# Preparing for and Executing Major Operations Changes

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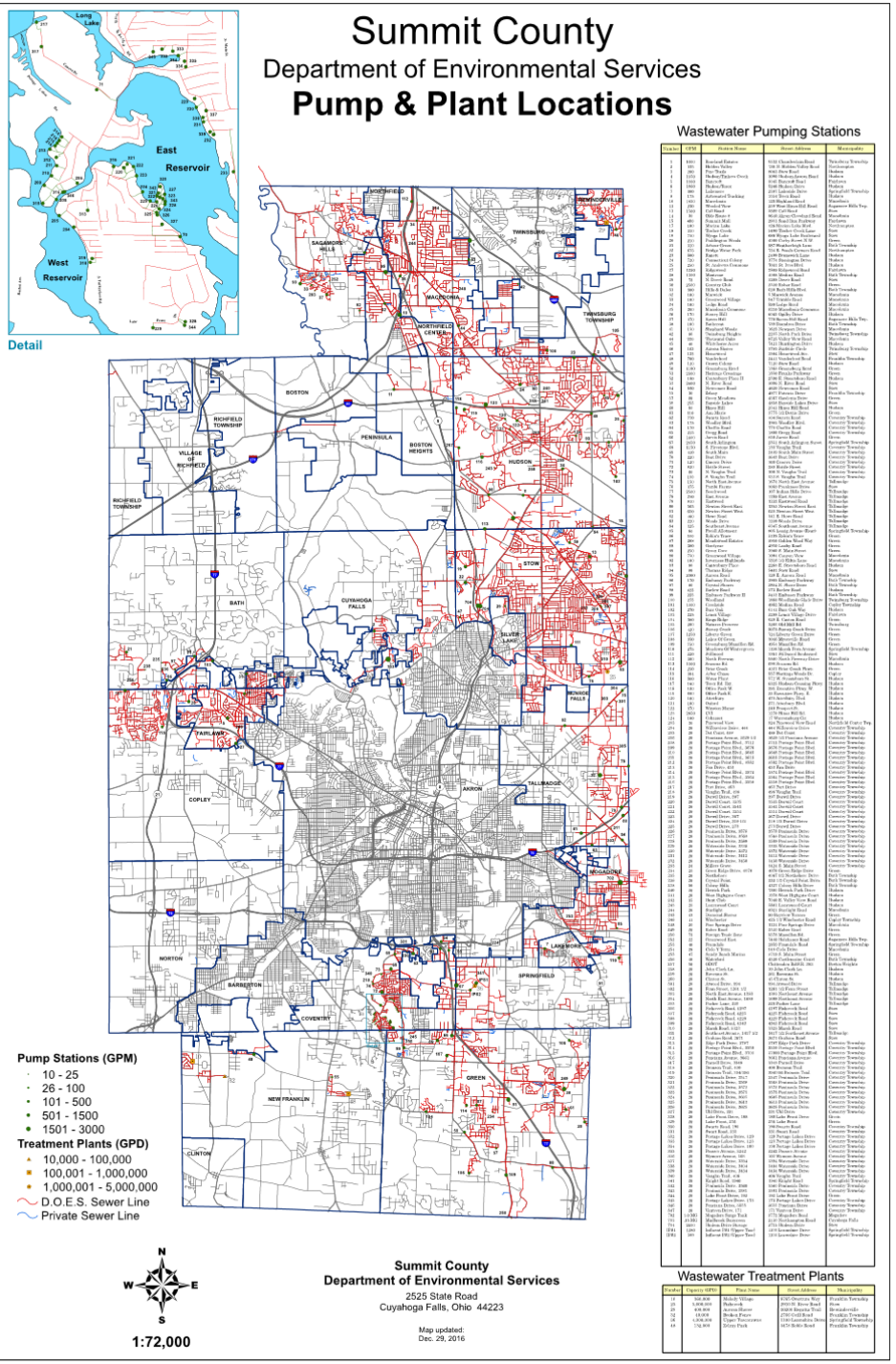
Summit County

# Upper Tuscarawas: Transition from RBC to BNR

- Overview of previous and upgraded plant
- Documentation
- Training
- Preventive Maintenance
- Sampling and Analysis
- Workplace cultural awareness
- Lessons learned

# Summit County, Ohio

- 50,000 people
- 20 communities
  - Akron is the largest city, but is independently sewered and treated




# Collection and Treatment Systems

- 219 pump stations
- 6 wastewater treatment plants
  - Broken Fence (40,000gpd)
  - Melody Village (100,000gpd)
  - Zelray Park (132,000gpd)
  - Upper Tuscarawas (4.0 MGD)
  - Fishcreek (5.0 MGD)


# Upper Tuscarawas (Plant #36)

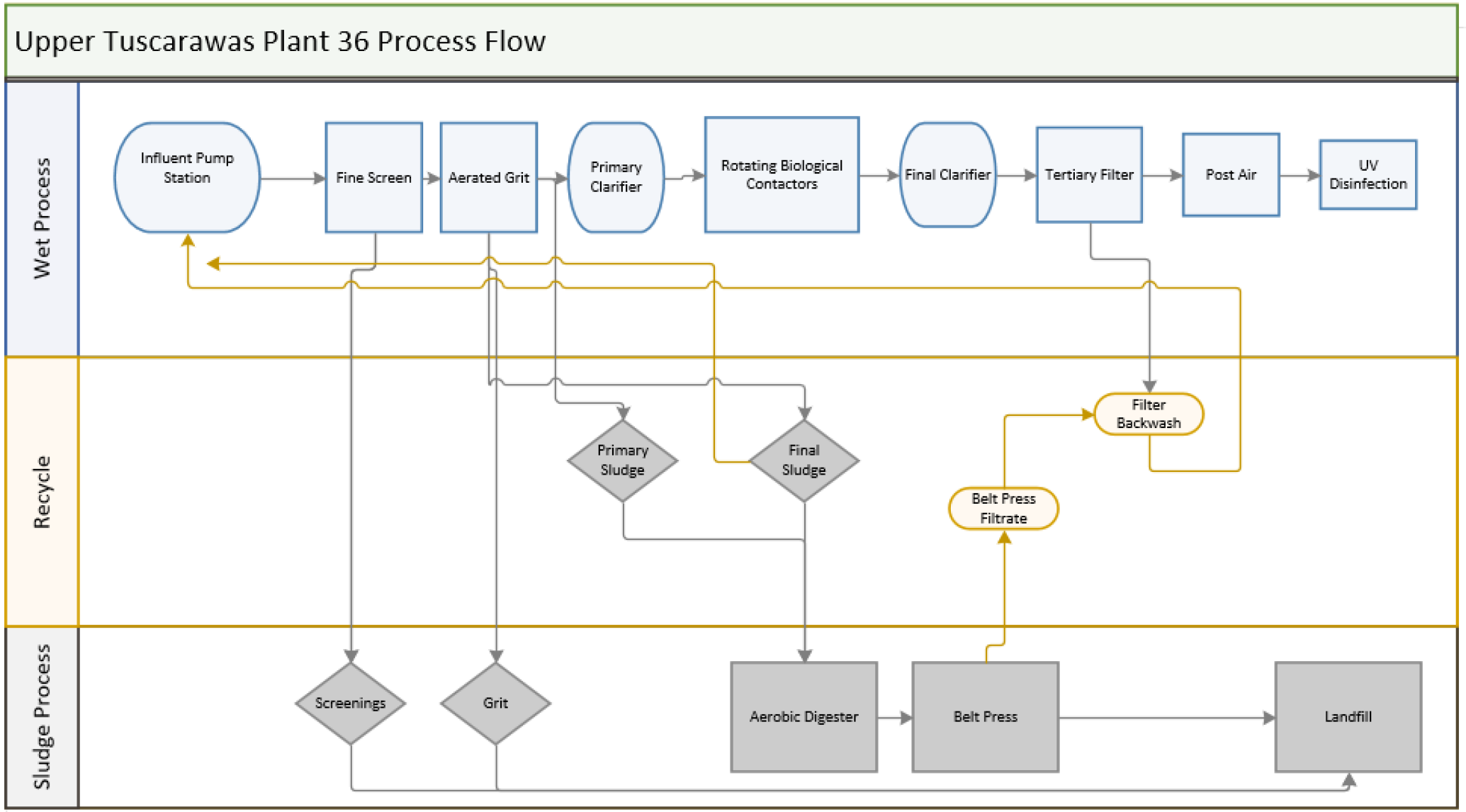
- Designed and built in the late 1970s
- First in service in 1980
- 25% of flow (up to 1 MGD) belongs to Stark County
- 4.0 MGD average and 10.0 MGD Max (hydraulic)

# Previous Process Units

| |
|---|
| Influent pump stations |
| Manual bar rack |
| Grit removal |
| Fine screen |
| Primary clarification |
| Chemical phosphorus removal |
| Rotating Biological Contactors |
| Final Clarifiers |
| Tertiary Filters |
| Post aeration |
| UV Disinfection |
| Aerobic Digestion |
| Belt Press |

# Current Process Units

| |
|---|
| Influent pump stations |
| Manual bar rack |
| Grit removal |
| Fine screen |
| ~~Primary clarification~~ |
| Chemical phosphorus removal |
| ~~Rotating Biological Contactors~~ Biological Nutrient Removal |
| Final Clarifiers |
| Tertiary Filters |
| Post aeration |
| UV Disinfection |
| Aerobic Digestion |
| Belt Press |


Upper Tuscarawas Plant 36 Process Flow
Wet Process
Recycle
Sludge Process
Influent Pump Station
Fine Screen
Aerated Grit
Primary Clarifier
Rotating Biological Contactors
Final Clarifier
Tertiary Filter
Post Air
UV Disinfection
Filter Backwash
Primary Sludge
Final Sludge
Belt Press Filtrate
Screenings
Grit
Aerobic Digester
Belt Press
Landfill

The VIP process is illustrated below

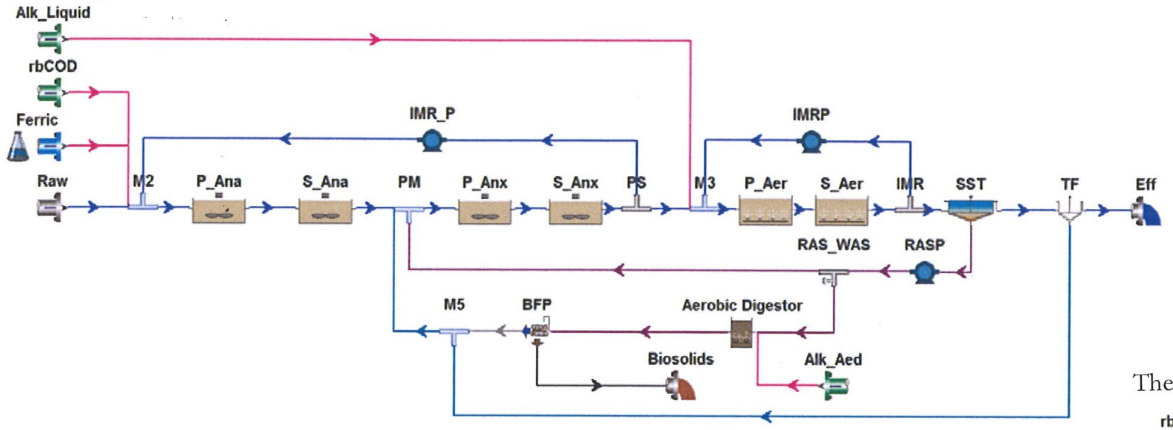



Figure 4-10: Virginia Initiative Plant (VIP) Process

The modified UCT process is illustrated below in Figure 4-6.

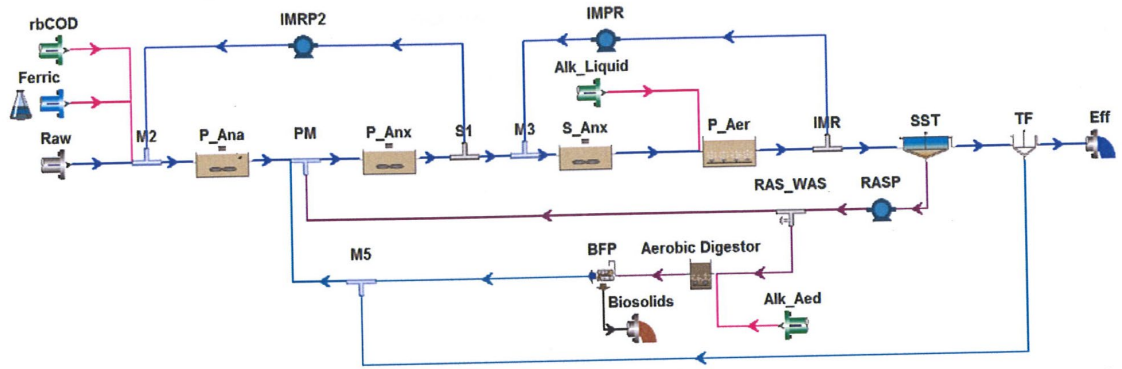



Figure 4-6: Modified UCT Process

VIP/MUCT Process Digrams

Prepared by MS Consultants

"Upper Tusc WWTP #36 RBC Replacement Basis of Design" June 2017

# BNR Facility

- Anaerobic/ Anoxic/ Aerobic zones
- Scum removal
- Fiberglass baffles will allow plant to choose between VIP and MUCT design style

# Documentation

- Write down everything you can, early and often
  - "Quick to start, slow to finish"
- Transfer to a master file on a computer
  - Continuous improvement- add and remove as you go!
- As you think through all the little details, write it down.
  - Forces you to think and re-think processes.
- If you write it down, you won't have to work so hard to remember later!!
- Startup alarm log

# Documentation

## Round sheets

Collect important information
Ensure consistency
Guide observations
Include targets or limits

## Checklists

Good for training, too!

## Physical Rounds

- ☐ Physical inspection of all equipment
  - ☐ Does it sound right? Smell right? Look right?
- ☐ Check old plant
  - ☐ EQ tanks empty unless above 5 MGD
- ☐ Check all pumping rates
  - ☐ Influent (2.5 MGD/tank)
  - ☐ RAS (80-100% influent)
  - ☐ IMLR Anoxic (50-150% influent)
  - ☐ IMLR Anaerobic (200-400% influent)
- ☐ Check all mixers (good roll pattern, no faults, no dead spots)
- ☐ Sludge Blankets (around 2 feet)
- ☐ Check weirs (clean, not blocked, no bulking sludge)
- ☐ Skim (not operable yet)
- ☐ Check chemical tank levels
  - ☐ Also check for signs of leaks around pumps and tanks
  - ☐ Tank reorder level is 24 inches
  - ☐ Maximum fill level is 10 feet
- ☐ Complete round sheets
- ☐ Fill out logbook
- ☐ Collect samples
  - ☐ Phosphorus: influent, anaerobic, effluent
  - ☐ Ammonia: effluent
  - ☐ Mixed Liquor
  - ☐ RAS Well

## Computer/SCADA Rounds

- ☐ Adjust wasting (12-day SRT)
- ☐ Check/ adjust chemical dosing
- ☐ Check alarms (Alarms can NOT be ignored, must be responded to, or reported)
- ☐ Check instrumentation
  - ☐ pH
    - ☐ (7.2 - 8.0)
  - ☐ DO
    - ☐ Primary Aerobic: (2.0– 3.0)
    - ☐ Secondary Aerobic: (1.5 - 2.0)
  - ☐ ORP
    - ☐ Anaerobic: (-250 to -150)
    - ☐ Primary Anoxic: (-100 to 100)
    - ☐ Secondary Anoxic: (-100 to 0)
  - ☐ Nitrates
    - ☐ Anaerobic (less than 5)

## Lab Work

- ☐ Mixed Liquor Suspended Solids (MLSS)
  - ☐ East Aeration
  - ☐ West Aeration
  - ☐ East RAS
  - ☐ West RAS
- ☐ Settleability
  - ☐ East Aeration
  - ☐ West Aeration
- ☐ Microscopic Analysis
  - ☐ East Aeration
  - ☐ West Aeration
- ☐ Phosphorus
  - ☐ Influent
  - ☐ Anaerobic
  - ☐ Effluent
- ☐ Ammonia
  - ☐ Effluent
- ☐ Calculations
  - ☐ Desired Wasting (SRT=12 day)
  - ☐ SVI (50-150)

**Anaerobic Zone East**

| *Parameter* | Primary ORP | Secondary ORP | Mixers | NO3 | IMLR | Micro-C Dose | Micro-C Flow |
|---|---|---|---|---|---|---|---|
| *Targets* | *-250 to -150* | *-250 to -150* | *(2) On* | *Less than 5* | *200%-400% Influent* | *n/a* | *n/a* |
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
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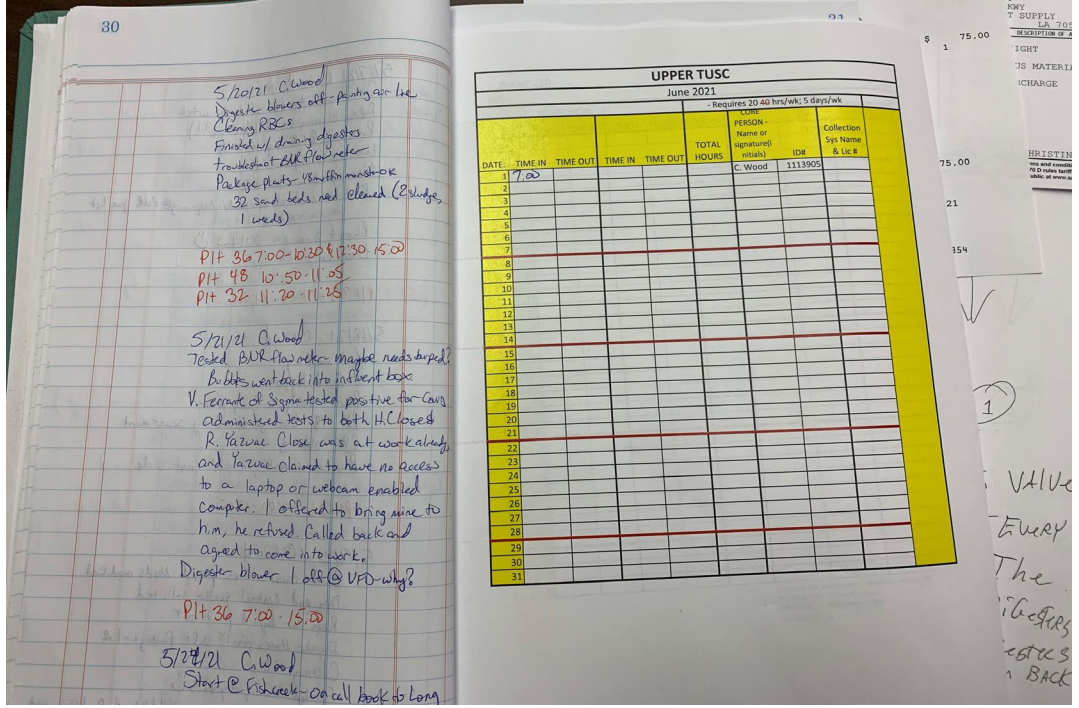
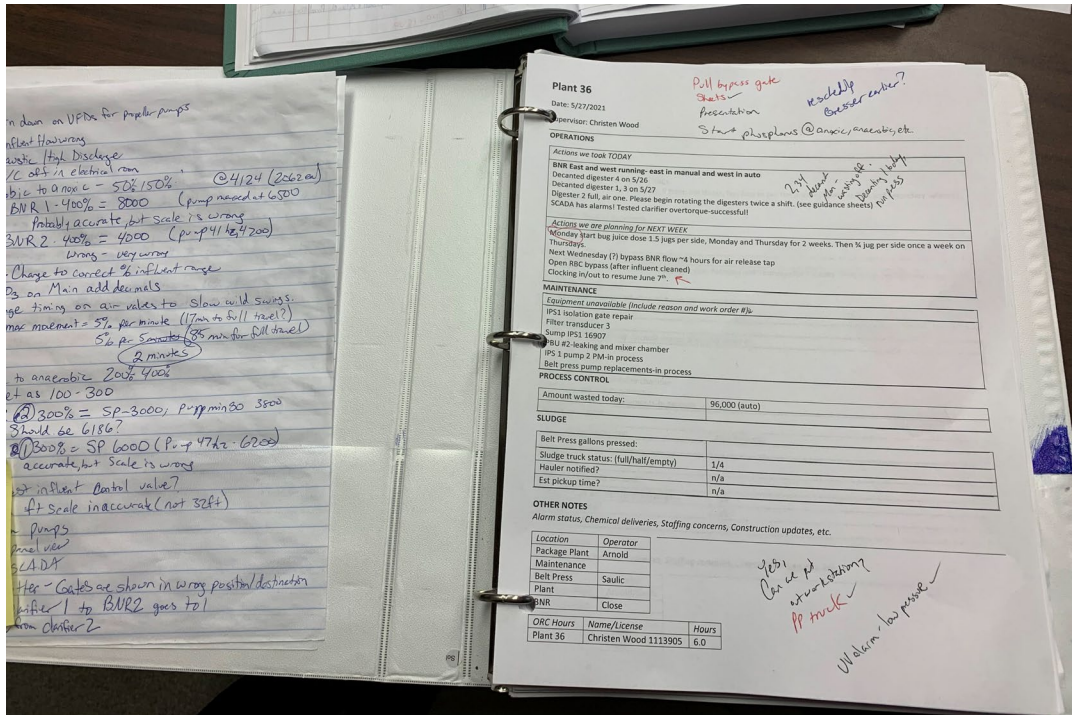
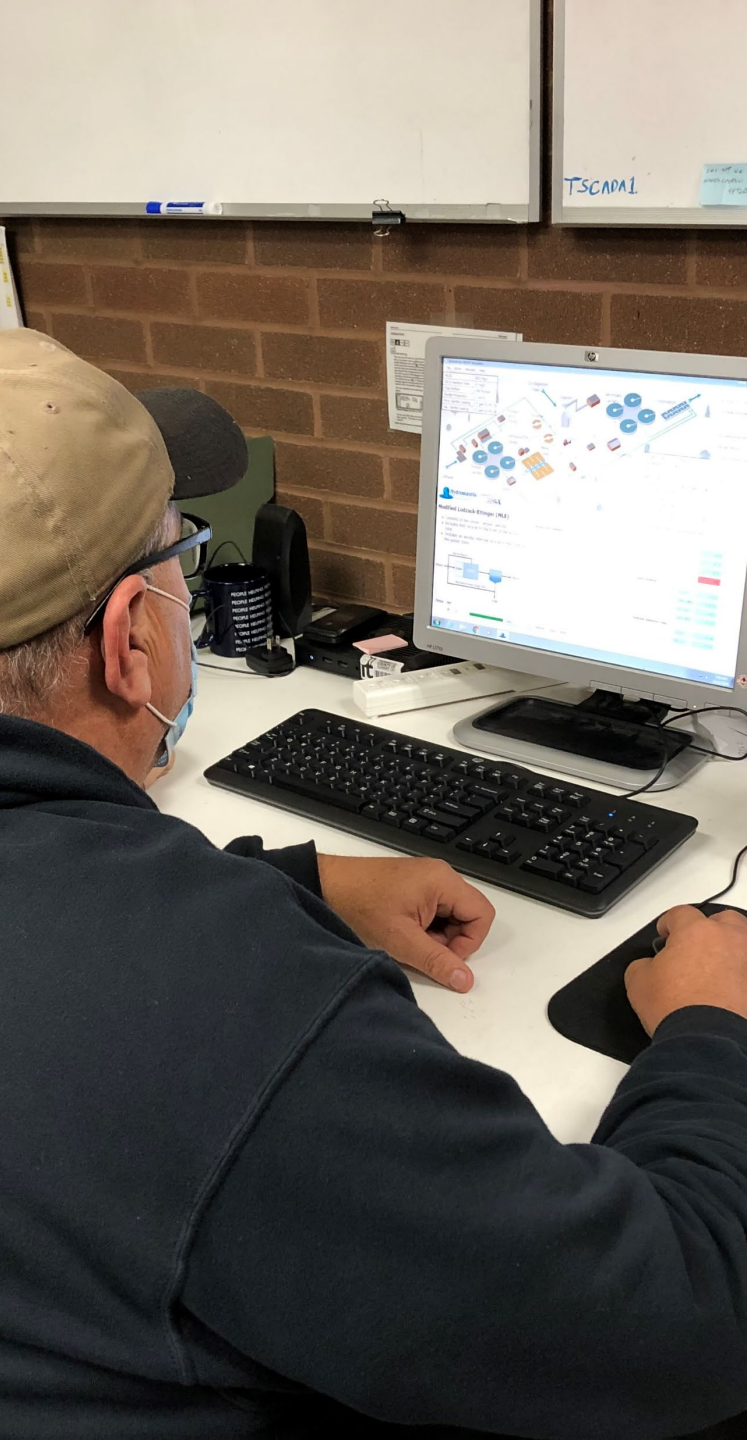
| 28 | | | | | | | |
| 29 | | | | | | | |
| 30 | | | | | | | |
| 31 | | | | | | | |

# Documentation

- Daily log
  - “Anything with the potential to affect effluent quality or quantity”
  - During new process startups-that is EVERYTHING
    - Better notes, better chance of being able to recreate a chain of events






# Internal Training

## Contact Hours

- 7-part series

## Simulator Software

- Hydromantis

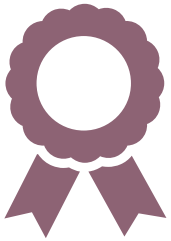
## Walkthrough/Talkthrough

# Vendor Training

Important BUT difficult to get operations training

Video training for review later

# Hands-On



Most operators learn best hands-on

Allow (Or Force!) workers to assist with testing, programming, equipment checks, etc.

Use checklists and round sheets

# Preventive Maintenance

- Collect as much preventive maintenance information from the vendor training as possible
- Write it down! Manuals are cumbersome, and you are likely to forget anything that isn't written down.
- Create a schedule that works best and write the schedule down too.
- Accountability for completing work

# Preventive Maintenance

- Don’t forget the old equipment!
- Cleaning
- Use process shutdowns to do maintenance work, too
- Exercising both new and old equipment

# Sampling and Analysis

- Think through the data analysis you need for:
  - Day-to-day process control
  - Regulatory requirements
  - Optimization goals
  - Emergency operations
  - Troubleshooting

# Sampling and Analysis

- Put all the data in one place.
  - Easier cross-checking
  - Include:
    - Sample location
    - Volume needed
    - Tests
    - Calculations
    - Limits or targets
- Collect data both before and after the major process change. (Baseline)

# Excel: Index Match

=IF(INDEX(Historian!A7:BE7,MATCH("FLWAVG",Historian!A3:BE3,0))=0,"",INDEX(Historian!A7:BE7,MATCH("FLWAVG",Historian!A3:BE3,0)))

| | Plant | Plant | Effluent | INFLUENT | | | |
|---|---|---|---|---|---|---|---|
| | Flow (AVG) | Flow (Week) | Flow (Max) | TSS | BOD | NH3 | P |
| Sample ID | FLWAVG | FLWTOT | EFFFLWMAX | INFTSS | INFBOD | INFNH3 | INFTPO |
| Units | MGD | MGD | MGD | mg/L | mg/L | mg/L | mg/L |
| Source | Historian | Historian | Historian | Lab | Lab | Lab | Lab |
| | | | | | | | |
| 05-Jan-19 00:00:00 | 3.13 | 21.94 | 5.43 | 206.67 | 261.33 | 22.3 | 4.5 |

| EFFLUENT | | | | | |
|---|---|---|---|---|---|
| TSS | BOD | NH3 | P | E. coli | DO |
| EFFTSS | EFFBOD | EFFNH3 | EFFTPO | EFFECO | EFFDOX |
| mg/L | mg/L | mg/L | mg/L | CFU | mg/L |
| Lab | Lab | Lab | Lab | Lab | Historian |
| | | | | | |
| 12.00 | 11.00 | 5.90 | 1.40 | | 8.05 |

| Effluent | | | | | | | |
|---|---|---|---|---|---|---|---|
| TSS | TSS | BOD | BOD | P | P | NH3 | NH3 |
| | | | | | | | |
| Loading | % Removal (Plant) | Loading | % Removal (Plant) | Loading | % Removal (Plant) | Loading | % Removal (Plant) |
| Calculate | Calculate | Calculate | Calculate | Calculate | Calculate | Calculate | Calculate |
| | | | | | | | |
| 314 | 94.2% | 287.526461 | 95.8% | 36.5942769 | 68.9% | 154.218738 | 73.5% |

| Location Codes | |
|---|---|
| ***Wet Side*** | |
| ANE | Anaerobic Zone-East |
| ANW | Anaerobic Zone-West |
| ARE | Aerobic Zone-East |
| ARW | Aerobic Zone-West |
| AXE | Anoxic Zone- East |
| AXW | Anoxic Zone-West |
| BYE | Equalization Train/Bypass |
| BYF | Tertiary Filter Bypass |
| CAE | Caustic East |
| CAW | Caustic West |
| CLE | Final Clarifier-East |
| CLW | Final Clarifier-West |
| EFF | Plant Effluent |
| FIL | Tertiary Filter |
| IBN | Influent BNR |
| INF | Plant Total Influent |
| MCE | Micro-C East |
| MCW | Micro-C West |
| SAE | Sodium aluminate east |
| SAW | Sodium Aluminate West |
| ***Dry Side*** | |
| BAW | Filter Backwash |
| BPF | Belt Press Filtrate |
| BPI | Belt Press Influent (Digester Eff) |
| CAK | Sludge Cake |
| NRE | Anaerobic Internal Mixed Liquor Return- East |
| NRW | Anaerobic Internal Mixed Liquor Return- West |
| RSE | Return Activated Sludge-East |
| RSW | Return Activated Sludge-West |
| WSE | Waste Sludge East |
| WSW | Waste Sludge West |
| XRE | Anoxic Internal Mixed Liquor Return- East |
| XRW | Anoxic Internal Mixed Liquor Return- West |

| Test Codes | |
|---|---|
| ALK | Alkalinity |
| BLA | Sludge Blanket |
| BOD | cBOD |
| COD | Chemical Oxygen Demand |
| DOX | Dissolved Oxygen |
| ECO | E. coli |
| FLO | Flow (gpm) |
| FLW | Flow (MGD) |
| NH3 | Ammonia |
| ONO | NO2 +NO3 |
| ORP | Oxidation-Reduction Potential |
| PHX | pH |
| PO4 | Ortho-Phosphorus |
| PTS | Percent Total Solids |
| PVS | Percent Volatile Solids |
| SBO | sBOD |
| SET | Settlability |
| TON | Wet Tons Hauled |
| TPO | Total Phosphorus |
| TSS | Total Suspended Solids |
| UIS | Units In Service |

| | | |
|---|---|---|
| **ANEONO** | **AXWONO** | **EFFNH3** |
| **ANEORP** | **AXWORP** | **EFFPO4** |
| **ANEPO4** | **AXWPO4** | **EFFTPO** |
| **ANWONO** | **BPFCOD** | **IBNFLW** |
| **ANWORP** | **BPFFLO** | **INFALK** |
| **ANWPO4** | **BPFNH3** | **INFCOD** |
| **AREALK** | **BPFONO** | **INFFLW** |
| **AREDOX** | **BPFTPO** | **INFNH3** |
| **ARENH3** | **BPIPTS** | **INFONO** |
| **AREONO** | **BPIPVS** | **INFPO4** |
| **AREPHX** | **BYEBOD** | **INFTPO** |
| **AREPO4** | **BYEFLW** | **MCEFLO** |
| **ARESET** | **BYETSS** | **MCWFLO** |
| **ARETSS** | **BYFBOD** | **NREFLW** |
| **ARWALK** | **BYFFLW** | **NRWFLW** |
| **ARWDOX** | **BYFTSS** | **RSEFLW** |
| **ARWNH3** | **CAEFLO** | **RSEPVS** |
| **ARWONO** | **CAKPTS** | **RSETSS** |
| **ARWPHX** | **CAKTON** | **RSWFLW** |
| **ARWPO4** | **CAWFLO** | **RSWPVS** |
| **ARWSET** | **CLEBLA** | **RSWTSS** |
| **ARWTSS** | **CLETSS** | **SAEFLO** |
| **AXEONO** | **CLWBLA** | **SAWFLO** |
| **AXEORP** | **CLWTSS** | **XREFLW** |
| **AXEPO4** | **EFFFLW** | **XRWFLW** |
| | | **WSEFLW** |
| | | **WSWFLW** |

| Wet Side | ALK | BLA | BOD | COD | DOX | FLO | FLW | NH3 | ONO | ORP | PHX | PO4 | SET | TPO | TSS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Plant Total Influent | L | | | L | | | I | L | L | | | L | | L | |
| Anaerobic Zone-East and West | | | | | | | | | I | I | | O | | | |
| Anoxic Zone- East and West | | | | | | | | | I | I | | O | | | |
| Aerobic Zone-East and West | L | | | | I | | | L | L | | I | O | O | | O |
| Final Clarifier-East and West | | O | | | | | | | | | | | | | L |
| Plant Effluent | | | | | | | I | L | | | | O | | L | |
| Equalization Train/Bypass | | | L | | | | I | | | | | | | | L |
| Tertiary Filter Bypass | | | **L** | | | | O | | | | | | | | L |
| Micro-C East and West | | | | | | I | | | | | | | | | |
| Caustic East and West | | | | | | I | | | | | | | | | |
| Sodium Aluminate East and West | | | | | | I | | | | | | | | | |

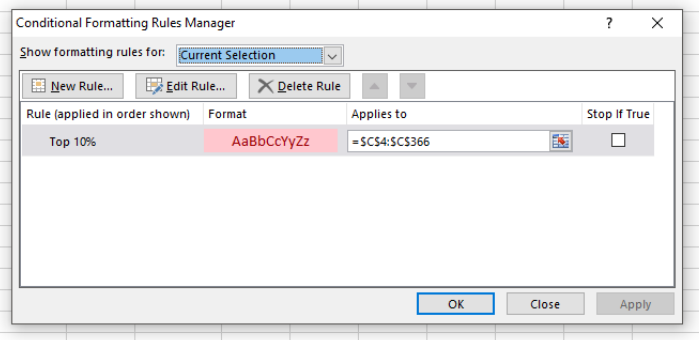
| Dry Side | COD | FLO | FLW | NH3 | ONO | PTS | PVS | TON | TPO | TSS |
|---|---|---|---|---|---|---|---|---|---|---|
| Belt Press Filtrate | L | I | | L | L | | | | L | |
| Belt Press Influent (Digester Eff) | | | | | | L | L | | | |
| Sludge Cake | | | | | | L | | O | | |
| Anaerobic Internal Mixed Liquor Return- East and West | | | I | | | | | | | |
| Anoxic Internal Mixed Liquor Return- East and West | | | I | | | | | | | |
| Return Activated Sludge-East and West | | | I | | | | L | | | O |
| Waste Sludge East and West | | | I | | | | | | | |

| |
|---|
| I=Instrumentation |
| O=Operator |
| L=Laboratory |
| N=N/A |

# Data Flagging

- Use conditional formatting to highlight data that doesn't "match"
  - Top or bottom %
  - Values exceeding a limit
  - Duplicates
  - Min, Max, Avg

| | SCADA.PS5048_STATION_FLOW_TOT_YESTER.F_CV | 1/1/2020 | 12/31/2020 | | |
|---|---|---|---|---|---|
| | TAG NAME | START | END | | |
| Timestamp | Value | | | | |
| 02-Jan-20 00:00:00 | 63748.27311 | 63748.27 | | | |
| 03-Jan-20 00:00:00 | 61272.66504 | 61272.67 | | | |
| 04-Jan-20 00:00:00 | 56449.96191 | 56449.96 | | | |
| 05-Jan-20 00:00:00 | 52854.68359 | 52854.68 | | | |
| 06-Jan-20 00:00:00 | 68810.93848 | 68810.94 | | | |
| 07-Jan-20 00:00:00 | 64377.52604 | 64377.53 | | | |
| 08-Jan-20 00:00:00 | 59188.10335 | 59188.10 | | | |
| 09-Jan-20 00:00:00 | 52018.5612 | 52018.56 | | Min | 38185.89 |
| 10-Jan-20 00:00:00 | 52776.17611 | 52776.18 | | Max | 160517.18 |
| 11-Jan-20 00:00:00 | 54612.52507 | 54612.53 | | Avg | 54988.37 |
| 12-Jan-20 00:00:00 | 56776.81836 | 56776.82 | | Sum | 19960777.87 |
| 13-Jan-20 00:00:00 | 75463.74837 | 75463.75 | | | |
| 14-Jan-20 00:00:00 | 78124.00911 | 78124.01 | | | |
| 15-Jan-20 00:00:00 | 65596.24772 | 65596.25 | | | |
| 16-Jan-20 00:00:00 | 58738.58008 | 58738.58 | | | |
| 17-Jan-20 00:00:00 | 51820.12565 | 51820.13 | | | |
| 18-Jan-20 00:00:00 | 52945.15072 | 52945.15 | | | |
| 19-Jan-20 00:00:00 | 53502.09375 | 53502.09 | | | |
| 20-Jan-20 00:00:00 | 76777 | 76777.00 | | | |
| 21-Jan-20 00:00:00 | 81402.59245 | 81402.59 | | | |
| 22-Jan-20 00:00:00 | 72337.03646 | 72337.04 | | | |
| 23-Jan-20 00:00:00 | 64455.81445 | 64455.81 | | | |
| 24-Jan-20 00:00:00 | 66620.84049 | 66620.84 | | | |
| 25-Jan-20 00:00:00 | 60915.2054 | 60915.21 | | | |
| 26-Jan-20 00:00:00 | 68985.99902 | 68986.00 | | | |
| 27-Jan-20 00:00:00 | 86034.92513 | 86034.93 | | | |
| 28-Jan-20 00:00:00 | 81577.35807 | 81577.36 | | | |
| 29-Jan-20 00:00:00 | 67658.17188 | 67658.17 | | | |
| 30-Jan-20 00:00:00 | 66441.85156 | 66441.85 | | | |
| 31-Jan-20 00:00:00 | 63452.71973 | 63452.72 | | | |
| 01-Feb-20 00:00:00 | 60926.96517 | 60926.97 | | | |
| 02-Feb-20 00:00:00 | 59367.28939 | 59367.29 | | | |
| 03-Feb-20 00:00:00 | 66169.33431 | 66169.33 | | | |
| 04-Feb-20 00:00:00 | 68312.15039 | 68312.15 | | | |
| 05-Feb-20 00:00:00 | 68322.91833 | 68322.92 | | | |
| 06-Feb-20 00:00:00 | 68184.59059 | 68184.59 | | | |



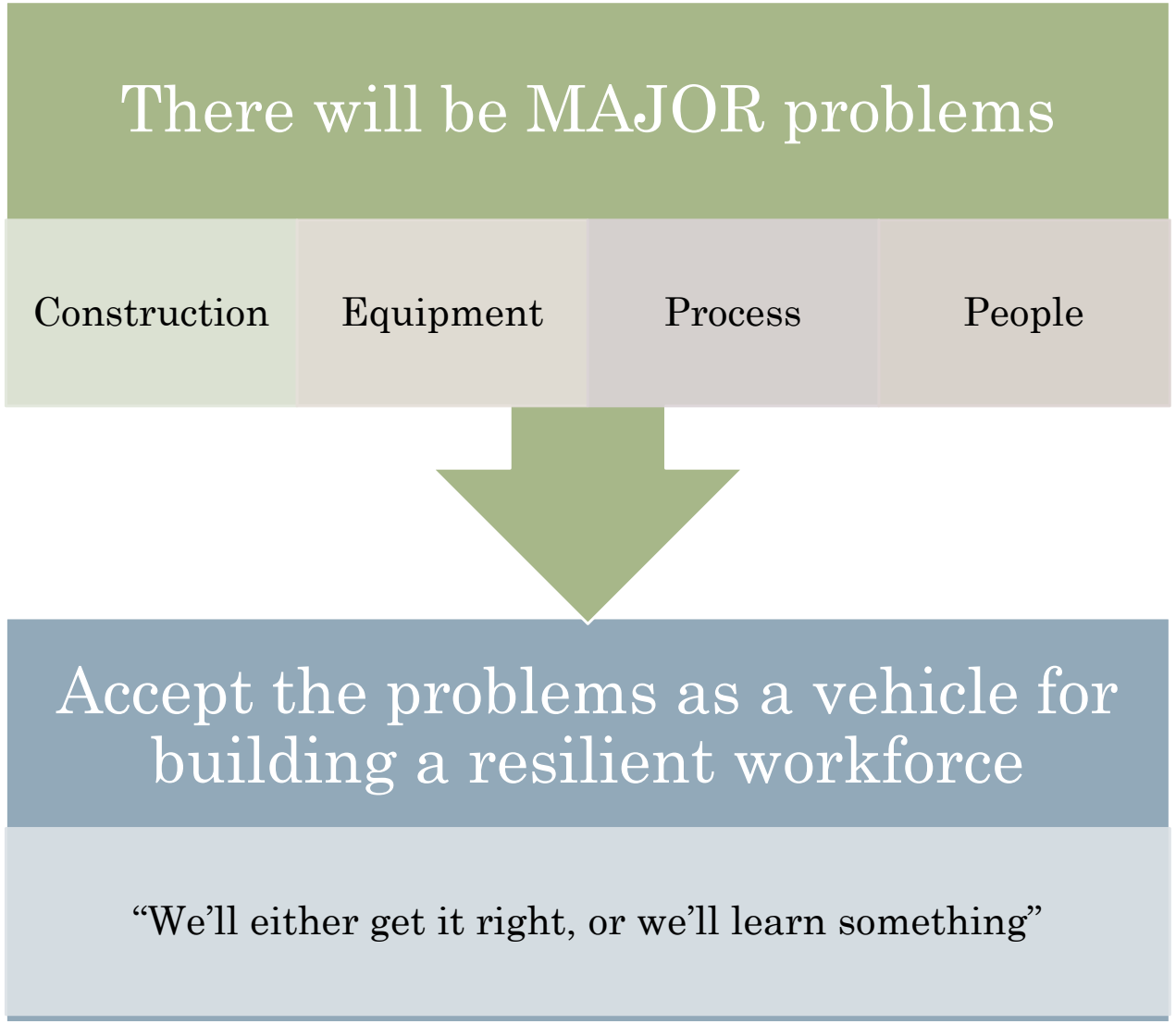
# Workplace Cultural Awareness

- Set groundwork early
  - But don't get overly technical until later
- Make the new process your "north star"
  - Can also be a trojan horse…
- Identify strengths and weaknesses
  - Who can become a leader in areas?
  - How do we begin to learn the skills?

# Workplace Cultural Awareness

- Get staff involved and exposed to as much of the change as possible
- Encourage problem solving
  - Troubleshoot problems that would normally be left for maintenance
- Encourage tough questions
  - Be willing to concede on some decisions/documentation you've already done
    - If you wrote it down in the computer- its easy to update or change!

# Workplace Cultural Awareness



# Lessons Learned

- Get involved!
- Effluent quality always wins
- Check, check, check, and check again
- The best tests include all points of failure, so simulate bad conditions instead of using fake signals
- Document early in the process. You can always edit it once you have a baseline
- Most importantly: **Panic early and often.**
  - Not sure it helps, but I will be willing to commiserate with you!