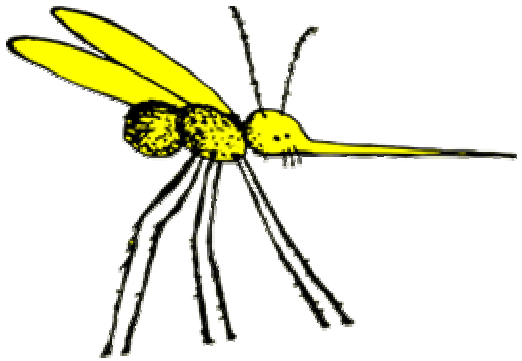
Reference	Description	Quantity	UOM	Hrs Per UOM	Site Hours	Cost Per UOM	Site Cost	Material Cost Per UOM	Material Cost	Total Cost	Occur-ance	Annualized Cost
01833-530-0030	MOW LAWN, PUSH MOWER	577.50	MSF	0.067	38.693	1.179	680.87	0.000	0.00	680.87	17.0	11574.79
01833-530-0050	MOW LAWN, RIDING MOWER	153.40	MSF	0.027	4.142	0.475	72.87	0.000	0.00	72.87	17.0	1238.79
01833-530-0020	MOW LAWN, ROUGH AREAS	796.63	MSF	0.100	79.663	1.760	1402.07	0.000	0.00	1402.07	17.0	23835.19
01833-530-0090	LAWN TRIMMING, WEED WHACKER	18170.0	LF	0.001	18.170	0.018	327.06	0.000	0.00	327.06	17.0	5560.02
01833-520-0230	PRUNE SHRUBS	1.69	MSF	1.143	1.932	20.117	34.00	20.117	34.00	68.00	6.00	408.00
01833-510-0040	EDGE SIDEWALKS, POWER EDGER	143.63	CLF	0.091	13.070	1.602	230.10	0.000	0.00	230.10	17.0	3911.70
12.3-500-1010	REPLACE LAMP,POLE MOUNTED FIXTURE,BALL FIELD/STADIUM	4.00	EA	0.474	1.896	16.800	67.20	52.000	208.00	275.20	0.10	27.52
12.3-500-1010	REPLACE LAMP,POLE MOUNTED FIXTURE,STREET/PARKING	28.00	EA	0.474	13.272	16.800	470.40	52.000	1456.00	1926.40	0.10	192.64
9.6-140-1020	REPLACE LAMP, PATH/SITE LIGHTING	3.00	EA	0.464	1.392	16.450	49.35	28.500	85.50	134.85	0.10	13.49
01833-540-0020	LAWN AERATION, 18" WALK BEHIND CULTIVATOR	577.50	MSF	0.084	48.510	1.478	853.55	0.000	0.00	853.55	1.00	853.55
01833-540-0030	LAWN AERATION, 48" TRACTOR DRAWN CULTIVATOR	153.40	MSF	0.011	1.687	0.194	29.76	0.000	0.00	29.76	1.00	29.76
01833-540-0050	LAWN FERTILIZING, DROP SPREADER	577.50	MSF	0.333	192.31	5.861	3384.73	1.850	1068.38	4453.11	1.00	4453.11
01833-540-0060	LAWN FERTILIZING, ROTARY SPREADER	153.40	MSF	0.057	8.744	1.003	153.86	1.750	268.45	422.31	1.00	422.31
01833-540-0090	LAWN OVERSEEDING, DROP SPREADER	577.50	MSF	0.800	462.00	14.080	8131.20	7.750	4475.63	12606.8	1.00	12606.83

Reference	Description	Quantity	UOM	Hrs Per UOM	Site Hours	Cost Per UOM	Site Cost	Material Cost Per UOM	Material Cost	Total Cost	Occur-ance	Annualized Cost
G-0035	STREET SNOW REMOVAL (2-4"), RIDE-ON EQUIPMENT	19.90	MI	0.206	4.099	3.626	72.16	0.500	9.95	82.11	1.00	82.11
G-0037	PARKING LOT SNOW REMOVAL (2-4"), RIDE-ON EQUIPMENT	1165.40	MSF	0.033	38.458	0.586	682.92	0.011	12.82	695.74	1.00	695.74
G-0033	SIDEWALK SNOW REMOVAL (OVER 4"), WALK BEHIND EQUIPMENT	143.63	CLF	0.141	20.252	2.482	356.49	0.401	57.60	414.09	1.00	414.09
G-0036	STREET SNOW REMOVAL (OVER 4"), RIDE-ON EQUIPMENT	1.81	MI	0.291	0.527	5.122	9.27	0.750	1.36	10.63	1.00	10.63
G-0038	PARKING LOT SNOW REMOVAL (OVER 4"), RIDE-ON EQUIPMENT	105.95	MSF	0.061	6.463	1.074	113.79	0.011	1.17	114.96	1.00	114.96
TOTALS FOR : A01-01		Totals:			1161.84		20757.63		9749.63	30507.26		73,113.86

Utilities

Utilities	OM	Electrical		36040KWH	$5,074.00	1 year	$5,074.00
	OM	Propane (heating)		862 GAL	$912.00	1 year	$912.00
	OM	Water		40600 GAL	$739.00	1 year	$739.00
Based on 5-Year Average							

Note: Working on method for capturing administrative, supervision, meeting costs and as % of CRV, distributing cost across asset portfolio



THE END - ANY QUESTIONS?