

# Streamlining Reporting, Compliance, and Mitigating Against Human Factors

David L. Naranjo

IT Applications Administrator

Trinity River Authority of Texas



Trinity River Authority of Texas  
*Enriching the Trinity basin as a resource for Texans*

# Overview

- ▶ Background
- ▶ Introduction
- ▶ Old Paradigm
- ▶ New Paradigm
- ▶ Conclusion



Trinity River Authority of Texas  
Enriching the Trinity basin as a resource for Texans

# Background – Who Am I?

Experience in military aircraft maintenance operations management is applied to optimize water information systems implementation



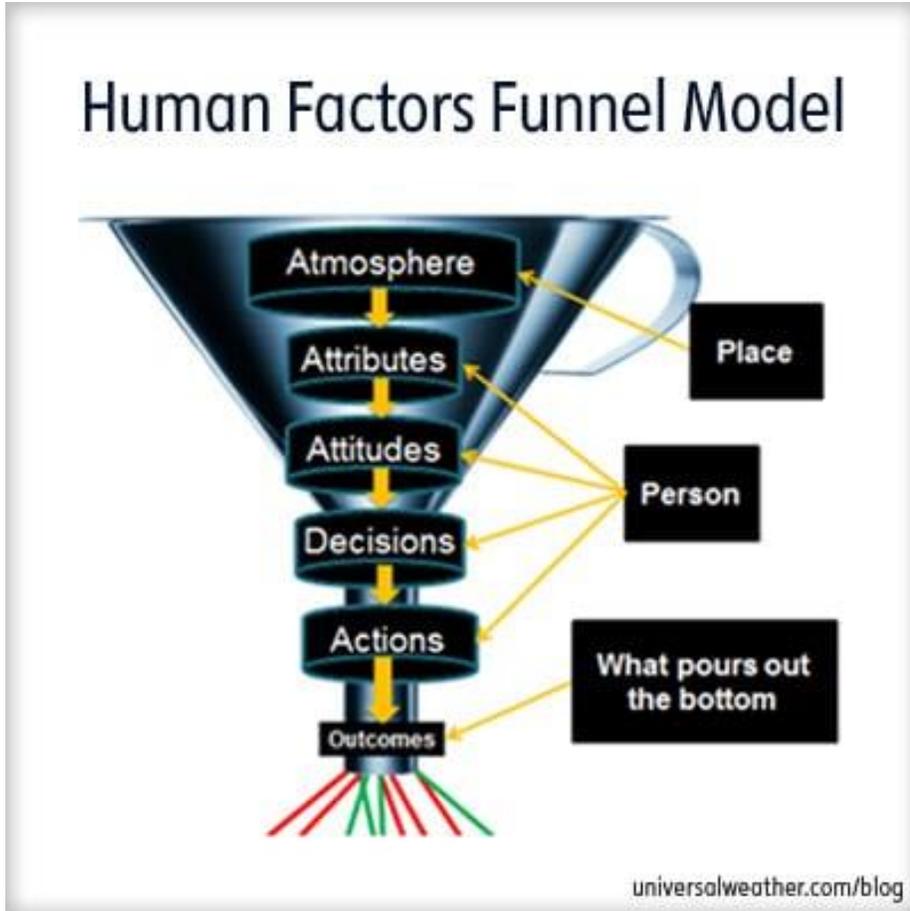
(Boiling, 2019)



Liquids Operations Control Room



# Introduction – The Reason

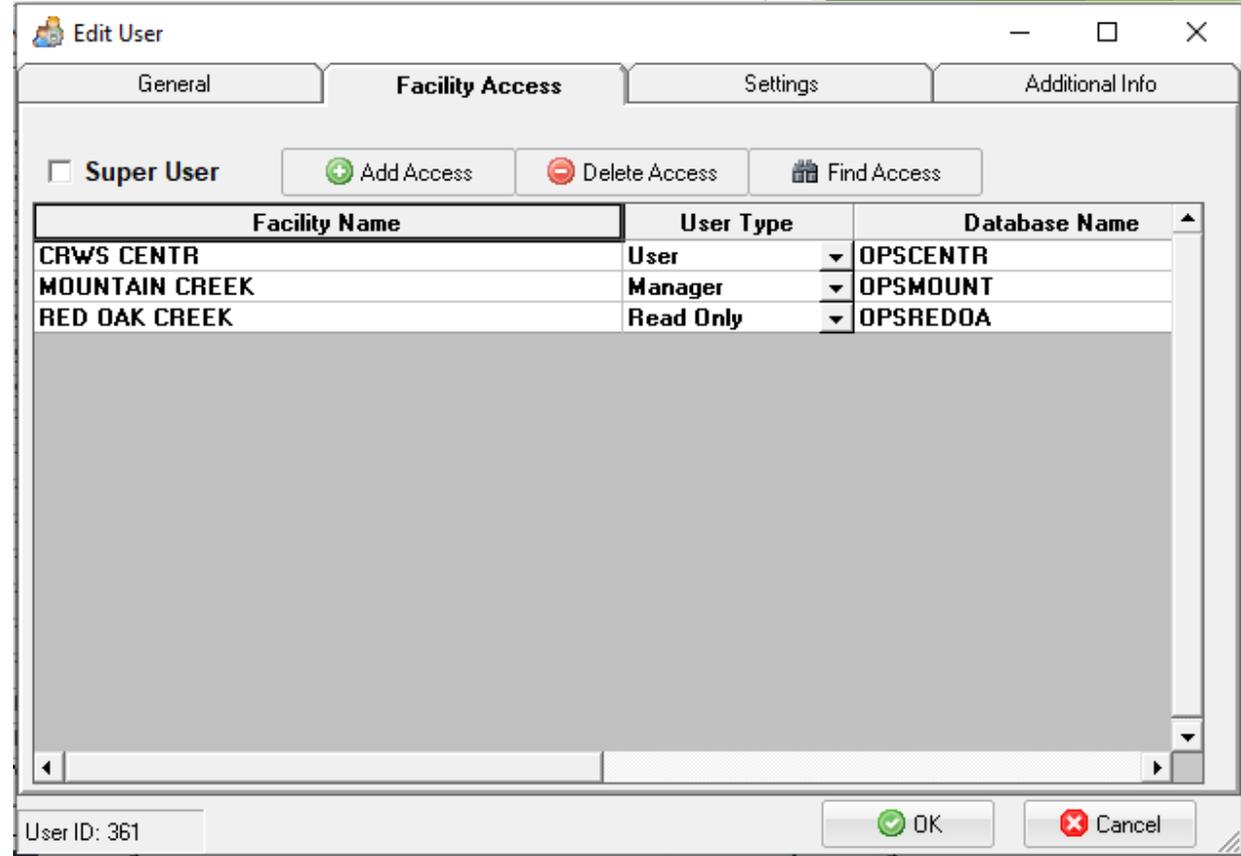


Human factors can play a considerable role in the success and failures of a wastewater or water facility

(Baron, 2012)

# Old Paradigm – The Opportunities

Ad-Hoc security presents a challenge with securing data from manipulation or access by those who should not have permission



WIMS Ad-Hoc User Setup

# Old Paradigm – The Opportunities

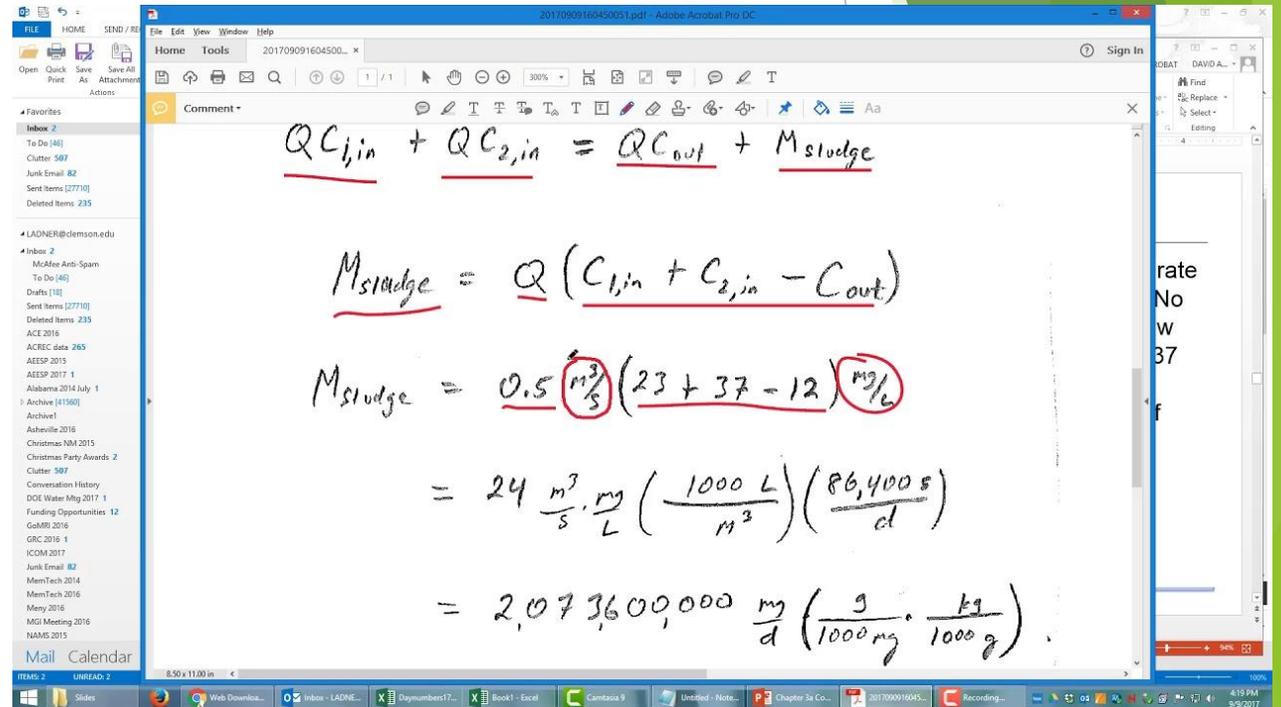


(Lawrence, 2018)

Manual water data collection using pen and paper can be lost, damaged, destroyed, or illegible

# Old Paradigm – The Opportunities

Performing calculations manually may differ between operators that may not produce a result with higher precision or may be inaccurate



$$\underline{QC_{1,in}} + \underline{QC_{2,in}} = \underline{QC_{out}} + \underline{M_{sludge}}$$

$$\underline{M_{sludge}} = \underline{Q} (\underline{C_{1,in}} + \underline{C_{2,in}} - \underline{C_{out}})$$

$$M_{sludge} = 0.5 \left( \frac{m^3}{s} \right) (23 + 37 - 12) \left( \frac{mg}{L} \right)$$

$$= 24 \frac{m^3}{s} \cdot \frac{mg}{L} \left( \frac{1000 L}{m^3} \right) \left( \frac{86,400 s}{d} \right)$$

$$= 2,073,600,000 \frac{mg}{d} \left( \frac{g}{1000 mg} \cdot \frac{kg}{1000 g} \right)$$

(Mass Balance for Sludge Calculation in Water Treatment Plant, 2017)

# Old Paradigm – The Opportunities

	A	B	C	D
1		Daily Total		
2		34		
3		54		
4		23		
5		51		
6		=SUM(B3,B4,B5)		
7				
8				
9				
10				
11				
12				
13				

Excel spreadsheet formulas can be easily manipulated and do not provide a means of validating the data or provide an audit trail

Accidental Excel Formula Change

# Old Paradigm – The Opportunities

Entering data manually into WIMS after operator rounds have been accomplished and generating reports - is redundant and costs valuable time

TRINITY RIVER AUTHORITY								
ROCRWS								
PH VALUE								
MONTH OF <u>FEBRUARY</u> YEAR <u>2017</u>								
DATE	COLLECTOR	TIME OF COLLECT	TIME OF TEST	INF PH	INF TEMP	EFFLUENT DUPLICATE	EFFLUENT TEMPERATURE	EFFLUENT PH
1	Jh.	12:47pm	12:52pm	7.49	23°C	7.57	22°C	7.47
2	Jh.	10:26pm	10:26pm	7.17	19°C	7.36	20°C	7.35
3	Jh.	2:06pm	2:12pm	7.27	20°C	7.34	20°C	7.33
4								
5	DAVID	1:57p	2:05p			7.11	21	7.04
6	DAVID	2:25pm	2:30p	7.36	21	7.14	23	7.24
7	DAVID	1:29p	1:30p			7.53	23	7.32
8	Jh.	1:52pm	1:58pm	7.28	20°C	7.35	21°C	7.23
9	Jh.	3:42pm	3:57pm	7.24	20°C	7.24	21°C	7.22

Manual Data Collection



	Daily Com	3291	3273	3481
		Eff pH Lab at Peak Flow	Eff DO	Eff E. coli
		mg/L	mg/L	CoV/100ML
1 Wed		7.41	7.9	1
2 Thu		7.35	8.0	1
3 Fri		7.33	8.0	1
4 Sat				
5 Sun		7.06	7.5	
6 Mon		7.24	7.4	1
7 Tue		7.32	7.4	1
8 Wed		7.23	7.4	1
9 Thu		7.22	7.7	1

Manual Data Entry

# Old Paradigm – The Opportunities

Lagging indicators include: privilege creep, intentional or unintentional data manipulation, data inconsistency, delayed reporting erroneous or averaged calculations, and unnecessary expenditures; opportunities to improve, all of which do not support informed decision making and increases the risk of failures



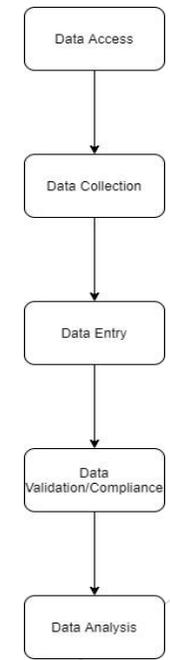
(Del Buono, 2017)

# New Paradigm – The Strategic Plan

Strategic planning on WIMS implementation identifies strategic objectives that address the opportunities presented by the Old Paradigm

## Objectives

<p><b>Objective #1: Collect and enter accurate water data as close to the source as possible.</b> In order to improve our data collection and entry efforts we need to replace the old manual paradigm. Implementing modern techniques to performing operator rounds using technology will aid in reducing human error. Earlier use of WIMS allowed the creation of data points Ad Hoc to the specific needs of the user that created them at that current time. Over the years this has created a uniformed way of entering and storing data within WIMS. Standardizing the data points and normalizing the data Authority-wide can reduce ambiguity and place all users in the same language.</p>	
<p>Action plans to achieve objectives</p>	<ul style="list-style-type: none"> <li>- Maximo to WIMS operator round solution</li> <li>- Variable naming convention</li> <li>- Variable audit</li> <li>- WIMS Data Entry Forms</li> <li>- WIMS Lab Cal</li> <li>- WIMS BOD Manager</li> <li>- WIMS Plant Automation</li> </ul>
<p>Person / Group responsible</p>	<p>WIMS Power User Group</p>



- **Data Access**
  - WIMS User Profiles (RBAC)
- **Data Collection**
  - Maximo to WIMS Operator Round Solution
  - WIMS Plant Automation
- **Data Entry**
  - Variable Audit
  - Variable naming convention
  - WIMS Data Entry Forms (Ad Hoc)
- **Data Validation/Compliance**
  - WIMS Data Approval
  - WIMS Compliance Engine
  - WIMS Sampling Requirements
- **Data Analysis**
  - WIMS Modeling
  - WIMS BOD Manager
  - Strategic Power BI
  - Operational Power BI
  - Standardized WIMS Dashboards
  - WIMS Reports (Ad Hoc)
  - WIMS Graphs (Ad Hoc)
  - DMR Reports

TRA Strategic Plan Objectives

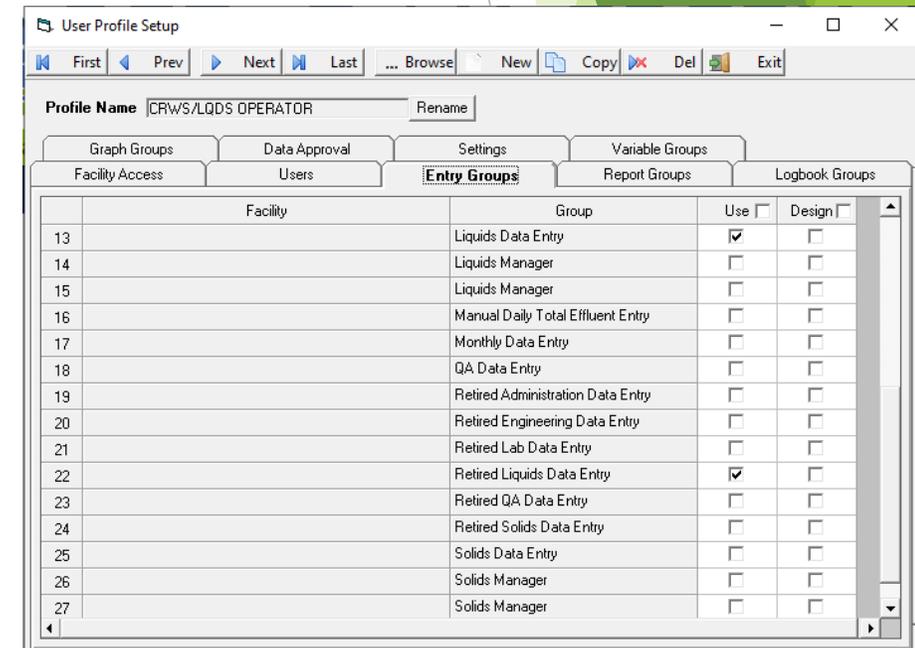
WIMS Data Lifecycle

# New Paradigm – The Strategic Plan

Using security, validation, auditing, and calculation tools increase data integrity

ROLES		ENTRY GROUPS - USE																	
		Solids Data Entry	Solids Data Entry / Retired Liquids Data Entry	Liquids Data Entry	Liquids Data Entry / Retired Liquids Data Entry	Administrati on Data Entry	Administrati on Data Entry/Liquid s Manager	Administrati on Data Entry/Solids Manager	Administrati on Data Entry/Engin eering Manager	Administrati on Data Entry / Retired Administrati on Data Entry	Administrati on Data Entry / Retired Administrati on Data Entry/Liquid	Administrati on Data Entry / Retired Administrati on Data Entry/Solids	Administrati on Data Entry / Retired Administrati on Data Entry/Engin	Engineering Data Entry	Engineering Data Entry / Retired Engineering Data Entry	QA Data Entry	QA Data Entry / Retired QA Data Entry	Lab Data Entry	Lab Data Entry / Retired Lab Data Entry
Liquids	Liquids Division			X	X														
	Liquids Chief			X	X														
	Liquids Senior			X	X														
	Liquids Operator			X	X														
Solids	Solids Division	X	X																
	Solids Chief Operator	X	X																
	Solids Senior	X	X																
	Solids Operator	X	X																
Engineering	PCSA Engineer												X	X					
	PCS Administrat												X	X					
	PCSA Analyst												X	X					
	Plant Engineer												X	X					
	Lab Division																	X	X
Lab	Lab Supervisor																	X	X
	Lab Senior Chemist																	X	X
	Lab Senior Biologist																	X	X
	Lab Chemist																	X	X
	Lab Biologist																	X	X
	Lab Technician																	X	X

Role-Based Access Control Matrix



WIMS User Profile Setup



# New Paradigm – The Strategic Plan

The screenshot shows a software window titled "Edit User" with four tabs: "General", "Facility Access", "Settings", and "Additional Info". The "General" tab is active. It contains the following fields and controls:

- User Name\*:** (50 chars maximum) with the value "SPONGEBOBTESTPA" and a "Change Username" button.
- Password\*:** (20 chars maximum) with masked characters "\*\*\*\*\*" and "Change Password" and "Reset" buttons.
- Windows Login Name:** with the value "spongebobtestpants".
- Name:** with the value "Spongebob Testpants".
- Comments:** with the value "Test Account".
- User Profile:** a dropdown menu showing "ROCRWS - OPERATOR" and a "View" button.

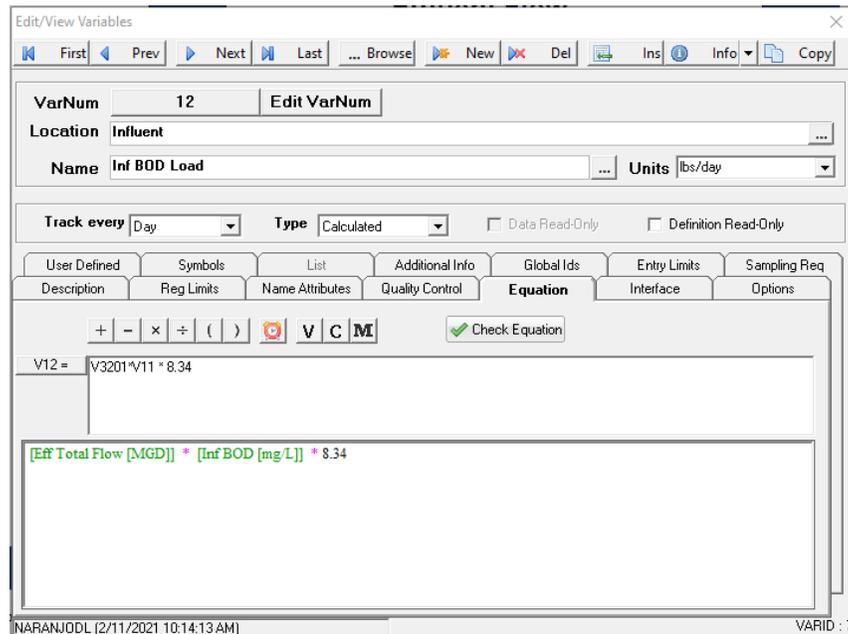
A note at the bottom left of the form area states: "\* - Required". At the bottom of the window, there is a "User ID: 361" label and "OK" and "Cancel" buttons.

Assigning a User Profile to a user

# New Paradigm – The Strategic Plan

		Limit Name	Start Date	End Date	Description	Current Limit	Grouping
2	Edit	DAVG	5/1/2024	9/30/2024	Daily Average Limit	> 100	M
3	Edit	DAVG	10/1/2023	4/30/2024	Daily Average Limit	> 200	M
4	Edit	DAVG	5/1/2023	9/30/2023	Daily Average Limit	> 100	M
5	Edit	DAVG	10/1/2022	4/30/2023	Daily Average Limit	> 200	M
6	Edit	DAVG	5/1/2022	9/30/2022	Daily Average Limit	> 100	M
7	Edit	DAVG	10/1/2021	4/30/2022	Daily Average Limit	> 200	M
8	Edit	DAVG	5/1/2021	9/30/2021	Daily Average Limit	> 100	M
9	Edit	DAVG	10/1/2020	4/30/2021	Daily Average Limit	> 200	M
10	Edit	DAVG	5/1/2020	9/30/2020	Daily Average Limit	> 100	M
11	Edit	DAVG	10/1/2019	4/30/2020	Daily Average Limit	> 200	M

WIMS Compliance Engine



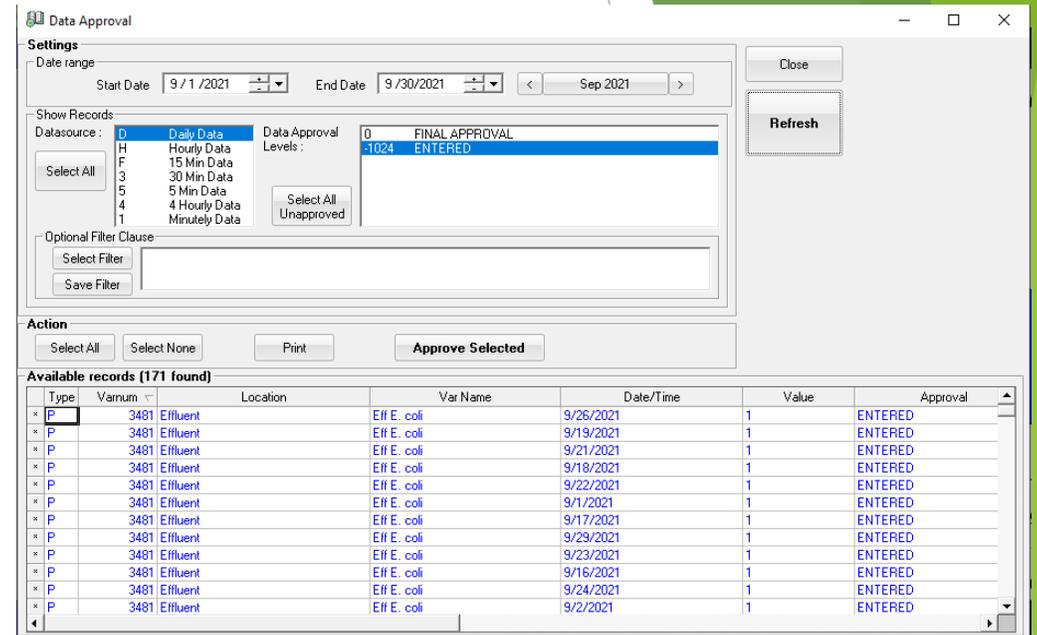
VarNum: 12, Location: Influent, Name: Inf BOD Load, Units: lbs/day

Track every: Day, Type: Calculated

Equation:  $V12 = \sqrt{3201 * V11} * 8.34$

Equation:  $[Eff\ Total\ Flow\ [MGD]] * [Inf\ BOD\ [mg/L]] * 8.34$

Vetted WIMS Calculated Variables



Date range: Start Date 9/1/2021, End Date 9/30/2021

Available records (171 found)

Type	VarNum	Location	Var Name	Date/Time	Value	Approval
P	3481	Effluent	Eff E. coli	9/26/2021	1	ENTERED
P	3481	Effluent	Eff E. coli	9/19/2021	1	ENTERED
P	3481	Effluent	Eff E. coli	9/21/2021	1	ENTERED
P	3481	Effluent	Eff E. coli	9/18/2021	1	ENTERED
P	3481	Effluent	Eff E. coli	9/22/2021	1	ENTERED
P	3481	Effluent	Eff E. coli	9/1/2021	1	ENTERED
P	3481	Effluent	Eff E. coli	9/17/2021	1	ENTERED
P	3481	Effluent	Eff E. coli	9/29/2021	1	ENTERED
P	3481	Effluent	Eff E. coli	9/23/2021	1	ENTERED
P	3481	Effluent	Eff E. coli	9/16/2021	1	ENTERED
P	3481	Effluent	Eff E. coli	9/24/2021	1	ENTERED
P	3481	Effluent	Eff E. coli	9/2/2021	1	ENTERED

WIMS Data Approval

RED OAK CREEK Updated and Deleted Records  
Report Date Range: 9/1/2021 - 9/30/2021

VarNum	Variable	Audit Date & Time	Audit User	Data Date
11	Inf BOD	9/13/2021 10:36:09 AM	MORGANT	8/29/2021
1202	AerBasin MLSS Lab (6AM)	9/6/2021 8:10:11 AM	DENNIER	9/6/2021
1403	AerBasin MLSS Lab (8pm)	9/5/2021 8:08:29 PM	DENNIER	9/4/2021

WIMS Updated and Deleted Records Report

# New Paradigm – The Strategic Plan



Collecting and entering accurate water data as close to the sources as possible streamlines capture and mitigate against human factors

# New Paradigm – The Strategic Plan

Sequence	Location	Asset	Asset/Location Description	Job Plan	Inspection Form	Name
1	122-91A	>	Laboratory Building	>	1048	Rainfall, Temps - 6-2
5	122-21A	>	Plant Influent Pump Station	>	1021	NH3 - 6-2
6	122-40B	>	Aeration Basin #1	>	1021	NH3 - 6-2
7	122-40C	>	Aeration Basin #2	>	1021	NH3 - 6-2
8	122-58A	>	Effluent Structure	>	1021	NH3 - 6-2

**All**   **Incomplete**   **Completed**

▼ Rainfall, Temps - 6-2

1. What is the barometric reading?

2. What is the rainfall reading?

3. What is the high temperature?

4. What is the low temperature?

1. What is the barometric reading?

Rainfall, Temps, 6-2, Barometric Pressure  
*Unspecified*



Mountain Creek Regional Wastewater System  
pH Calibration and Analysis Process Control  
September 2021

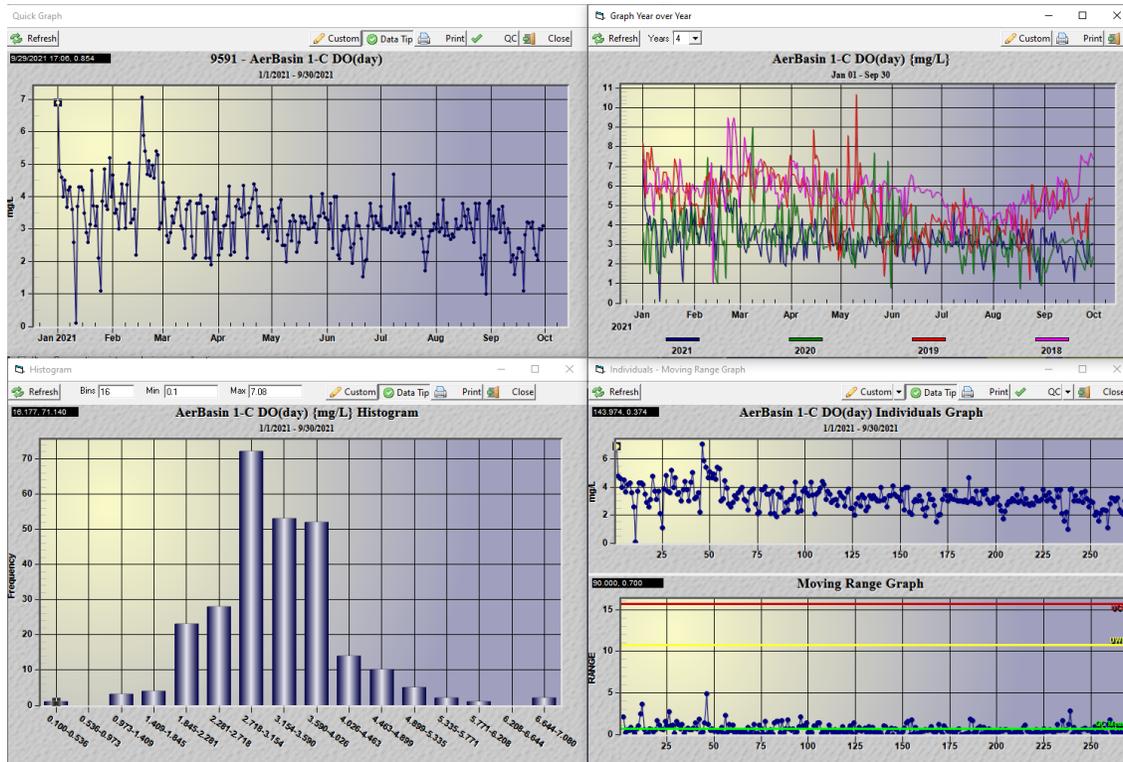
Date	10PM to 6AM Shift						6AM to 2PM Shift						2PM to 10PM Shift						
	pH Meter Calibration Temperature	pH Meter Calibration 7.0 Standard	pH Meter Calibration 10.0 Standard	pH Meter Calibration 4.0 Standard	pH Meter Calibration Slope	pH Meter Calibration Quality Control Check	pH Meter Calibration Temperature	pH Meter Calibration 7.0 Standard	pH Meter Calibration 10.0 Standard	pH Meter Calibration 4.0 Standard	pH Meter Calibration Slope	pH Meter Calibration Quality Control Check	pH Meter Calibration Temperature	pH Meter Calibration 7.0 Standard	pH Meter Calibration 10.0 Standard	pH Meter Calibration 4.0 Standard	pH Meter Calibration Slope	pH Meter Calibration Quality Control Check	
	Deg C	SU	SU	SU		SU	Deg C	SU	SU	SU		SU	Deg C	SU	SU	SU		SU	
9/1/2021																			
9/2/2021													22.40	7.01	10.04	4.01	58.60	9.97	
9/3/2021							22.30	7.01	10.04	4.01	58.50	9.96							
9/4/2021							23.10	7.01	10.03	4.01	58.50	9.97							
9/5/2021							21.70	7.01	10.04	4.01	58.60	10.00	23.60	7.00					
9/6/2021							21.20	7.01	10.04	4.00	58.70	10.02	22.40	6.99					
9/7/2021													22.00	7.01					
9/8/2021							21.90	7.01	10.04	4.00	58.70	9.99	22.90	7.01					
9/9/2021							22.00	7.01	10.04	4.01	58.60	9.98							
9/10/2021																			
9/11/2021							21.70	7.01	10.04	4.00	58.60	9.99	22.80	6.99					
9/12/2021																			
9/13/2021	23.10	7.07					22.70	7.01	10.03	4.01	58.50	9.97	23.00	7.00					
9/14/2021	22.90	7.00											22.80	7.00					
9/15/2021							22.60	7.01	10.04	4.01	58.30	9.99	23.00	7.02					
9/16/2021													23.30	7.01					
9/17/2021																			
9/18/2021																			
9/19/2021																			
9/20/2021													585.00	7.01					
9/21/2021							22.40	7.01	10.04	4.01	58.80	9.99	22.70	7.01					
9/22/2021	22.80	7.00					22.20	7.01	10.04	4.01	58.70	10.02	23.20	7.03					
9/23/2021													23.00	7.01					
9/24/2021	22.20						21.90	7.01	10.04	4.01	58.70	9.98							
9/25/2021	21.80	7.01																	
9/26/2021							22.80	7.01	10.05	4.01	58.70	9.99	22.20	7.04					
9/27/2021													22.20	7.00					
9/28/2021							22.20	7.01	10.04	4.01	58.70	9.98	23.30	7.00					
9/29/2021	21.70	7.00					21.00	7.00	10.05	4.00	58.80	9.98	22.10	6.99					
9/30/2021	22.10	6.99					21.20	7.01	10.05	4.00	58.60	9.98	22.50						
Minimum	21.70	6.99					21.00	7.00	10.03	4.00	58.70	9.96	22.10	6.99	10.04	4.01	58.60	9.97	
Maximum	23.10	7.07					23.10	7.01	10.05	4.01	58.80	10.02	585.00	7.04	10.04	4.01	58.60	9.97	
Total	156.60	42.07					375.40	119.16	170.69	68.12	703.20	169.75	998.90	133.13	10.04	4.01	58.60	9.97	
Average	22.37	7.01					22.08	7.01	10.04	4.01	43.95	9.99	49.95	7.01	10.04	4.01	58.60	9.97	

Operator rounds data captured in Maximo inspection form

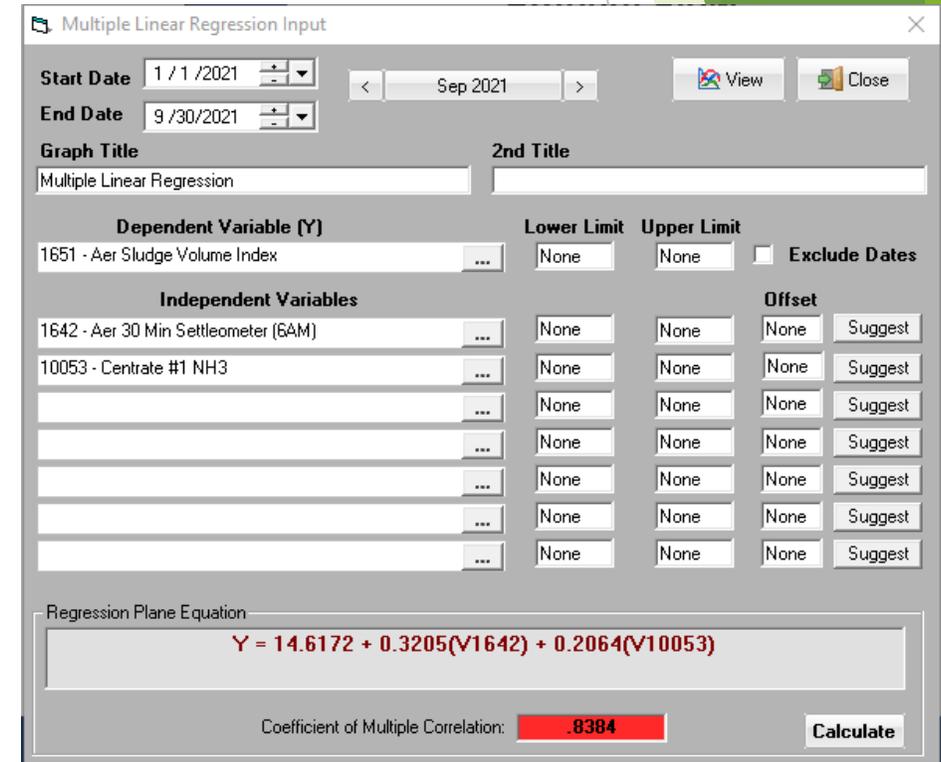
Operator rounds data from Maximo transferred into WIMS via interface

# New Paradigm – The Strategic Plan

Data visualization and analytics give managers insights, provide answers, and enable informed process control adjustments



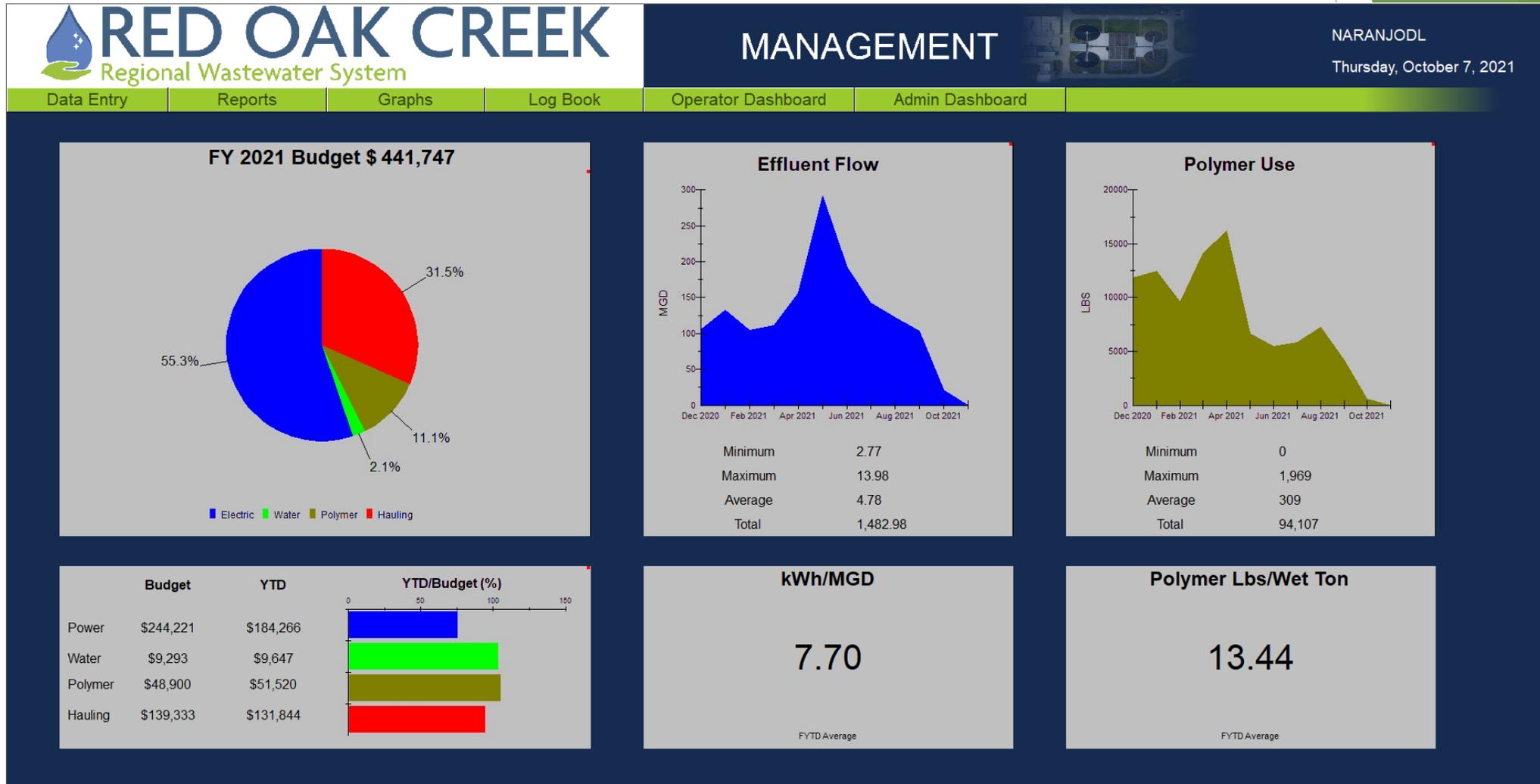
WIMS Variable Analysis Graph



Predictive Model Example



# New Paradigm – The Strategic Plan



Plant Management Dashboard



## RED OAK CREEK Regional Wastewater System

## OPERATORS

NARANJODL

Thursday, October 7, 2021

Data Entry

Reports

Graphs

Log Book

Solids Dashboard

Management Dashboard

### Key Performance Indicators

Graphs	Last	Min	Max	Avg
Inf Flow (MGD)	3.440	3.434	3.998	3.617
Eff Total Flow (MGD)	3.266	3.161	3.841	3.432
Plant Detention Time (Hours)	22.24	18.88	22.90	21.13
RAS (% of Inf flow)	76.60	70.48	89.78	79.60
Sludge Retention Time (Days)	12.43	6.99	18.89	11.29
AB MLSS Lab (mg/L)	2,420	1,750	2,680	2,375
AB 30M Settleometer (mL/L)	160	150	180	174
AB SVI (mg/L)	66.1	62.5	102.9	73.8
F/M Ratio	0.06	0.05	0.09	0.07
MCRT (Days)	12.31	6.95	18.61	11.18

### Liquids Status for September 2021



RAS (% of Inf flow)



F/M Ratio



Sludge Retention Time (Days)



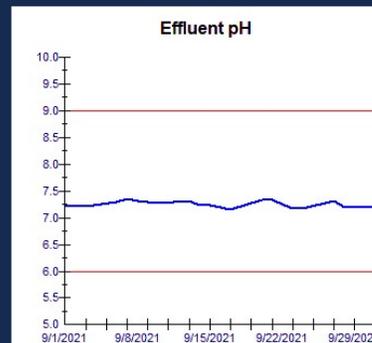
MCRT (Days)



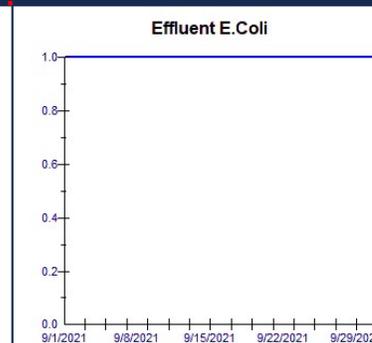
AB SVI (mg/L)

### Key Parameters

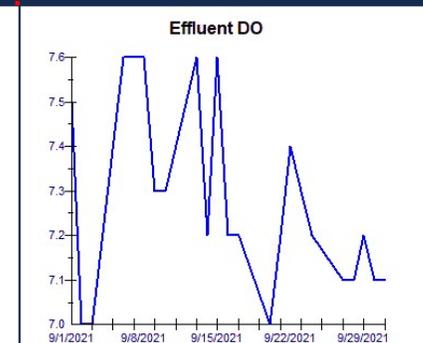
Graphs	Last	Min	Max	Avg
Eff pH	7.20	7.15	7.35	7.25
Eff E.Coli	1	1	1	1
Eff DO	7.10	7.00	7.60	7.29
AB DO	3.10	1.00	4.60	2.92
Clarifier Blanket (in)	12	10	16	13
Inf TSS	115	88	230	153
AB nH3	0.43	0.37	1.11	0.61
Eff CBOD	1.00	1.00	2.10	1.20
Eff TSS	2.00	2.00	2.00	2.00
Eff nH3	0.10	0.10	0.10	0.10



Effluent pH



Effluent E.Coli



Effluent DO



## RED OAK CREEK Regional Wastewater System

### OPERATORS

NARANJODL

Thursday, October 7, 2021

Data Entry

Reports

Graphs

Log Book

Liquids Dashboard

Management Dashboard

#### Key Performance Indicators

Graphs	Last	Min	Max	Avg	Total
Cake Total Solids (%)	17	17	21	19	266
Centrifuge Total Runtime	10.0	10.0	19.0	14.7	206
Wet Tons Hauled	23.50	16.72	23.50	19.87	218.58
WAS Flow (X1000)	129.6	78.8	204.9	130.3	3,908
Sludge Feed (X1000)	45.6	0.0	94.7	55.0	1,650
Decant Total (X1000)	84.0	30.2	181.6	75.3	2,257.8
Holding Tank Start Level	8.9	5.5	9.5	7.5	226
Holding Tank End Level	3.4	3.2	4.3	3.4	103
Polymer Use	100	40	389	140	4,204
Polymer lbs/tons Dry Solids	8.6	7.8	17.1	12.1	170

#### Solids Status for September 2021



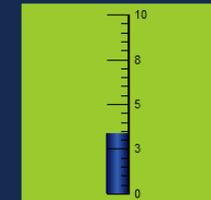
Cake Total Solids (%)



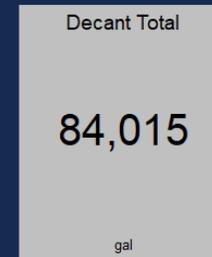
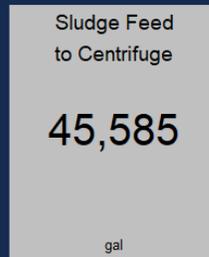
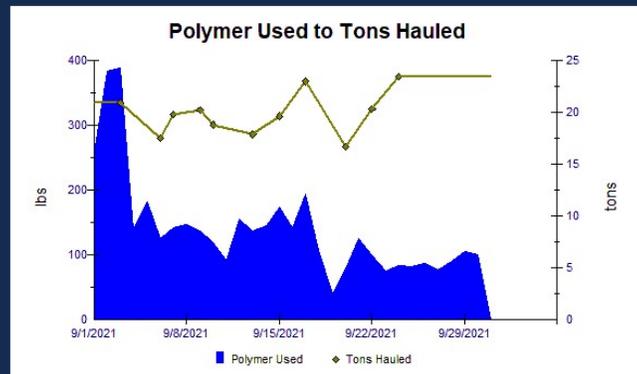
Centrifuge Total Runtime



Holding Tank Start Level



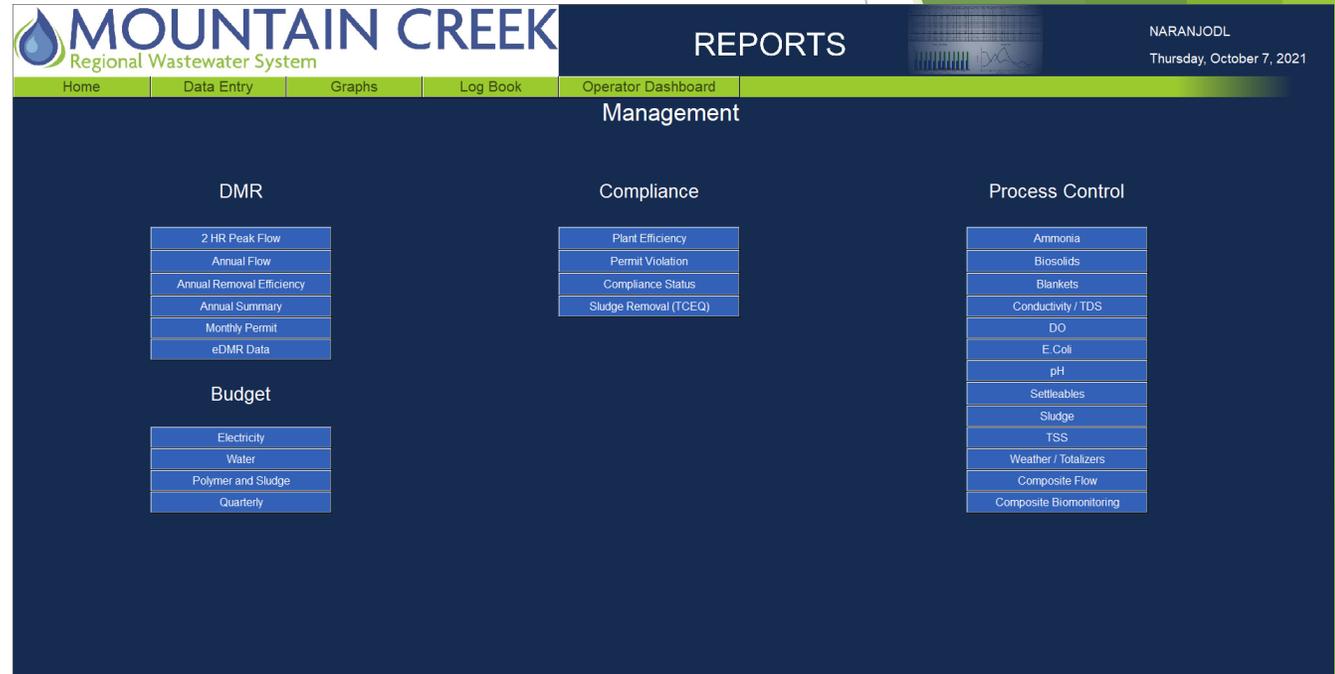
Holding Tank End Level





# New Paradigm – The Strategic Plan

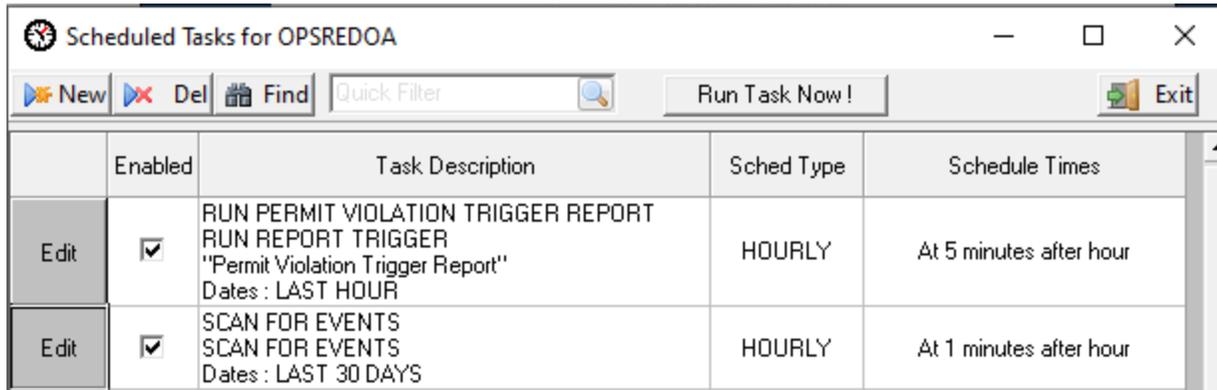
Limits monitoring, automated reporting, and alerting provide data transparency and informs operators of events enabling rapid corrective actions and reporting; and informed decision making



Dashboard provides buttons for report generation

# New Paradigm – The Strategic Plan

By using the WIMS compliance engine, limits monitoring aid in regulatory reporting and process control management



Scheduled Tasks for OPSREDOA				
<span>New</span> <span>Del</span> <span>Find</span> <input type="text" value="Quick Filter"/> <span>Run Task Now!</span> <span>Exit</span>				
	Enabled	Task Description	Sched Type	Schedule Times
Edit	<input checked="" type="checkbox"/>	RUN PERMIT VIOLATION TRIGGER REPORT RUN REPORT TRIGGER "Permit Violation Trigger Report" Dates : LAST HOUR	HOURLY	At 5 minutes after hour
Edit	<input checked="" type="checkbox"/>	SCAN FOR EVENTS SCAN FOR EVENTS Dates : LAST 30 DAYS	HOURLY	At 1 minutes after hour

WIMS Scheduled Tasks

RED OAK CREEK Compliance Status Report Report Date Range: 10/1/2021 - 10/31/2021				
Varnum	Variable	Violations	Limit Description	Limit
3204	Effl 2hr Interval Average {MGD}	0	Daily Maximum Limit	>15
3205	Effl 2hr Interval Average (GPM) {gpm}	0	Daily Maximum Limit	>10417
3208	Eff Annual Average Flow {MGD}	0	Annual Average Limit	>6
3221	Eff CBOD {mg/L}	0	Daily Maximum Limit	>25
		0	Daily Average Limit	>10
		0	Single Grab Limit	>35
3222	Eff CBOD Load {Lbs}	0	Daily Average Limit	>500
3223	Eff CBOD 7-Day Avg {mg/L}	0	7-Day Average	>15
3241	Eff TSS {mg/L}	0	Single Grab Limit	>60
		0	Daily Average Limit	>15
		0	Daily Maximum Limit	>40
3242	Eff TSS Load {Lbs}	0	Daily Average Limit	>751
3243	Eff TSS 7-Day Avg {mg/L}	0	7-Day Average Limit	>25
3273	Eff DO {mg/L}	0	Daily Minimum Limit	<6
3291	Eff pH Lab at Peak Flow {mg/L}	0	Daily Maximum Limit	>9
		0	Daily Minimum Limit	<6
3321	Eff Ammonia {mg/L}	0	Daily Maximum Limit	>8
		0	Daily Average Limit	>4
		0	Single Grab Limit	>11
3322	Eff Ammonia Load {Lbs}	0	Daily Average Limit	>200
3324	Eff Ammonia 7-Day Avg {mg/L}	0	7-Day Average Limit	>6
3481	Eff E. coli {Col/100ML}	0	Daily Average Limit	>126
		0	Daily Maximum Limit	>399
		<b>Total</b>	<b>0</b>	

WIMS Built In Compliance Report

# New Paradigm – The Strategic Plan

Automated trigger reports send an SMS message and emails to individuals when an event has occurred

 <span style="float: right;"><b>Permit Violation</b></span>					
Event	Date	Location	VarNum	Variable Name	Notes

Please be advised that the Railport Lift Station Wet Well Level has exceeded 10 ft.

Please be advised that the Railport Lift Station Wet Well Level has now dropped below 10ft.

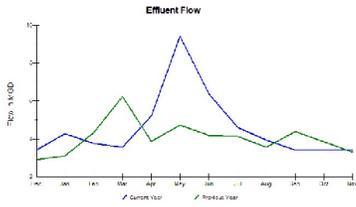
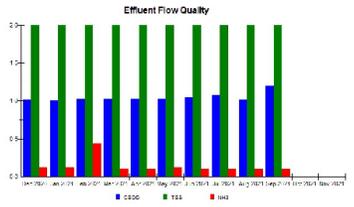
Alerts managers of a permit violation

Alerts managers of a wet well level exceeding and returning to acceptable limits

# New Paradigm – The Strategic Plan

Regulatory reports are created in WIMS, eliminating the need for manual monthly creation

Permit Limits	Flow Annual Average	Flow Daily Max	Flow 2hr Peak	Flow 2hr Post Peak	Rainfall Total	CBOD Daily Average	CBOD Daily Max	CBOD Load Daily Average	TSS Daily Average	TSS Daily Max	TSS Load Daily Average	NH3 Daily Average	NH3 Daily Max	NH3 Load Daily Average	DO Min	pH Max	pH Min	E. Coli Daily Average	E. Coli Daily Max	Collection System	
Month	MGD	MGD	MGD	MGD	INCHES	MGAL	MGAL	MGAL	MGAL	MGAL	MGAL	MGAL	MGAL	MGAL	MGAL	MGAL	MGAL	MGAL	MGAL	NUMBER OF	
Dec 2020	4.002	3.410	6.077	7.927	19.478	4.04	1.0	1.2	26.3	2.0	0.8	0.12	0.40	3.20	7.9	7.35	6.96	3	106		
Jan 2021	4.111	4.298	7.795	9.013	11.397	1.09	1.0	1.3	29.2	2.0	0.9	0.12	0.36	4.11	8.1	7.52	7.29	1	9		
Feb 2021	4.106	3.748	4.897	3.632	5.621	1.96	1.0	1.3	31.7	2.0	0.9	0.48	0.48	5.96	13.55	7.9	7.38	7.25	1	3	
Mar 2021	3.999	3.579	4.144	4.263	6.987	2.27	1.0	1.3	30.4	2.0	0.9	0.58	0.11	0.18	3.18	8.1	7.48	7.17	1	13	
Apr 2021	3.991	3.214	12.963	9.013	14.301	6.35	1.0	1.3	41.3	2.0	0.9	0.10	0.10	4.02	7.5	7.48	7.18	2	25		
May 2021	4.388	6.411	13.977	9.995	14.379	12.80	1.0	1.3	86.1	2.0	0.9	0.12	0.44	9.08	7.5	7.61	7.29	1	188		
Jun 2021	4.599	6.393	13.939	9.995	14.379	2.00	1.0	1.4	22.1	2.0	0.9	0.93	0.30	5.07	7.4	7.62	7.29	2	8		
Jul 2021	4.609	6.807	8.738	8.513	10.430	7.05	1.1	1.5	41.9	2.0	0.9	0.10	0.31	7.4	7.52	7.29	2	68			
Aug 2021	4.661	3.660	6.107	5.857	9.984	4.06	1.0	1.8	39.7	2.0	0.9	0.68	0.10	0.97	3.00	7.0	7.49	7.49	2	2,000	
Sep 2021	4.954	4.432	3.941	3.963	4.990	0.35	1.2	2.1	36.2	2.0	0.9	0.05	0.10	0.10	7.9	7.35	7.15	1	1		
Oct 2021																					
Nov 2021																					
Minimum	3.980	3.210	3.941	3.963	4.990	0.35	1.0	1.0	29	2.0	0.9	0.10	0.10	3.00	7.0	7.00	6.96	1	1		
Maximum	4.661	6.411	13.977	9.995	14.379	12.80	1.3	2.1	86	2.0	0.9	0.44	0.44	9.08	13.55	8.1	7.62	7.31	3	2,000	
Range	0.681	3.201	10.036	6.034	13.380	12.45	0.3	1.1	57	0.0	0.0	0.34	0.34	6.08	6.55	0.62	0.66	6.34	2	2,000	
Average	4.295	4.800	8.143	7.222	10.400	4.23	1.0	1.4	42	2.0	0.9	0.14	0.79	6.35	7.8	7.49	7.21	2	201		
StdDev	4.288	4.801	7.287	6.758	9.999	2.94	1.0	1.3	40	2.0	0.9	0.12	0.28	4.88	7.8	7.49	7.21	2	27		



## Red Oak Creek Regional Wastewater System Sludge Removal TCEQ Reporting Period 2021

VENDOR	DATE	WET TONS	TOTAL	MONTH	WET TONS	TOTAL	DRY TONS	METRIC DRY TONS
Protect Environmental	09-01-2020	15.65	\$637.74	September	288.56	\$11,758.84		
Protect Environmental	09-03-2020	16.18	\$659.34	October	275.37	\$11,221.34		
Protect Environmental	09-04-2020	16.41	\$668.71	November	340.24	\$13,864.78		
Protect Environmental	09-07-2020	19.29	\$786.07	December	412.78	\$16,820.85		
Protect Environmental	09-08-2020	16.32	\$665.04	January	341.02	\$13,896.60		
Protect Environmental	09-09-2020	16.92	\$689.49	February	250.08	\$10,190.79		
Protect Environmental	09-10-2020	13.06	\$532.20	March	305.03	\$12,430.00		
Protect Environmental	09-12-2020	19.49	\$794.22	April	348.55	\$14,203.44		
Protect Environmental	09-14-2020	17.52	\$713.94	May	317.34	\$12,931.61	74.52	
Protect Environmental	09-15-2020	17.25	\$702.94	June	263.46	\$10,939.76	67.37	
Protect Environmental	09-17-2020	17.12	\$697.64	July	345.04	\$16,389.45	73.06	
Protect Environmental	09-18-2020	13.73	\$559.50	August	310.28	\$14,738.35	63.82	
Protect Environmental	09-21-2020	17.2	\$700.90					
Protect Environmental	09-24-2020	18.08	\$736.76					
Protect Environmental	09-25-2020	19.79	\$806.44					
Protect Environmental	09-28-2020	18.31	\$746.13					
Protect Environmental	09-30-2020	16.24	\$661.78					
Protect Environmental	10-02-2020	13.45	\$548.09					
Protect Environmental	10-03-2020	15.37	\$626.33					
Protect Environmental	10-05-2020	17.26	\$703.35					
Protect Environmental	10-07-2020	17.46	\$711.50					
Protect Environmental	10-08-2020	10.71	\$436.43					
Protect Environmental	10-09-2020	15.25	\$621.44					
<b>TOTAL</b>		<b>3,002.75</b>	<b>\$159,305.61</b>				<b>336.07</b>	<b>304.89</b>

CODE	PARAMETER	MEASUREMENT	QUANTITY OR LOADING			QUALITY OR CONCENTRATION			NO. EX	FREQUENCY OF ANALYSIS	SAMPLE TYPE	
			AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM				UNITS
00300	Monitoring Location	SAMPLE MEASUREMENT				7.0						
	Oxygen, dissolved [DO]	PERMIT REQUIREMENT				6 MO MN			mg/L	0	Five Per Week	Grab
	1 - Effluent Gross	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT					6 MINIMUM		9 MAXIMUM				
00400	pH	SAMPLE MEASUREMENT				7.15		7.35				
	1 - Effluent Gross	PERMIT REQUIREMENT							S.U.	0	Five Per Week	Grab
00530	Solids, total suspended	SAMPLE MEASUREMENT	60.0		lb/d		2.0	2.0				
	1 - Effluent Gross	PERMIT REQUIREMENT	DAILY AVG			15 DAILY AVG		40 DAILY MAX	mg/L	0	Five Per Week	COMP12
00610	Nitrogen, ammonia total [as N]	SAMPLE MEASUREMENT	3.00		lb/d		0.10	0.10				
	1 - Effluent Gross	PERMIT REQUIREMENT	DAILY AVG			2 DAILY AVG		10 DAILY MAX	mg/L	0	Five Per Week	COMP12
50050	Flow, in conduit or thru treatment plant	SAMPLE MEASUREMENT	3.432	3.841	MGD							
	1 - Effluent Gross	PERMIT REQUIREMENT	DAILY AVG	Req Mon DAILY MAX							Continuous	TOTALZ
50050	P - See Comments	SAMPLE MEASUREMENT		10417 ZHR PEAK	gal/min							
	1 - Effluent Gross	PERMIT REQUIREMENT								0	Continuous	TOTALZ
50050	Flow, in conduit or thru treatment plant	SAMPLE MEASUREMENT	4.564		MGD							
	Gross (Supplementary)	PERMIT REQUIREMENT	6 ANNL AVG								0	Continuous
51040	E. coli	SAMPLE MEASUREMENT				1		1.0				
	1 - Effluent Gross	PERMIT REQUIREMENT				126 DAILY AVG		399 DAILY MAX	CFU/100 mL	0	Daily	Grab
80082	BOD, carbonaceous [5 day, 20 C]	SAMPLE MEASUREMENT	36.0		lb/d		1.2	2.1				
	1 - Effluent Gross	PERMIT REQUIREMENT	DAILY AVG			10 DAILY AVG		25 DAILY MAX	mg/L	0	Five Per Week	COMP12

# New Paradigm – The Strategic Plan

Plant efficiency report gives a snapshot of plant health by looking at regulatory, process control, and budgeting variables

## Red Oak Creek Regional Wastewater System Plant Efficiency Report

**Absolute Plant Efficiency (%):** 95.32

### Process Control (40% Weight)

Last Entered	Variable	Value	Units	Control Limits	Relative Efficiency (%)	Reason for Inefficiency
9/30/2021	RAS	76.60	%	50 - 120	100.00	
9/30/2021	Sludge Retention Time	7.97	Days	9 - 21	88.53	Lower Limit Exceeded
9/30/2021	Mean Cell Residence Time	7.92	Days	9 - 24	88.00	Lower Limit Exceeded
10/1/2021	F/M Ratio	0.06	Ratio	0.08 - 0.5	78.97	Lower Limit Exceeded
10/1/2021	Aer Sludge Volume Index	65.04	ml/g	60 - 200	100.00	
9/29/2021	Centrifuge Cake Total Solids	17.40	%	>=19	91.59	Lower Limit Exceeded
9/27/2021	Polymer Usage lbs/ton dry solids	7.79	lbs/ton	<=15	100.00	

**Absolute Efficiency (%):** 92.44

### Regulatory Compliance (50% Weight)

Last Entered	Variable	Value	Units	Permit Limits	Relative Efficiency (%)	Reason for Inefficiency
10/1/2021 6:00:00 AM	Effl 2hr Interval Average (GPM)	2,226.74	gpm	<=10417	100.00	
10/1/2021	Eff Daily Peak 2hr Flow	4.29	MGD	<=15	100.00	
10/1/2021	Eff Annual Average Flow	4.67	MGD	<=6	100.00	
9/30/2021	Eff pH Lab at Peak Flow	7.20	mg/L	6 - 9	100.00	
9/30/2021	Eff DO	7.10	mg/L	>=6	100.00	
9/29/2021	Eff E. coli	1.00	Col/100ML	<=399	100.00	

**Absolute Efficiency (%):** 100.00

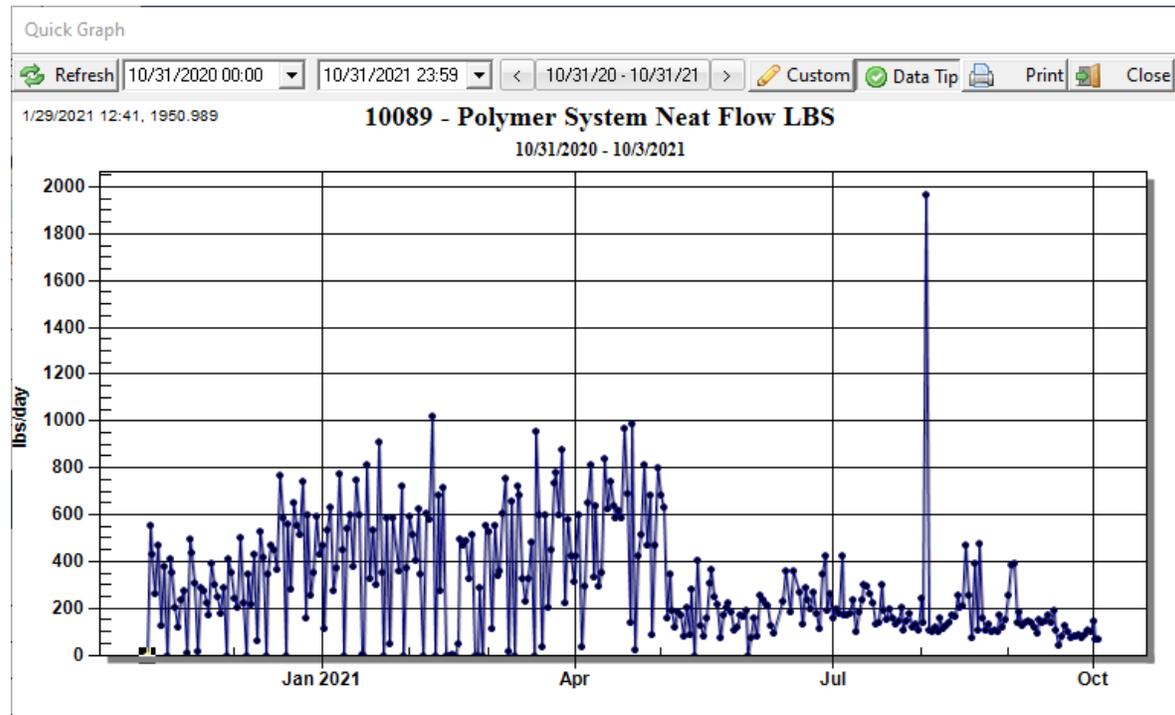
### Cost-of-Operations (10% Weight)

Expense Type	Budget	FYTD Spent	Current Monthly Average	Target Monthly Average	Relative Efficiency (%)	Reason for Inefficiency
Power	\$244,220.69	\$166,884.69	\$16,688.47	\$20,351.72	100.00	
Water	\$9,293.00	\$9,646.56	\$964.66	\$774.42	46.20	Annual Budget exceeded
Polymer	\$48,900.00	\$41,216.00	\$4,121.60	\$4,075.00	98.86	Target Monthly Average Exceeded
Hauling	\$139,333.00	\$129,265.75	\$12,926.58	\$11,611.08	88.67	Target Monthly Average Exceeded

**Absolute Efficiency (%):** 83.43

# Conclusion – The Results

Human factors mitigation is improved; short-term results are starting to surface; improved chances for long-term future success



Reduced noise and downward trend



Trinity River Authority of Texas  
*Enriching the Trinity basin as a resource for Texans*

# Summary

- ▶ Background
- ▶ Introduction
- ▶ Old Paradigm
- ▶ New Paradigm
- ▶ Conclusion



Trinity River Authority of Texas  
*Enriching the Trinity basin as a resource for Texans*

# Questions

- ▶ Contact Information: [naranjodl@trinityra.org](mailto:naranjodl@trinityra.org)

# References

Baron, B. (2012, December 2012). The Human Factors Funnel Model - Another Window On The Error Causation.

Boling, M. (2019, March 31). Leadership: A view from the Middle: Lessons from an Aircraft Maintainer.

Del Buono, T. (2017, May 18). *There Is Always Room For Improvement*. Retrieved from Practical Practice Management: <https://ppm4u.wordpress.com/2017/05/18/there-is-always-room-for-improvement/>

Lawrence, K. (2018, July 23). *Archives Recalls Fire That Claimed Millions of Military Personnel Files*. Retrieved from National Archives: <https://www.archives.gov/files/fprc-image9.jpg>

*Mass Balance for Sludge Calculation in Water Treatment Plant*. (2017, September 9). Retrieved from YouTube: <https://www.youtube.com/watch?v=ZkxV1axazlo>