Lessons Learned - New Plant Start Up

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Operations Superintendent

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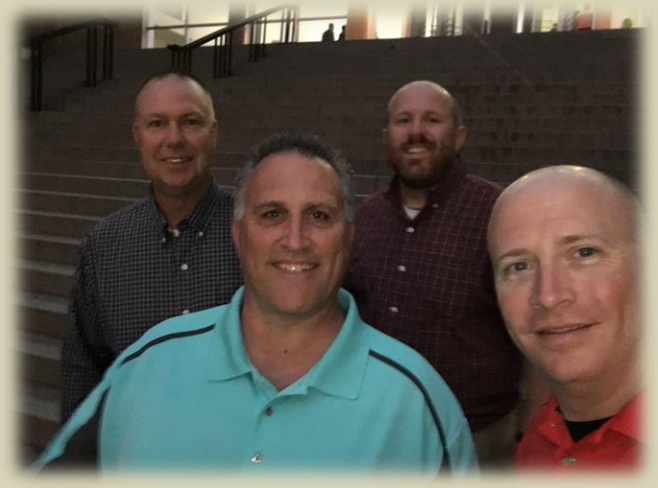
Operations Manager

- Healthiest County in Ohio
  State Ranked #1 for last 4 years running
- Wealthiest County
  State Ranked #1 household median income
- Wisest
  50% of residents has bachelor degrees or higher
- 2nd Happiest County in U.S.
  Only behind Loudoun County, Virginia
- Fastest growing county in Ohio

Delaware County Regional Sewer District

- Alum Creek Water Reclamation Facility
- Olentangy Environmental Control Center
- Lower Scioto Water Reclamation Facility
- North Star Re-Use Facility
- Scioto Reserve Re-Use facility
- Tartan Fields Re-Use Facility
- Scioto Hills
- Hoover Woods
- Bent Tree

Delaware County Regional Sewer District Operational Staff



51 Operational Employees

- 51 % is OEPA Certified
- 25% is OWEA Lab Certified
- 25% has college degrees
- 80% has CDL

New Plants to Start Up in 2017

North Star Wastewater Re-Use Facility

- Built by Developer starting 2007
- Accepted by Delaware County 2008
- Start Up Procedures started 2009

Lower Scioto Water Reclamation Facility

- Built by Developer- Delaware County 2009
- Accepted by Delaware County 2013
- Start Up Procedures started 2016

North Star Wastewater Re-Use Facility

- Construction completed 2009
- Service area includes 1695 acres
- 900 residential lots and 43 commercial lots
- Treatment Capacity of .500 MGD
- Zero discharge for golf course irrigation
- Operated under PTI recommended standards
- Regulated LAMP Permit 2013
- 55 million gallon storage impoundment
- 6 monitoring wells

North Star Wastewater Re-Use Facility Start Up Timeline

2009

- Initial flow was estimated at less than 1000 gpd
- Hired contractor to haul from pump station in lieu of treating
- Eventually pump station turned on to pump to plant
- Operator maintaining and exercising equipment
- No discharge to impoundment
- Economy crashed, no development

2010

- Pump station on pumping to plant
- Minimal flows, holding flow at plant, providing minimal treatment
- Operating under PTI recommendations, no effluent limits
- Treating flow at plant in batches
- Operator maintaining and exercising equipment
- Discharged May and June

2011

- Pump station on pumping to plant
- Minimal flows, holding flow at plant, providing minimal treatment
- Operating under PTI recommendations, no effluent limits
- Treating flow at plant in batches
- Operator maintaining and exercising equipment
- Discharged January and April

2012

- Pump station on pumping to plant
- Minimal flows, holding flow at plant, providing minimal treatment
- Operating under PTI recommendations, no effluent limits
- Treating flow at plant in batches
- Operator maintaining and exercising equipment
- Discharged April, July, September, November, December

2013

- Pump station on pumping to plant
- Minimal flows, holding flow at plant, providing minimal treatment
- Operating under New LAMP permit, effluent limits required
- Treating flow at plant in batches
- Pre-fab aeration tanks starting to fail
- Operator maintaining and exercising equipment
- Discharged April, May, June, July,

2014

- Pump station on pumping to plant
- Minimal flows, holding flow at plant, providing minimal treatment
- Operating under New LAMP permit, effluent limits required
- Treating flow at plant in batches
- Pre-fab tanks being repaired
- Moratorium placed on developer to stop building
- Operator maintaining and exercising equipment
- Discharged March

2015

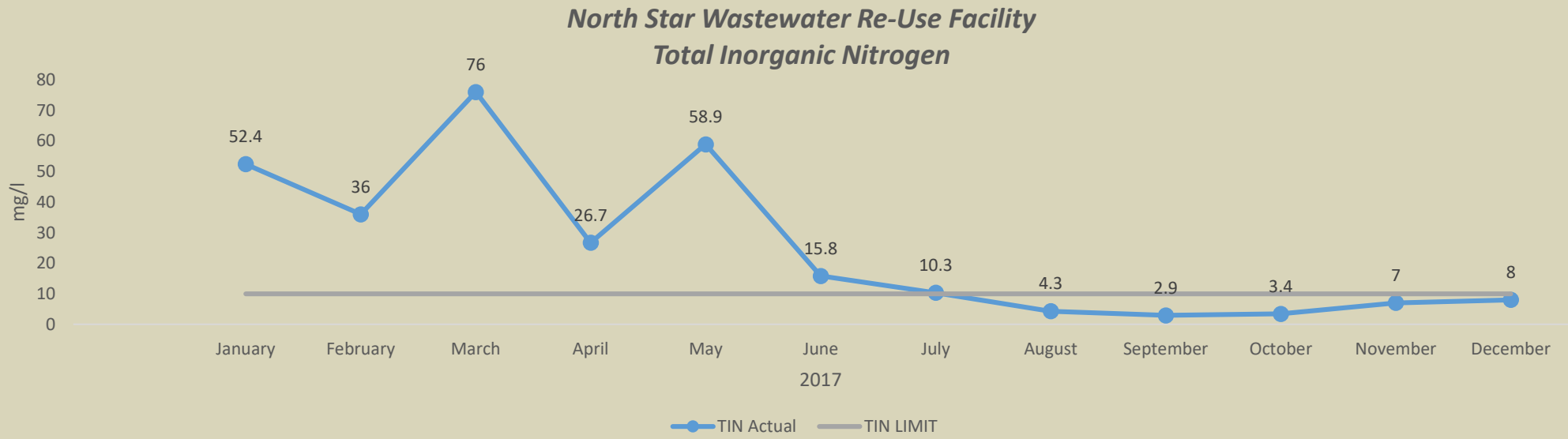
- Operations stopped
- Pump station off, contractor hauling flow from pump station
- Pre-fab tanks being repaired
- Moratorium still in place
- No discharge from plant

2016

- Pre-fab tank repairs complete
- Moratorium lifted
- Pump Station back on pumping to plant in December
- Operating under New LAMP permit, effluent limits required
- Discharged in December

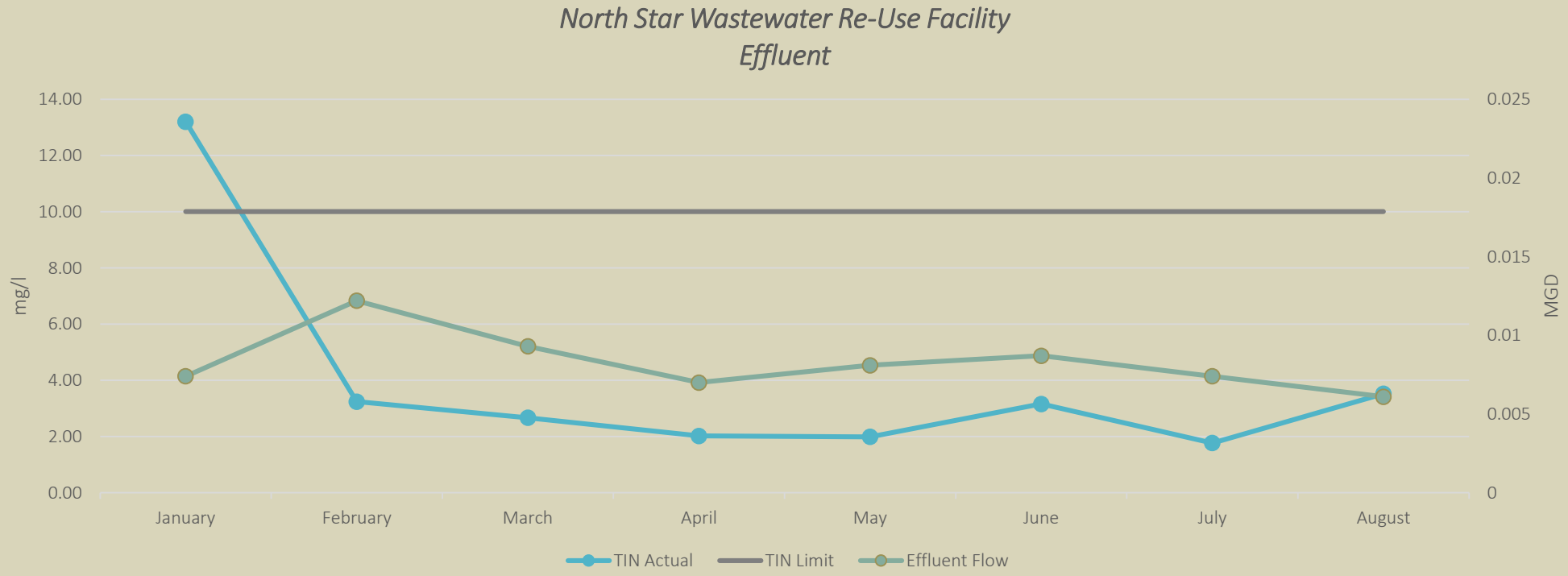
2017

- Pump Station in auto pumping to plant
- Operating under New LAMP permit
- Rough start with TIN compliance due to tank testing, no RAS pumping, Calcium Nitrate Ca(NO3)2 from pump station and road closure
- Operational learning curve, mainly with large bubble mixing-high D.O concentrations in anoxic zones
- Average daily flows 0.0302 MGD
- 1st half 2017 average TIN 39.47 mg/l
- 2nd half 2017 average TIN 6.0 mg/l mg/l



2018

- Average TIN 3.75 mg/l to date
- Operators maintaining building and grounds
- Operators learning and optimizing treatment processes
- Development growing in service area
- Average daily flows to date 0.0084 MGD



Start Up Strategy

1-Select existing tankage to be used for low flow start up, minimal tankage available to be compatible with start up flow, 1 anoxic tank and 1 aeration to be used.

2-Fill tanks with impoundment water

3-Build solids inventory by hauling in sludge from other plants to start nitrification process

4- Optimize anoxic zone by large bubble mixing and use of carbon feed system

5- Set up aeration blower on-off schedule to support the denitrification process

6-Treatment Steps, 1st Nitrification, 2nd Denitrification and 3rd Nutrient Removal

7- Process Control Targets:
MLSS- 2500 mg/l (2.5 spin) NH3- < 1.0 mg/l NO3- < 5.0 mg/l 30 minute SSV- 800-5 minutes, 400-30 minutes

8- LAMP permit effluent parameters:
CBOD-40 mg/l TSS-45 mg/l TIN-10 mg/l E coli- 126- #100 ml

Start Up Challenges

- Low flows
- Structure failure
- Equipment failure
- Equipment warranties expired
- New LAMP permit issued 2013
- Trying to treat while testing tanks
- Trying to denitrify with no RAS pumping
- Tank freezing due to low flow
- Broken non-pot lines, RAS lines
- County Road to plant out of service for several months
- Calcium Nitrate Ca(NO3)2 in force main to much for plant
- Calcium Nitrate turned off, Force Main goes septic

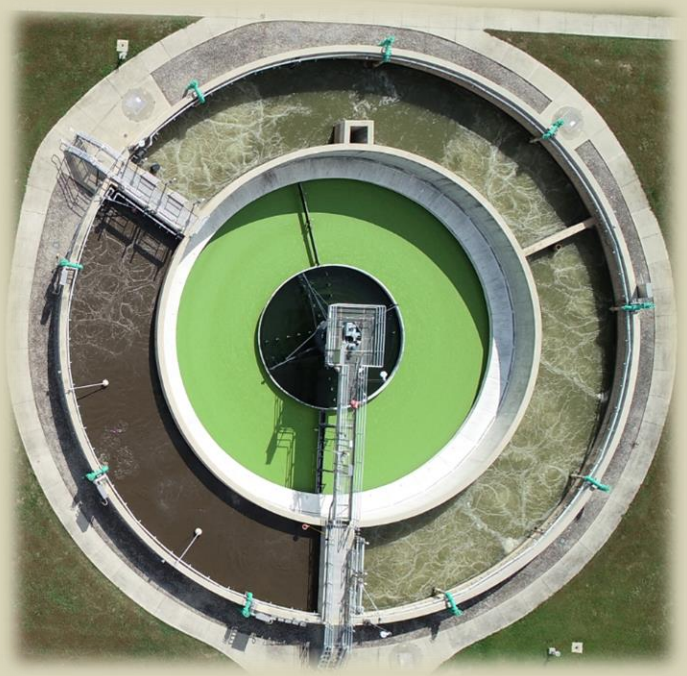
Lower Scioto Water Reclamation Facility

- Screening
- Anoxic Zones
- Aeration
- Clarification
- Tertiary Filtration
- Aerobic Digestion
- UV Disinfection
- Centrifuge

Lower Scioto Water Reclamation Facility Start Up Timeline

2009

- Construction complete
- Economy crashed, no development, no collection system
- County employees attended over 150 hours manufacturer start up training
- Spare parts received, equipment inventory conducted



2010

- Plant sits idle, no operational activity
- No development, no collection system, no pipes in or out
- Developer responsible for maintaining plant
- Contractor exercising equipment

2011

- Plant sits idle, no operational activity
- No development , No collection system
- Developer responsible for maintaining plant
- Contractor exercising equipment
- Influent/Effluent line from plant to O'Shaughnessy P.S project started

2012

- Plant sits idle, no activity
- No development , No collection system
- Developer responsible for maintaining plant
- No exercising equipment
- Influent/Effluent line from plant to O'Shaughnessy P.S project completed

2013

- County assumes developer debt, takes full ownership and responsibility of plant
- Operations Manager and Package Plant Staff moves into Admin Building in October
- Operators starts maintaining building and grounds
- Staff begins evaluations of design, tanks and valving configurations

2014

- Operators maintaining buildings and grounds
- Reviewing design prints for tank valving configurations

2015

- Operators maintaining buildings and grounds
- Reviewing design prints for tank valving configurations
- Start planning operational strategy
- O'Shaughnessy Pump Station nears completion

2016

- Operators maintaining buildings and grounds
- Reviewing design prints for tank valving configurations
- Planning operational strategy
- Testing new pump station and force main
- Exercising/Testing equipment and making repairs

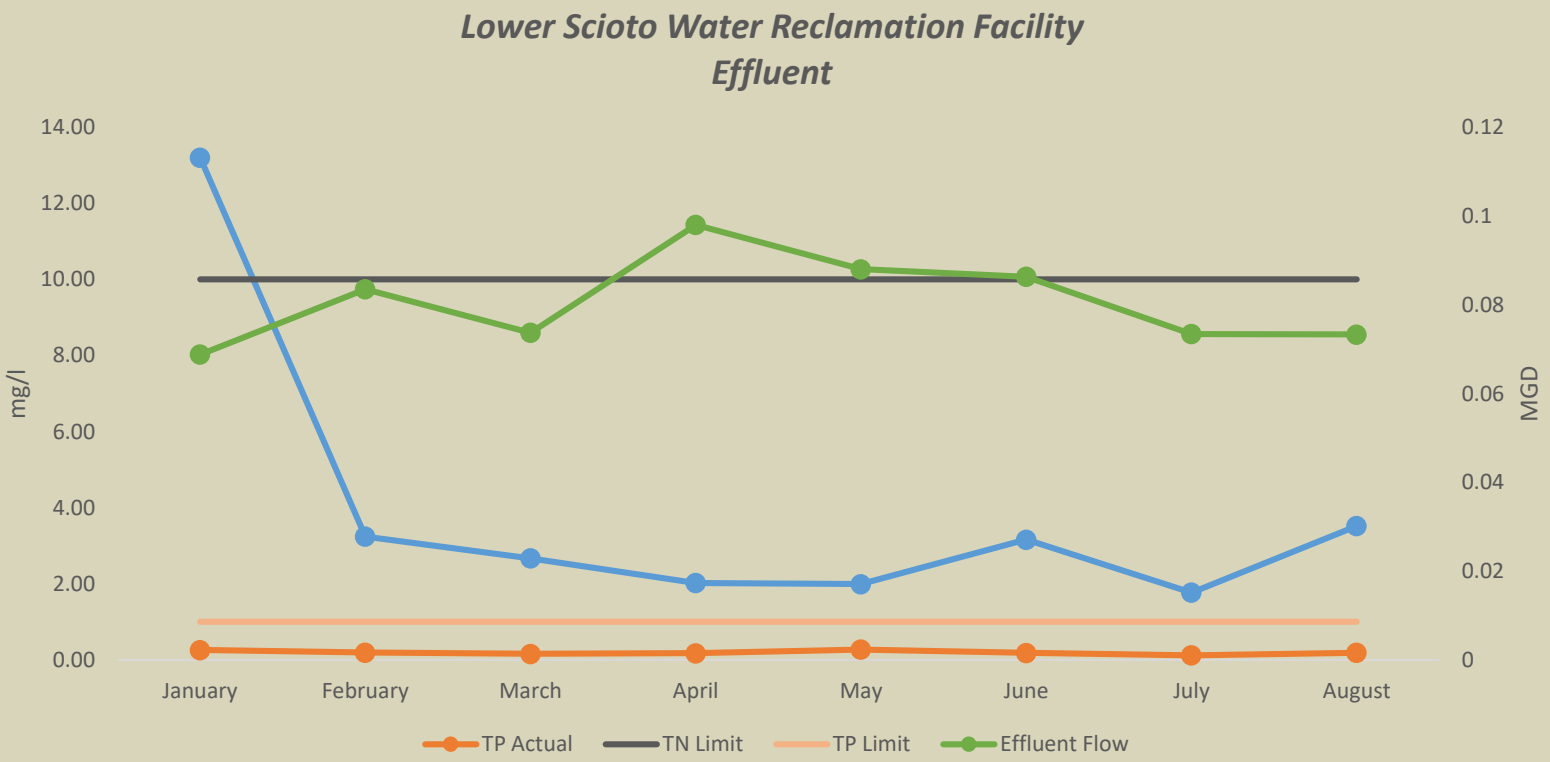
2017

- 30 day hydraulic testing began in July to determine functionality of plant
- Water from O'Shaughnessy reservoir was pumped into new pump station and then on to plant
- Results from testing was used to create plan of action to address issues before start up of plant
- On November 13th flow was diverted from the Clear Creek pump station at 10:27am to the O'Shaughnessy pump station and at 12:01pm flow made it to the plant

Flow Arrives to Plant November 13th 12:01 pm

2018

- Operators maintaining plant
- Development slowly starting
- Average daily flows to date 0.089 MGD
- Average effluent TN 3.9 mg/l to date
- Average TP 0.19 mg/l to date



Start Up Strategy

1- Select existing tankage to be used for low flow start up, minimal tankage available to be compatible with start up flow, 3 designed anoxic tanks with 1 being for aeration was used.

2-Fill tanks with ground/river water

3- Build solids inventory by hauling in sludge from other plants to start nitrification process

4- Optimize anoxic zone by large bubble mixing

5- Set up aeration blower on-off schedule to support the denitrification process

6-Treatment Steps, 1st Nitrification, 2nd Denitrification and 3rd Nutrient Removal

7- Process Control Targets:
MLSS- 2500 mg/l (2.5 spins) NH3- < 1.0 mg/l TN- < 10.0 mg/l 30 minute SSV- 800-5 minutes, 400-30 minutes

8- NPDES permit weekly effluent parameters:
CBOD-5 mg/l TSS-18 mg/l TN-10 mg/l TP- 1.5 mg/l E coli- 284- #100 ml

Start Up Challenges

- Low flows
- Low effluent discharge limits
- General equipment failure, pumps, actuators, level sensors, plc's, SCADA, etc.
- Equipment warranties expired
- Equipment breakdown
- Air release valve on the force main was leaking
- Ferric Chloride pumps and did not work properly, broken pipes and valves
- A non pot line above main feeder breaker and generator froze and busted damaging all surge protection and caused a power outage for about 24 hours

Lessons Learned

- Don’t build a wastewater plant during an economic crisis
- Make sure plant design includes tanks, blowers and pumps to accommodate low flow start up periods
- Evaluate pre-fab tanks vs. poured concrete walls
- Do not underestimate the solids inventory needed for start up
- Provide treatment one step at a time, nitrification, denitrification and nutrient removal
- Follow process control methods to evaluate environments
- Make sure all equipment valves are functioning before flow arrives
- Set up manufacturer start up training, review O&M manuals
- Try to trust SCADA, but do so cautiously
- Be prepared for Murphy's Law to apply "**Anything that can go wrong will go wrong**".

Questions ?