Making Work Management Systems Work for You: The City of Bend Water Reclamation Facility Expansion Story

Presentation at: INFRA 2015

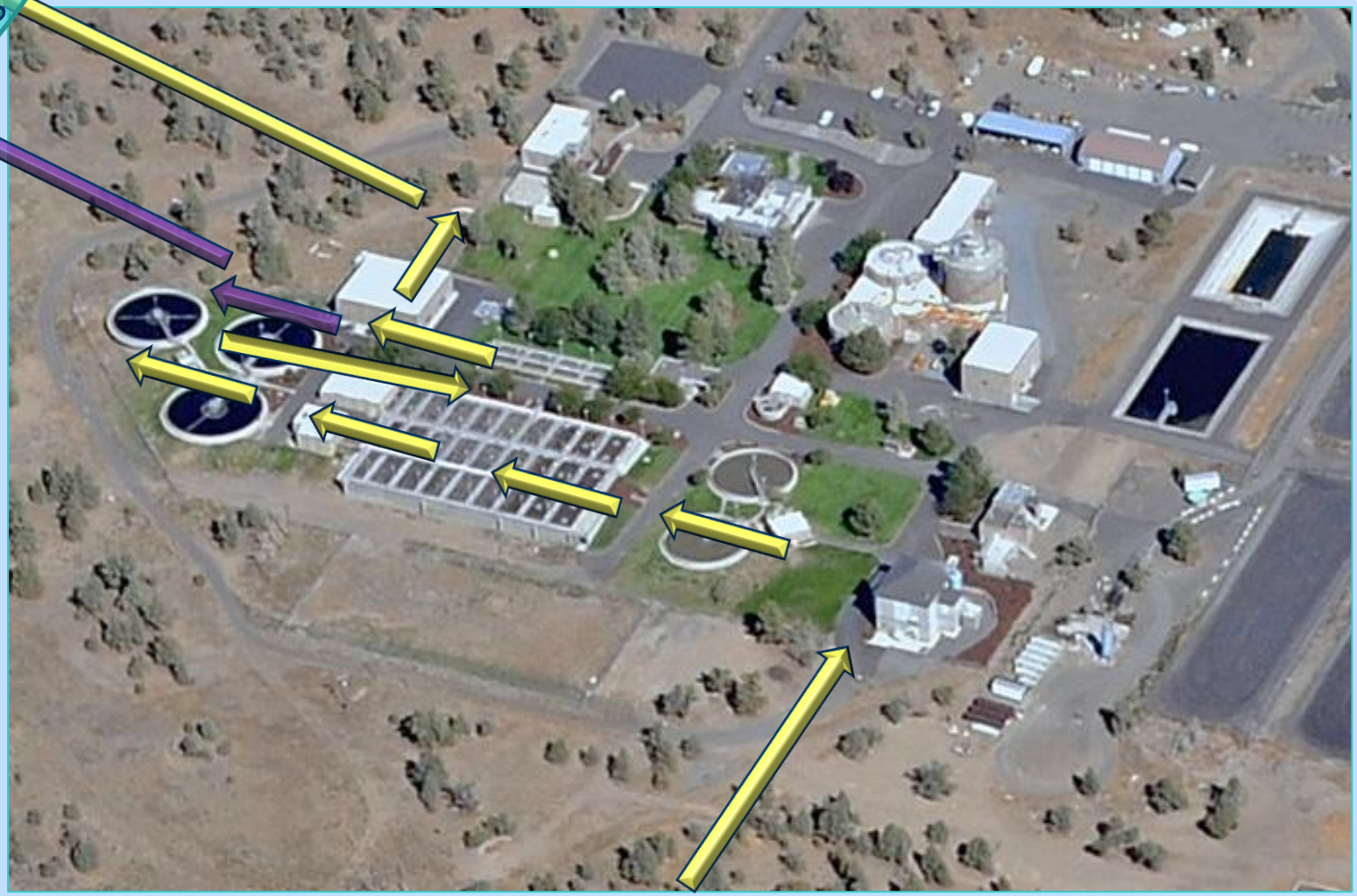
Agenda

- Overview Project
- Highlights
  - Preliminary activities
  - Design activities
  - Construction period activities
- Making Work Management System Work for you
  - Objectives
  - Steps
  - Success factors
  - Lessons learned
  - Benefits

Overview

- City of Bend: 81,236 pop; Metro area 165,954 (2013)
- Median household income: $48,014 (2013)
- Median age: 36.6 yrs (2013)
- Post-recession growth

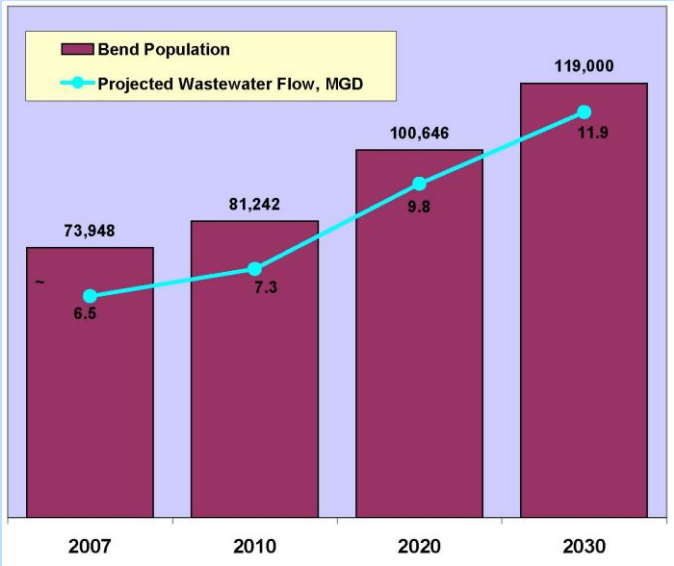
Existing Facilities Operation



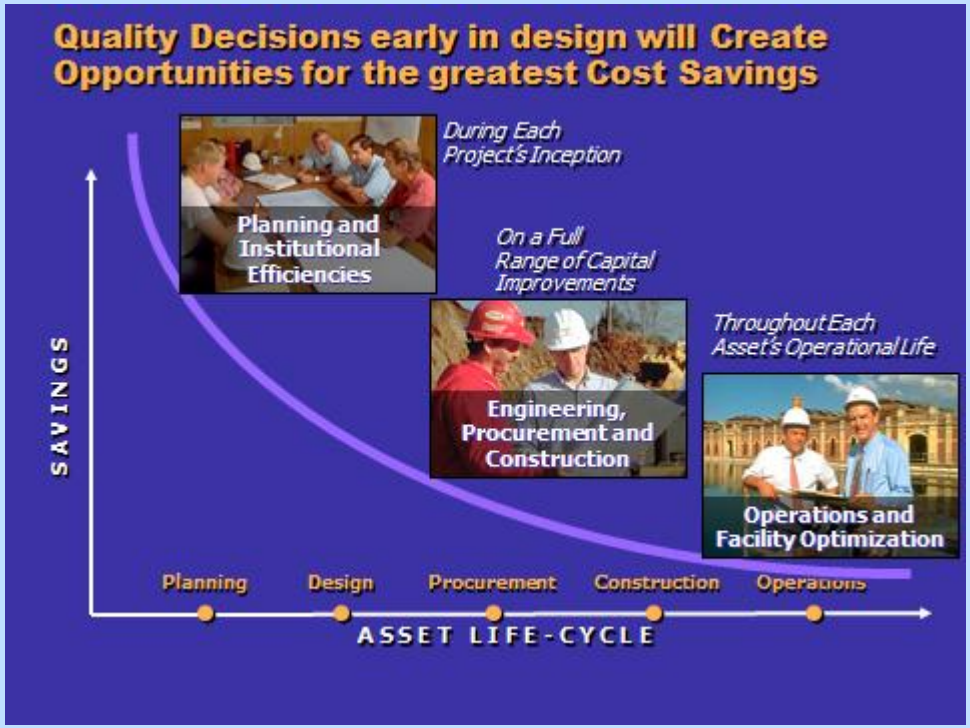
Treatment Process Flow Path

WRF: Facilities Plan to Construction

- Plan completed in June 2008 by Carollo Engineers
- Plan developed to provide a guidance document to year 2030
- Anticipated Bend population of 119,000 in 2030
- Current secondary treatment system deemed “insufficient to meet future flows and loads”
  - Current flows near 6.0 MGD
  - Design 2010-2012
  - Construction 2013 - current

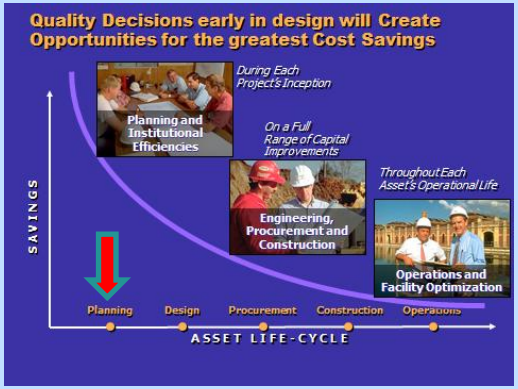


Asset Management: Opportunities to optimize asset value for your customers occurs throughout the entire life cycle

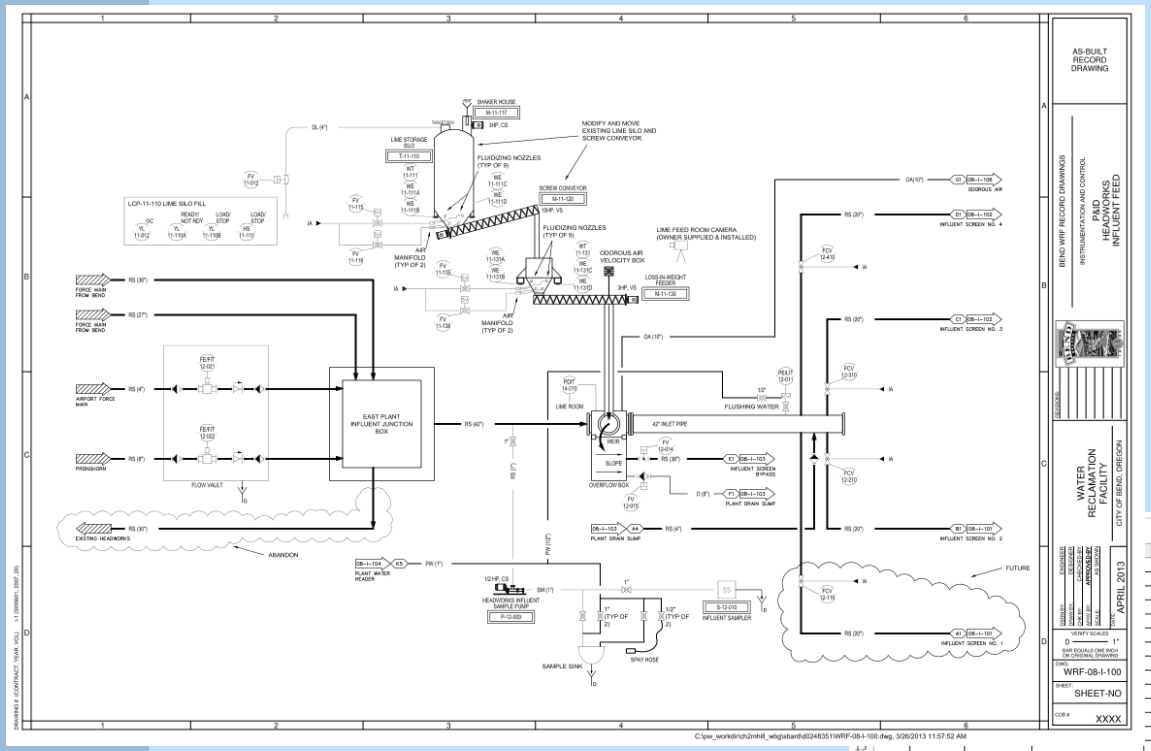


At the WRF, opportunities started early

- At the onset, the City of Bend performed:
  - Plant Upgrade pre-design activities
  - SCADA Project (Ongoing)
  - INFOR Work Management System deployment



Plant Upgrade pre-design activities

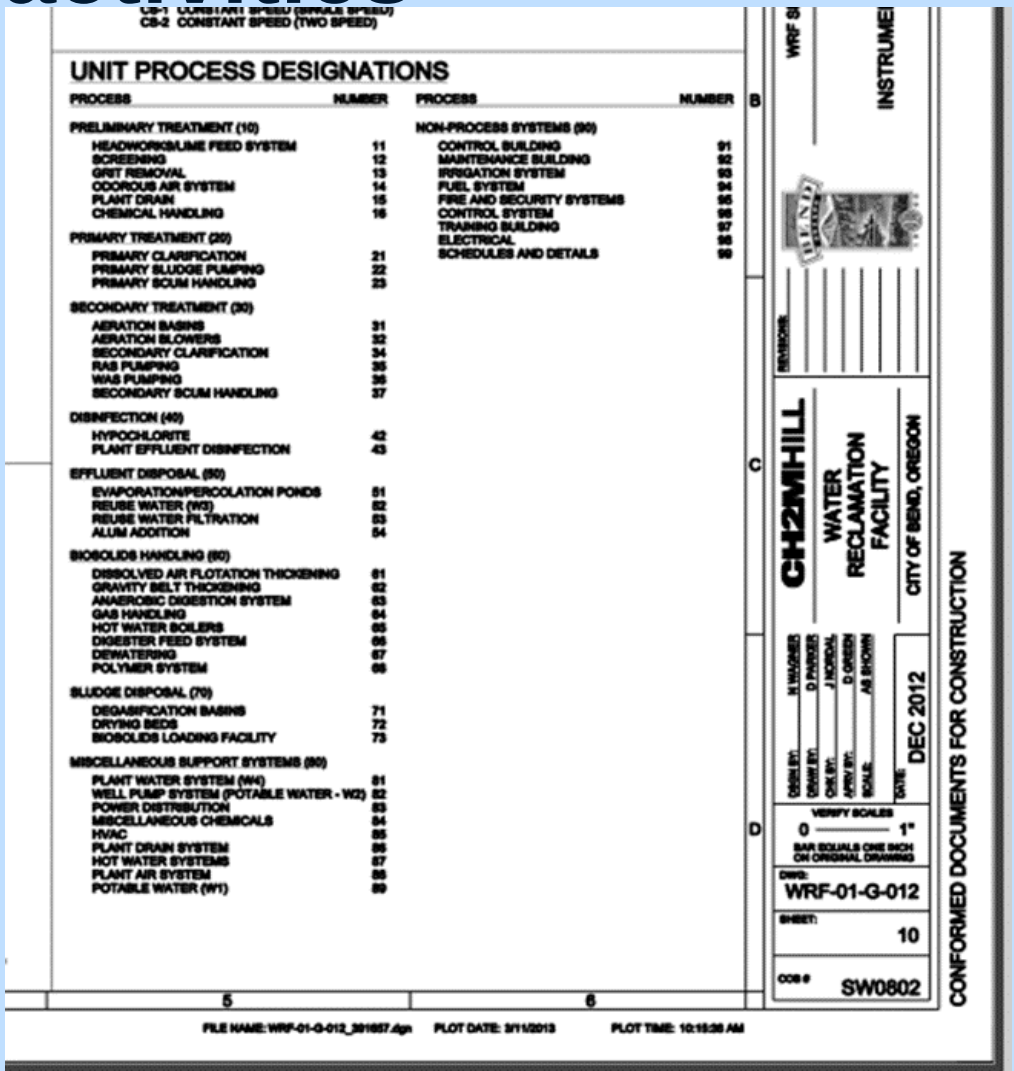


- Record Drawings and Plant O&M Data Consolidation

	E	F	G	H	I	J	K	L	M	N
	EQUIPMENT ITEM	TAG	MANUFACTURER	MODEL	SERIAL NUMBER	HP	VOLTS/AMPS	FRAME	RPM / SF	
	Lime Silo		Diversified	350-10NT	489	10				
			Storage Systems							
	Lime Silo Motor	M-11-120	Lincoln Electric	AF4P10TC61	U3990306414	10	230 / 460 V		1750 RPM	
							28 /14 Amps		1.25 SF	
	Gear Drive		Baldor	Catalog: G1F0972D						
	Vibrator		Invicta Vibrators	Unit-BL15-3/4 206086			230 / 460 V		1728 RPM	
							1.1/.64 Amps			
	Fluidizing Nozzle	FV-11-115	Asco	Catalog: 8210G004	T 381947		24 VDC			
	Air Valve No. 1									
	Solenoid									
	Fluidizing Nozzle	FV-11-116	Asco	Catalog: 8210G004	T 742164		24 VDC			
	Air Valve No. 2									
	Solenoid									
2	WRF	Headworks	Lime Silo Loading Valve	Valve	FV-11-012					
					ZS-11-012O		NO DATA			
					ZS-11-012C					
					FY-11-012					
3	WRF	Headworks	Lime Silo Weight	Load Cell (4 Each))	11WE111A	Sartorious	PR6201/34 D1	2806066886		
					11WE111B		NC: 940526201341			
					11WE111C		9.40526E+11			
					11WE111D					
				Junction		Sartorious	Type: PR6001/015	0907 0408 0406		

WRF Headworks Process Equipment

Plant Upgrade pre-design activities



CS-1 CONSTANT SPEED (SINGLE SPEED)
CS-2 CONSTANT SPEED (TWO SPEED)

UNIT PROCESS DESIGNATIONS

PROCESS	NUMBER
PRELIMINARY TREATMENT (10)	
HEADWORKS/LIME FEED SYSTEM	11
SCREENING	12
GRIT REMOVAL	13
ODOROUS AIR SYSTEM	14
PLANT DRAIN	15
CHEMICAL HANDLING	16
PRIMARY TREATMENT (20)	
PRIMARY CLARIFICATION	21
PRIMARY SLUDGE PUMPING	22
PRIMARY SCUM HANDLING	23
SECONDARY TREATMENT (30)	
AERATION BASINS	31
AERATION BLOWERS	32
SECONDARY CLARIFICATION	34
RAS PUMPING	35
WAS PUMPING	36
SECONDARY SCUM HANDLING	37
DISINFECTION (40)	
HYPOCHLORITE	42
PLANT EFFLUENT DISINFECTION	43
EFFLUENT DISPOSAL (50)	
EVAPORATION/PERCOLATION PONDS	51
REUSE WATER (W3)	52
REUSE WATER FILTRATION	53
ALUM ADDITION	54
BIOSOLIDS HANDLING (60)	
DISSOLVED AIR FLOTATION THICKENING	61
GRAVITY BELT THICKENING	62
ANAEROBIC DIGESTION SYSTEM	63
GAS HANDLING	64
HOT WATER BOILERS	65
DIGESTER FEED SYSTEM	66
DEWATERING	67
POLYMER SYSTEM	68
SLUDGE DISPOSAL (70)	
DEGASIFICATION BASINS	71
DRYING BEDS	72
BIOSOLIDS LOADING FACILITY	73
MISCELLANEOUS SUPPORT SYSTEMS (80)	
PLANT WATER SYSTEM (W4)	81
WELL PUMP SYSTEM (POTABLE WATER - W2)	82
POWER DISTRIBUTION	83
MISCELLANEOUS CHEMICALS	84
HVAC	85
PLANT DRAIN SYSTEM	86
HOT WATER SYSTEMS	87
PLANT AIR SYSTEM	88
POTABLE WATER (W1)	89

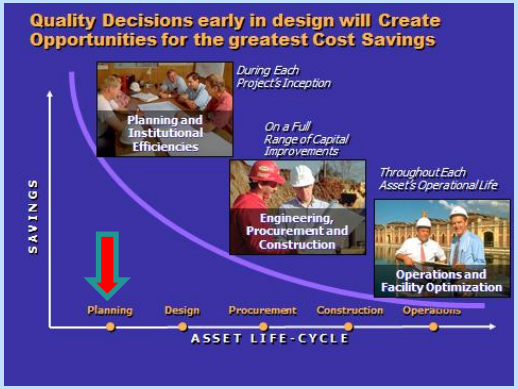
PROCESS	NUMBER
NON-PROCESS SYSTEMS (90)	
CONTROL BUILDING	91
MAINTENANCE BUILDING	92
IRRIGATION SYSTEM	93
FUEL SYSTEM	94
FIRE AND SECURITY SYSTEMS	95
CONTROL SYSTEM	96
TRAINING BUILDING	97
ELECTRICAL	98
SCHEDULES AND DETAILS	99

CH2MHILL
WATER RECLAMATION FACILITY
CITY OF BEND, OREGON
DEC 2012
VERIFY SCALES
0 — 1"
BAR EQUALS ONE INCH ON ORIGINAL DRAWING
DWG: WRF-01-G-012
SHEET: 10
CCB #: SW0802
CONFORMED DOCUMENTS FOR CONSTRUCTION

5 6

FILE NAME: WRF-01-G-012_391657.dgn PLOT DATE: 3/11/2013 PLOT TIME: 10:15:36 AM

- Organize and define system processes



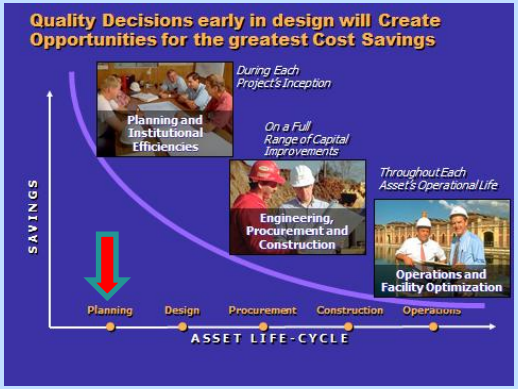
Plant Upgrade pre-design activities

- Plant Inventory of all existing systems (process, HVAC, electrical, etc.)

Process	Equipment Name	Location	Tag#
AERATION	Aeration Blower #1	Blower Bldg	B-032-1001
AERATION	Aeration Blower #2	Blower Bldg	B-032-1002
AERATION	Aeration Blower #3	Blower Bldg	B-032-1003
AERATION	Aeration Mixed Liquor Pump #1		M-31-010
AERATION	Aeration Mixed Liquor Pump #2		M-31-020
AERATION	Aeration Mixed Liquor Pump #3		P-31-341
AERATION	Aeration 12" Primary Flow Meter #1	Pipe Gallery	FIT-31-102
AERATION	Aeration 12" Primary Flow Meter #2	Pipe Gallery	FIT-31-202
AERATION	Aeration 12" Primary Flow Meter #3	Pipe Gallery	FIT-31-302
AERATION	Aeration 18" Primary Flow Meter #1	Pipe Gallery	FIT-31-304
AERATION	Aeration 18" Primary Flow Meter #2	Pipe Gallery	FIT-31-204
AERATION	Aeration 18" Primary Flow Meter #3	Pipe Gallery	FIT-31-302
AERATION	Aeration 10" RAS Flow Meter #1	Pipe Gallery	FIT-31-104
AERATION	Aeration 10" RAS Flow Meter #2	Pipe Gallery	FIT-31-204
AERATION	Aeration 10" RAS Flow Meter #3	Pipe Gallery	FIT-31-304
AERATION	Control Valves		
AERATION	Flow Meters		
AERATION	Aeration Blower #4	Blower Bldg	B-032-1004
AERATION	Sump Pump to Drain Pit		P-031-0031

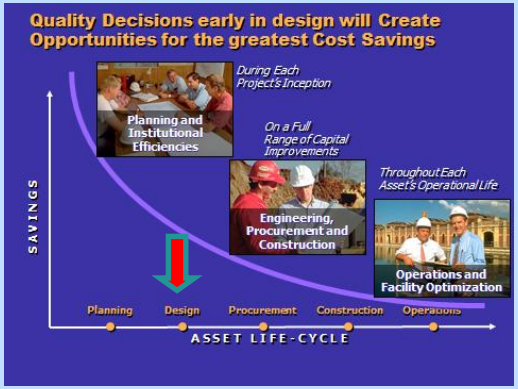
SCADA Project provides more

- Developed a SCADA Users Group team
- Define and status the existing SCADA system
- Develop and implement SCADA Standards, prioritize and implement projects



Other Project Design activities served as further building blocks

- Set up site for ease of documents storage and retrieval - Sharepoint, EADOC
- Process Control Narratives and P&ID's
- Develop Design documents



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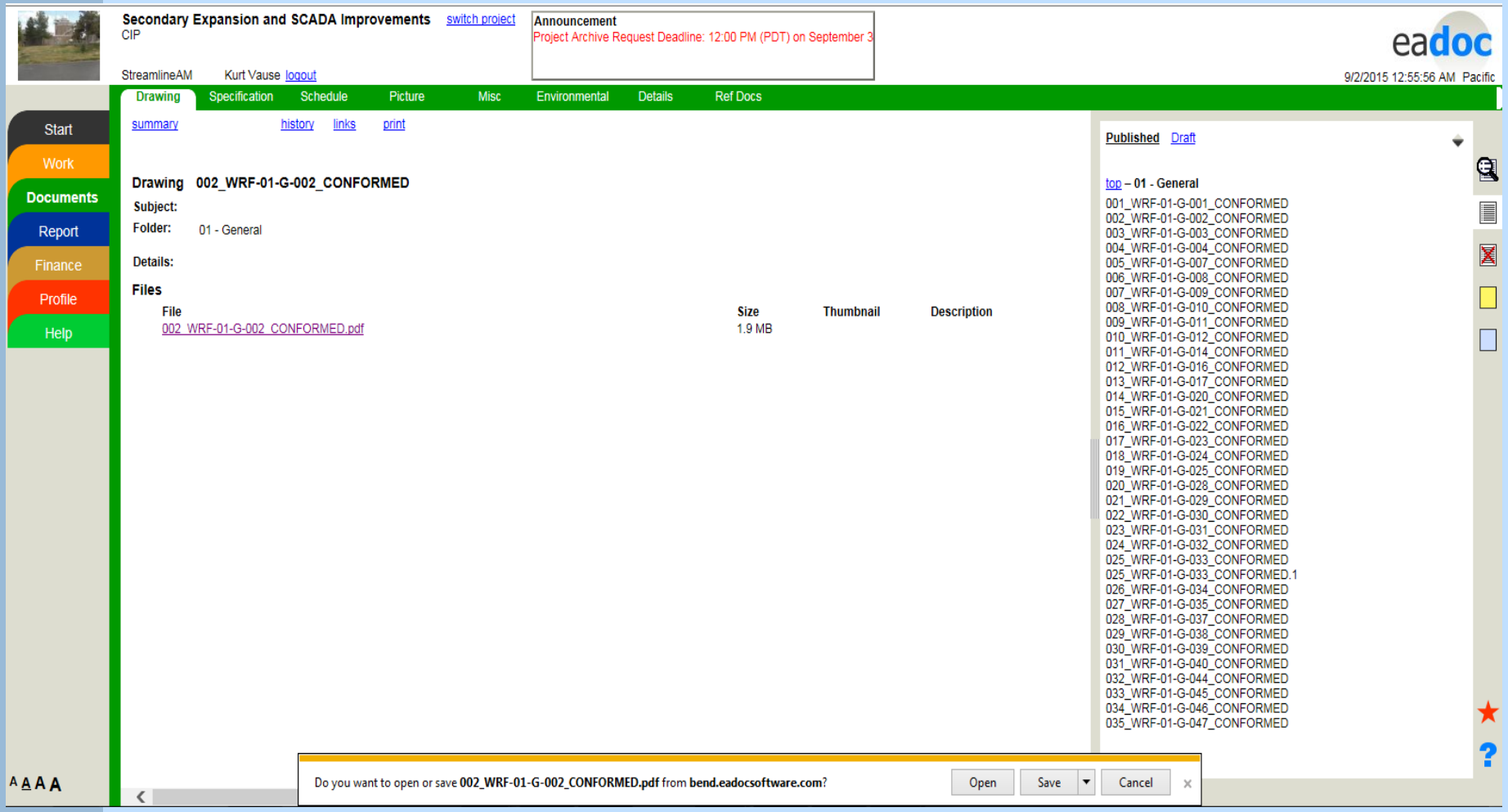
Project Document Management and Collaboration



Develop Process Control Narratives

PROCESS CONTROL NARRATIVES

1.1 Introduction

This control narrative describes the overall general control philosophy for the plant for each of the unit process areas. Specific loop descriptions, alarms, interlocks, and other special software control will be outlined at the Draft Construction Phase of the design.

1.1.1 General Control Definition

Described below, most equipment will be operated in two modes; LOCAL or REMOTE:

- In LOCAL mode, control of equipment is done in the field via field panels, instruments, sensors, hand switches, control valves, and local controls. The programmable logic controller (PLC) has no supervisory control over the equipment.
- In REMOTE mode (same as AUTO position on a JOG/OFF/AUTO or JOA switch) the equipment is controlled by the PLC and SCADA system with two main functions:
    - MANUAL: These functions are performed by PLCs via direct operator input via the Human Machine Interface (HMI).
    - AUTOMATIC: These functions are performed by PLCs via programmed control algorithms and changing process conditions. Operator has indirect control via the setpoints and parameters entered at the HMI.

10 Preliminary Treatment

Not part of project scope.

20 Primary Treatment

Primary Influent is gravity fed to the Primary Clarifiers after undergoing preliminary treatment at the Headworks. The Primary Clarifiers remove organic material from the primary influent flowstream in order to reduce loading at the secondary treatment processes. Primary Sludge (PSD) is removed by the Primary Sludge Pumps and pumped to the Anaerobic Digesters; the process flowstream exits the Primary Clarifiers as primary effluent that flows by gravity to the Aeration Basins. Scum and other floatable material is removed by the scum pumps and pumped to the Gravity Belt Thickener.

20.21 Primary Clarification

Reference P&IDs: 08-I-200, 08-I-202.

There are three Primary Clarifiers. Primary Influent flow is directed to a Primary Clarifier by manually opening or closing isolation gates immediately upstream of the Primary Clarifier at the Primary Influent Splitter Structure. For Primary Clarifier 3 (PC3) only, energy dissipating inlets and flocculation wells centered in the clarifier enhance flocculation. Each Primary Clarifier mechanism rotates around the column shaft to rake sludge to the center collection hopper at the base of the clarifier, and to skim accumulated scum to the scum beach. As the rake arm mechanism rotates past the walkway, a proximity sensor is triggered which opens the actuated foam spray valve inline to the spray bar along the clarifier walkway. These sprays and the rake arm skimmer push the scum onto the scum beach.

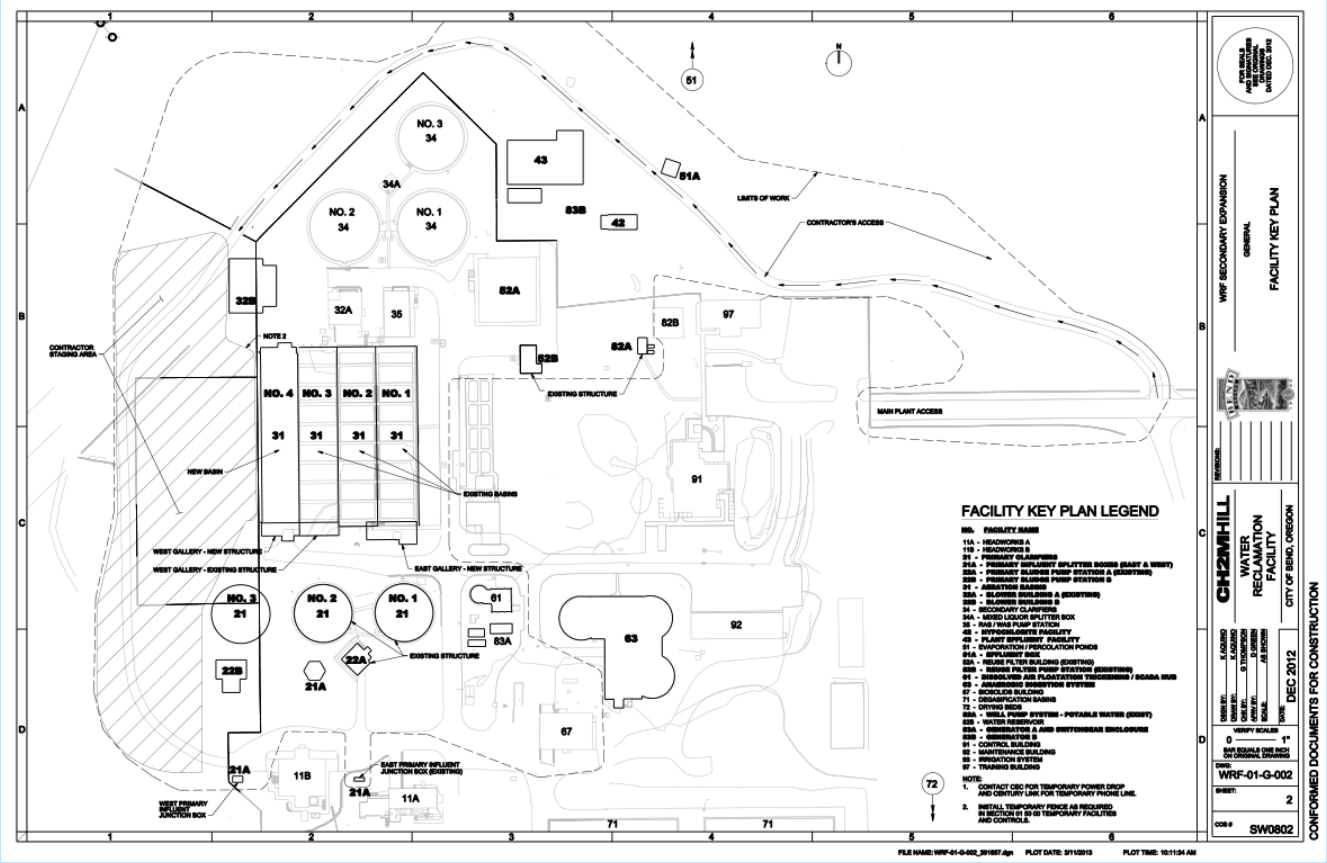
LOCAL Mode:

- There is only PLC monitoring of the Primary Clarifier rotating mechanism. A local control station is used for START and STOP control. An "E-Stop" button will be provided on PC3.

  On PC3, if the rotating mechanism becomes jammed or overloaded a HIGH torque alarm will be generated at the local control station and at the HMI. The PC3 mechanism will continue to operate in this condition. If the torque continues to increase to a HIGH-HIGH torque state a second alarm will be generated at the HMI and the mechanism will be automatically shut down by the motor drive requiring a local reset.

  Typically overflow weirs control water levels in the clarifiers. High level switches monitor for a high water surface level in each Primary Clarifier Launder. In the event that valves on the primary effluent lines are CLOSED the water surface level will rise and trigger a high water surface level alarm at the HMI.

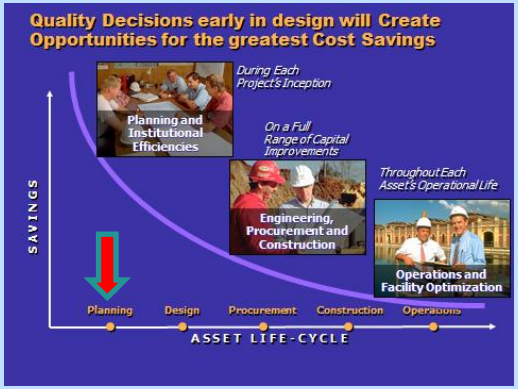
Develop the plans - Process Driven



INFOR Work Management System had been stood up

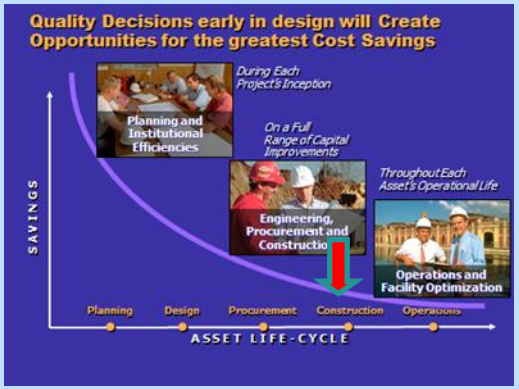
- Early stages of development
- Develop the team
- Develop the culture

But needed to address: Too much or too little information? What remained was to define the system and workflow needs



So, in making Work Management System work, the City:

- Established Overall objectives - Vertical Plant Hierarchy
  - A new plant inventory structure for new and existing plant assets
  - Living documentation processes for new and existing plant inventory
  - Compile, load & validate data in INFOR
  - Work Management System integration with existing systems and data

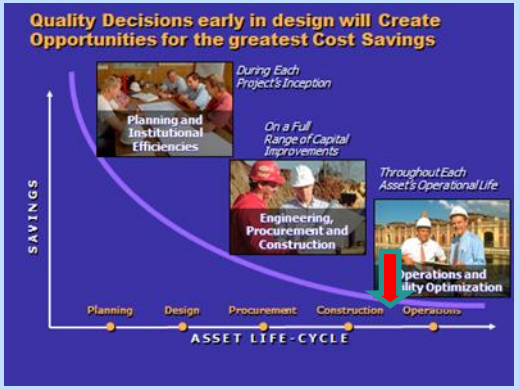


Steps in Project

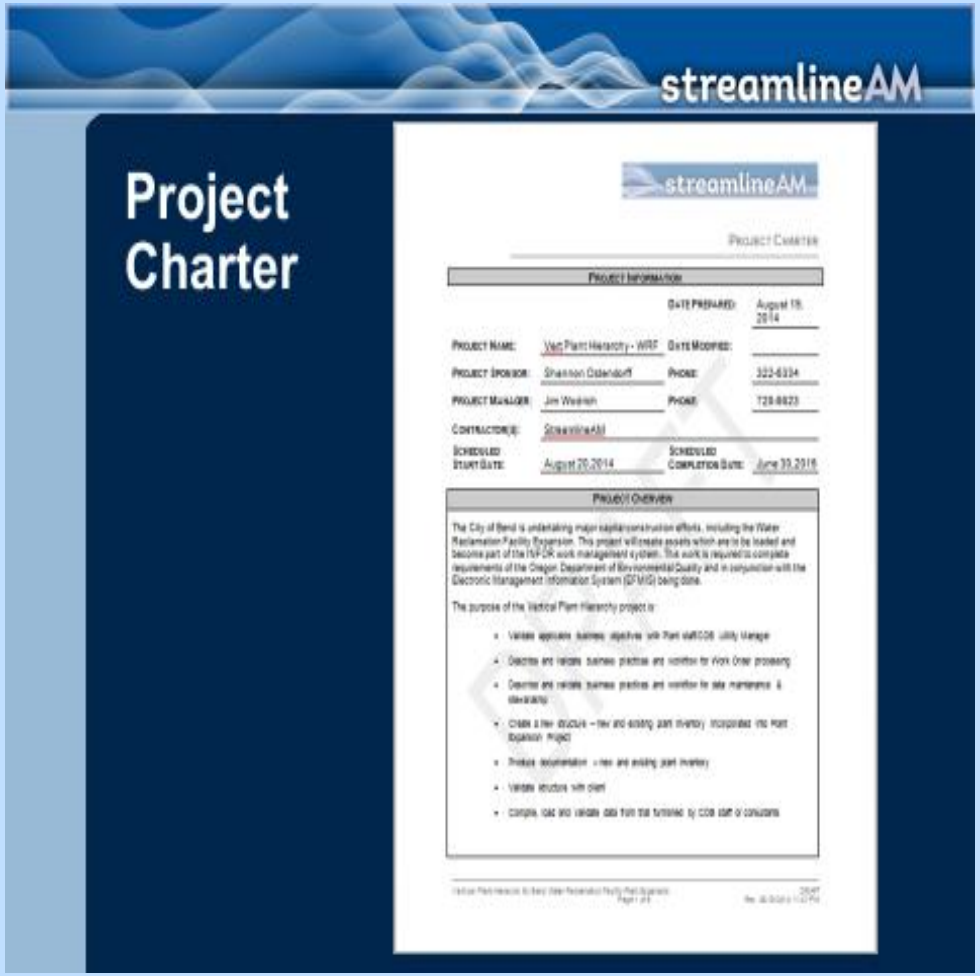
- Initial Workshops
- Data aggregation
- Hierarchy Development
- Hierarchy Validation
- Develop Data for new Hierarchy
- Test
- Load to production
- Living processes post go-live
- Check and verify
- Work through anomalies with existing systems

Critical success factors for creating added value from work management systems

- Staff engagement –Teamwork , respect, common goals, results, fun
- Data structure and organization understanding key
- Understanding business purposes of data
- Ability to integrate SCADA iHistorian to INFOR and with COB EFIMS

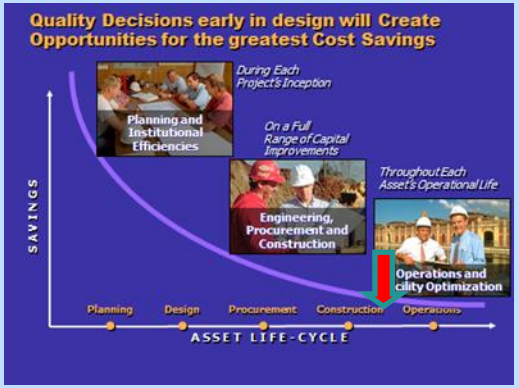


Staff consultation and engagement



And more:

- Review processes
- Importance of getting systems organized properly
- Key issues to resolve



You say Potato, I say Potato…and we need to work the whole thing out !

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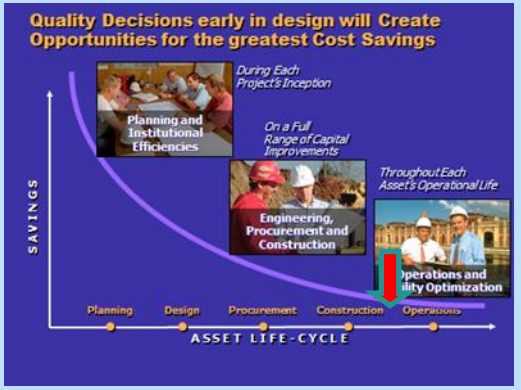
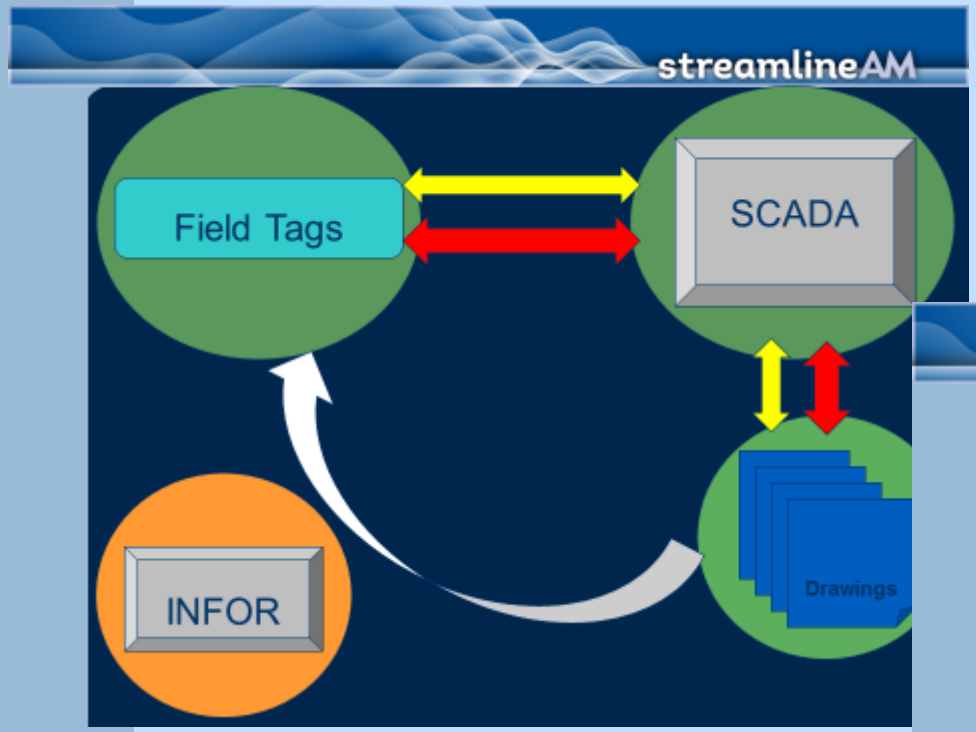
INFOR – Software
A Brief Introduction to Terminology

- Location – Actual Building, Room etc
- System – Collection of Positions and/or Assets that are Part of a Process
- Position – Function Done by An Asset (Pump Location versus Physical Pump)
- Asset – Physical Object
- Child Asset
- Logical Meter



Creating and training on Data Structure led to improved understanding



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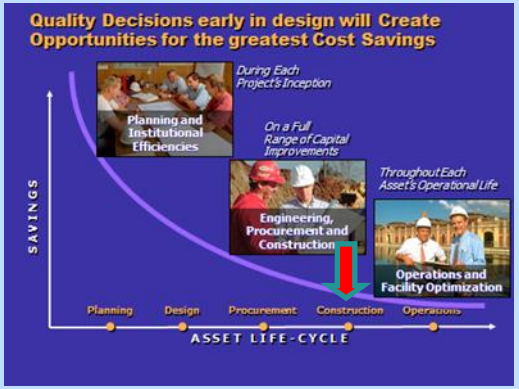
Why do this?

- Set it up for success
- Make your job more easier,more efficient, more effective
- Set groundwork for maintenance activities
  - Maintenance planning, scheduling
  - Life cycle costing and analysis

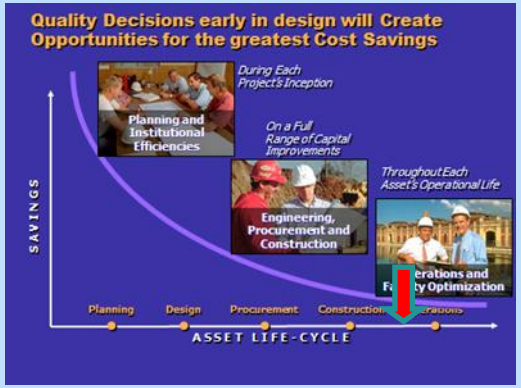
Other Important Construction Period activities included:

- Conformed Construction Documents
- EADOC tracking of RFI's, Submittals, Changes, OEM materials
- Plant SCADA and City IT System –Servers, Software, hardware, and teamwork was created
- Updated system hierarchy development



Systems design and work management system hierarchy development

HIGH SYSTEM	High System Description
10	Preliminary Treatment
20	Primary Treatment
30	Secondary Treatment
40	Disinfection
50	Effluent Disposal
60	Biosolids Handling
70	Sludge Disposal
80	Miscellaneous Support Systems
90	Miscellaneous Non-Support Systems



Field Guides help inform and ensure consistency

CITY OF BEND
WATER RECLAMATION FACILITY

MASTER PROCESS LIST

❄ Out of Service or Retired
Decimal numbering only used in plant process narratives

10 Preliminary Treatment
- 11 Headworks Lime Feed System
- 12 Screening
- 13 Grit Removal ❄
- 14 Odorous Air System
- 15 Plant Drain
- 16 Chemical Handling
- 17 Septage Handling

20 Primary Treatment
- 21 Primary Clarifiers & Scum Handling
- 22 Primary Sludge Pumping

30 Secondary Treatment
- 31 Aeration Basins
  - 31.1 Primary Effluent Distribution
  - 31.2 Aeration Basin
  - 31.3 Aeration Control
  - 31.4 Mixed Liquor Pumps
  - 31.5 Mixers
  - 31.6 Plant Drain Pump Station
- 32 Aeration Blowers
- 34 Secondary Clarification & Scum Handling
- 35 Return Activated Sludge (RAS) Pumping
- 36 Waste Activated Sludge (WAS) Pumping

40 Disinfection
- 41 Chlorine Contact Basins ❄
- 42 Chlorination System
  - 42.1 Hypochlorite Storage
  - 42.2 Hypochlorite Feed
  - 42.3 Gas Chlorination
- 43 Plant Effluent Disinfection
  - 43.1 UV Disinfection
  - 43.2 Plant Effluent

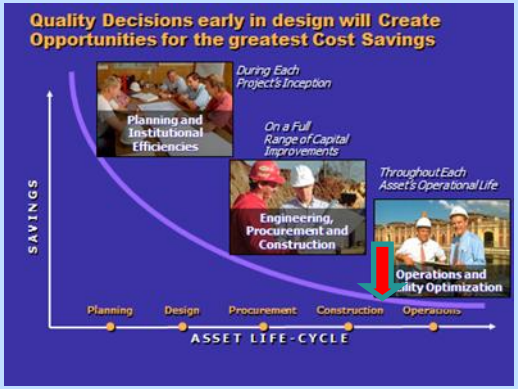
50 Effluent Disposal
- 51 Evaporation & Percolation Ponds
- 52 Reuse Water (W3)
- 53 Reuse Water Filtration
- 54 Alum Addition
- 55 Reuse Water (W3) - Duplicate ❄

60 Biosolids Handling
- 61 Dissolved Air Flotation Thickening ❄
- 62 Gravity Belt Thickening (GBT)
- 63 Anaerobic Digestion System
- 64 Gas Handling ❄
- 65 Hot Water Boilers
- 66 Digester Feed System
- 67 Dewatering
- 68 Polymer System

70 Sludge Disposal
- 71 Degasification Basins
- 72 Drying Beds
- 73 Sludge Loading

80 Support Systems
- 81 Plant Water (W4)
- 82 Potable Water (W2) Well Pump System
- 83 Power Distribution
- 84 Miscellaneous Chemicals
- 85 HVAC
  - 85.1 HVAC Existing Primary Sludge Pump Station
  - 85.2 HVAC New Primary Sludge Pump Station Electrical and Pump Rooms
  - 85.3 HVAC New Blower Building Electrical and Blower Rooms
  - 85.4 HVAC Plant Effluent Facility Electrical Room, Plant Water Pump Station, and Plant Effluent Metering Vault
  - 85.5 HVAC Hypochlorite Facility
  - 85.6 HVAC Aeration Galleries East & West
- 86 Plant Drain
  - 86.1 Drain System
- 87 Hot Water System
- 88 Plant Air System
- 89 Potable Water (W1) Avion Water Supply

90 Non-process Systems
- 91 Control Building
- 92 Maintenance Building
- 93 Irrigation System
- 94 Fuel System
- 95 Fire & Security System
- 96 SCADA
- 97 Training Building
- 98 Electrical




CITY OF BEND
WATER RECLAMATION FACILITY SITE MAP
10 Preliminary Treatment
20 Primary Treatment
30 Secondary Treatment
40 Disinfection
50 Effluent Disposal
60 Biosolids Handling
70 Sludge Disposal
80 Support Systems
90 Non-process Systems
E ELECTRICITY
11-A1 Headworks A Main
11-A2 Headworks A Influent Channel
11-A3 Headworks A Grit
11-B1 Headworks B Main
11-B2 Headworks B Lime Silo
11-B3 Headworks B Valve Box
11-B4 Headworks B Influent Channel
21-A1 Primary Influent Splitter Boxes East
21-A2 Primary Influent Splitter Boxes West
21-A3 Primary Influent Splitter Junction
21-B1 Primary Clarifier 1
21-B2 Primary Clarifier 2
21-B3 Primary Clarifier 3
22-A Primary Sludge Pump Station A
22-B Primary Sludge Pump Station B
31-A1 Aeration Basin East Gallery
31-A2 Aeration Basin West Gallery
31-B1 Aeration Basin 1
31-B2 Aeration Basin 2
31-B3 Aeration Basin 3
31-B4 Aeration Basin 4
32-A Blower Building A
32-B Blower Building B
34-A Mixed Liquor Splitter Box
34-B1 Secondary Clarifier 1
34-B2 Secondary Clarifier 2
34-B3 Secondary Clarifier 3
35 RAS/WAS Pump Station
41-A Chlorine Contact Basins (Not In Use)
41-B Gas Chlorine Facility (Not In Use)
42 Hypochlorite Facility
43 Plant Effluent Facility
51-A Effluent Box
51-B Evaporation/Percolation Ponds
52-A Reuse Filter Building
52-B Filter Pump Station
61 SCADA Hub
63-A Anaerobic Digestion Building
63-B1 Anaerobic Digester 1
63-B2 Anaerobic Digester 2
63-B3 Anaerobic Digester 3
67 Biosolids Building
71-A Degasification Basin East
71-B Degasification Basin West
72 Drying Beds
82-A Well Pump System (Potable Water)
82-B Water Reservoir
83-A Generator A & Switchgear Enclosure
83-B Generator B
91 Control Building
92-A Maintenance Building
92-B Pole Barn North
92-C Pole Barn South
93 Irrigation System
97 Training Building
Diesel Fuel Station

Lessons Learned

- Data management-
  - Record Drawings , SCADA Standards (how to keep current for both utility internal projects and external CIP projects.
- Planning and Design
- Staff engagement – Ownership
- Setting business objectives up front
- Living Process to sustain over long-term
- Implementing in steps
- Nobody said this was going to be easy ☺

Benefits from Effort

- more effective manner for work order creation, tracking and analysis
- improve scheduling of maintenance tasks.
- position the facility for the future through records management, training, and knowledge creation

Questions ?

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