

**American Academy of Environmental
Engineers and Scientists**

**2013 Superior Achievement Award
Altoona Westerly Wastewater Treatment Facility
Biological Nutrient Removal Project**

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Presented By:

**Engineer-of-Record: Mark Glenn, P.E., DEE, President
Gwin, Dobson & Foreman, Inc., Altoona, PA**



Upgraded Westerly WWTF

Westerly Treatment Facility

- Originally constructed in 1952
- Upgraded in 1990
 - Coarse screening and aerated grit removal
 - Complete mix activated sludge, single stage nitrification
 - Final clarification and UV disinfection
 - Equalization storage
- Avg. Daily Flow – 10.8 mgd, Peak Flow – 60 mgd
- Altoona Water Authority – System Owner/Operator

The Chesapeake Bay Strategy

- PA Dept. of Environmental Protection issued new NPDES permits to Altoona with mass annual nutrient load limits
- Average effluent Nitrogen of 14.4 mg/l exceeds future cap load by 80,000 pounds, reduce N discharge by 45%
- Average effluent Phosphorus of 3.0 mg/l exceeds future cap load by 15,000 pounds, reduce P discharge by 55%
- Nutrient Cap Load Target Concentrations:
 - Effluent Nitrogen – 5.0 mg/l
 - Effluent Phosphorus – 0.67 mg/l

Relative Impact



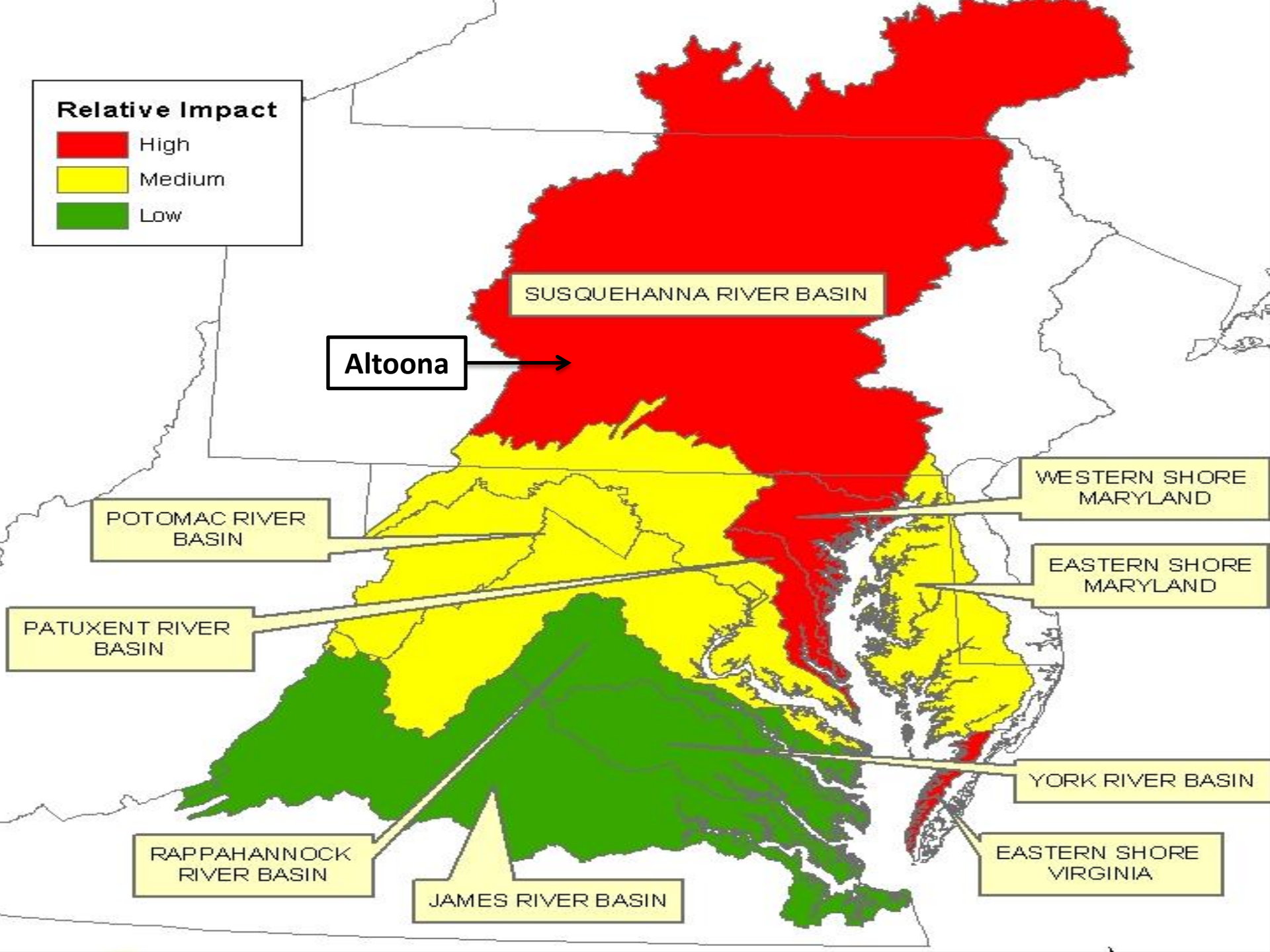
High



Medium



Low



Project Goals

- Reduce effluent nutrient levels to ensure future regulatory compliance
- Provide treatment of wet weather flows while preventing washout of NRT nutrient biomass
- Use sustainable design by maximizing existing facilities; reduce chemical consumption & sludge prod.
- Reduce energy costs using gravity flow, process energy and chemical consumption
- Generate nutrient credits for sale on PA credit market

Evaluation of Alternatives

- Conducted extensive influent testing to characterize waste over full range of flows
- Evaluated existing treatment processes and conducted preliminary screening of various Nutrient Removal Technologies (NRT)
- BioWin process modeling of selected NRT processes with site-specific kinetic rates verified by High F/M testing
- Evaluate wet weather CSO treatment options

Selected Process

- Replace existing screens with fine screens.
- Replace aerated grit system with vortex grit separators
- Convert south EQ tank to two plug flow reactors.
- Convert existing aeration basins to two plug flow reactors.
- Construct fourth secondary clarifier.
- Provide chemical feed systems.
- Upgrade SCADA/instrumentation systems.



Conversion of South Equalization Tank to NRT Reactors

Selected Process

- Provide nutrient removal using four plug NRT reactors.
- Operational flexibility to operate various nutrient removal processes including Bardenpho, MLE, VIP, A20 and Hybrid
- Step feed high, diluted wet weather flow to last oxic and swing zones to provide secondary (contact stabilization) treatment



Existing Aeration Tanks Converted to NRT Reactors and
Adjacent Step-Feed Channel to Last Oxidic Zone

Hybrid BNR Feature

- Process combines the mixed liquor recycle feature from the VIP process with the Bardenpho process
- Mixed liquor from the final anoxic zone is recycled to the first anaerobic zone
- Lowers the oxidation/reduction potential (ORP) in the anaerobic zone
- Increases phosphorus release and enhances biological phosphorus removal
- Consistently meets P limits without chemical addition



NRT Reactor

Step Feed

- Diverts high wet weather CSO flow to last oxic zone
- Provides biological treatment of all flows via contact stabilization (1-2 hour detention)
- Preserves treatment process sequence (anaerobic, anoxic and aerobic)
- Preserves nitrifiers and maintains N removal during and after high flow events
- Prevents elevated DO concentrations in process.
- Preserves solids washout in clarifiers

Sustainable Design

- Converted existing aeration tank into two plug flow NRT reactors
- Converted existing equalization basin into two plug flow NRT reactors
- Existing tanks were retrofitted with baffle walls to create anaerobic, anoxic and aerobic zones
- Constructed slightly submerged walls with underflow ports
- Located recycle pumps in existing pipe gallery
- Reused air distribution piping, existing flow distribution channels, RAS piping and effluent channels



Retrofitting of Existing Equalization Tank to NRT Reactor



Pipe Gallery Tunnel with Internal Recycle & Air Piping

Operational Flexibility

- Facility can operate in a variety of plug flow NRT removal modes (MLE, Stage 4/5 Bardenpho)
- Current operation uses Virginia Initiative Plant process during step feed wet weather CSO flows
- Second anoxic zone is a switch zone (mixer and diffusers) and can operate as an oxic zone during step feed
- VIP process produces lower effluent N during cold weather without the second anoxic zone
- Internal RAS/MLSS/Nutrient recycle streams can draw and pump to multiple zones
- Wet weather CSO flow treated in contact stabilization mode in switch zone/last oxic zone



Switch Zone – Membrane Diffusers (oxic) & Submersible Mixers (anoxic)

Final Clarification

- Project included the addition of a fourth clarifier and upgrades to existing three clarifiers
- Surface overflow rate adequate for 60 mgd peak
- Employed rapid sludge removal via spiral blade sludge collectors
- Full radius skimmers
- Current density baffles (Stamford-type)
- Sludge blanket density meters



Final Clarifiers with Stamford Baffles

SCADA Process Control Features

- Step-feed process flow control
- Mixed liquor and nitrate recycle return rate
- RAS and WAS return rates
- DO control of air supply valves and blower speeds
- NO_3 control of nitrate recycle pumps and methanol
- RP control of mixed liquor recycle
- pH control of caustic soda feed
- NH_4 and PO_4 instruments provide process alarms

Other Facility Improvements

- Fine Screening
- Non-Aerated Vortex Grit Separation
- Final Clarifier Additions and Upgrades
- Ultraviolet Disinfection System
- Aerobic Digester System Upgrades
- Effluent Screw Lift Pumps



Headworks Fine Screening



Vortex Grit Separation System (preserve influent carbon)



Ultraviolet Disinfection System



Centrifuge Sludge Dewatering System



60" Diameter Screw Lift Flood Pumps

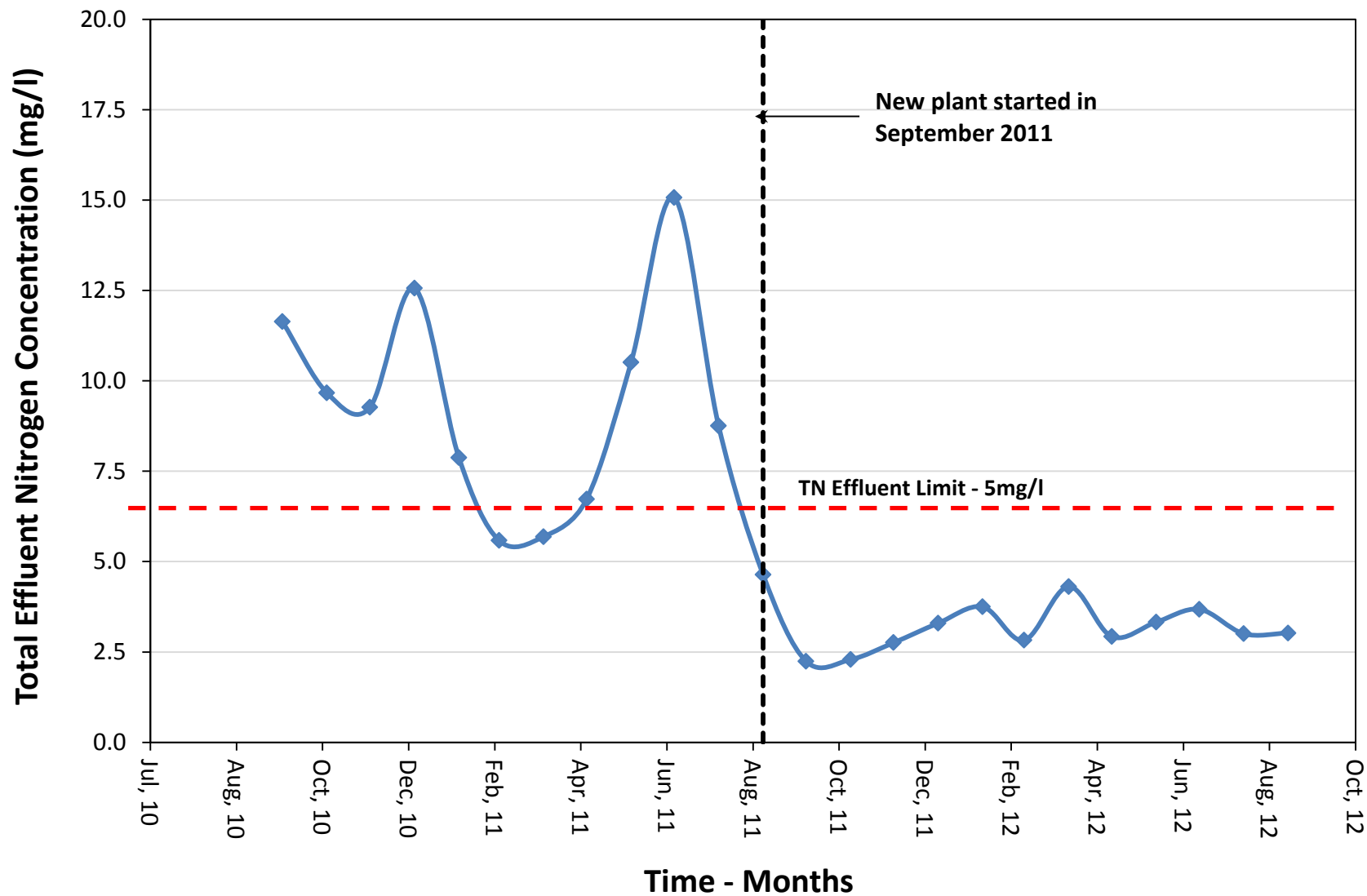


Energy Efficient Turbo Blowers (high turndown capability)

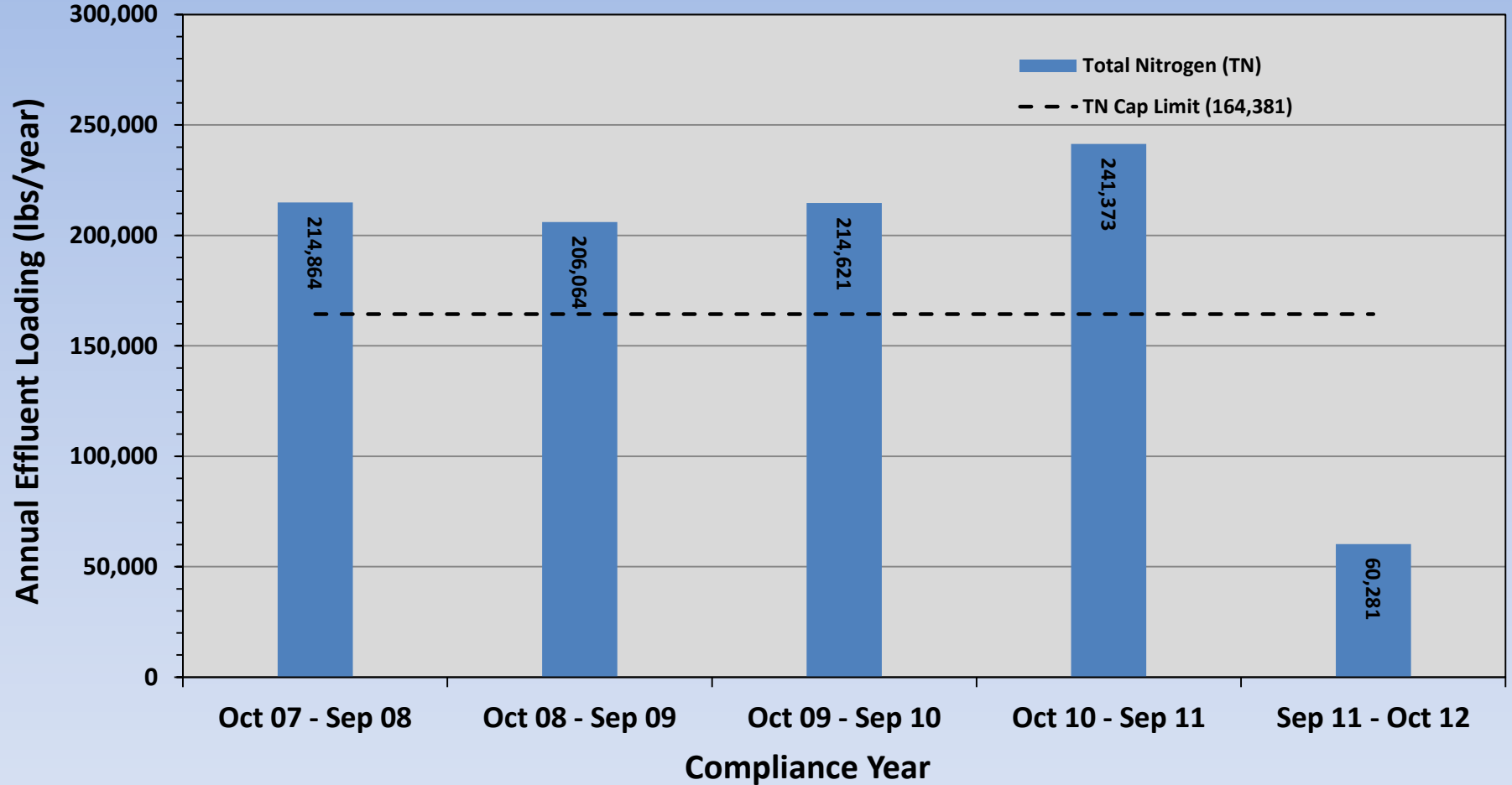
Results

- Process reduced effluent nitrogen concentration to near 3.0 mg/l with no Carbon addition
- Reduced annual N loading from 240,000 pounds to 70,000 pounds
- Reduced annual P loading from 32,000 to 6,700 pounds in 2012, biologically not chemically
- Generated \$300,000 in nutrient credit revenue
- Processed 100% of all wet weather flows within permit limits and without BNR process upset
- Annual operating costs reduced by \$110,000

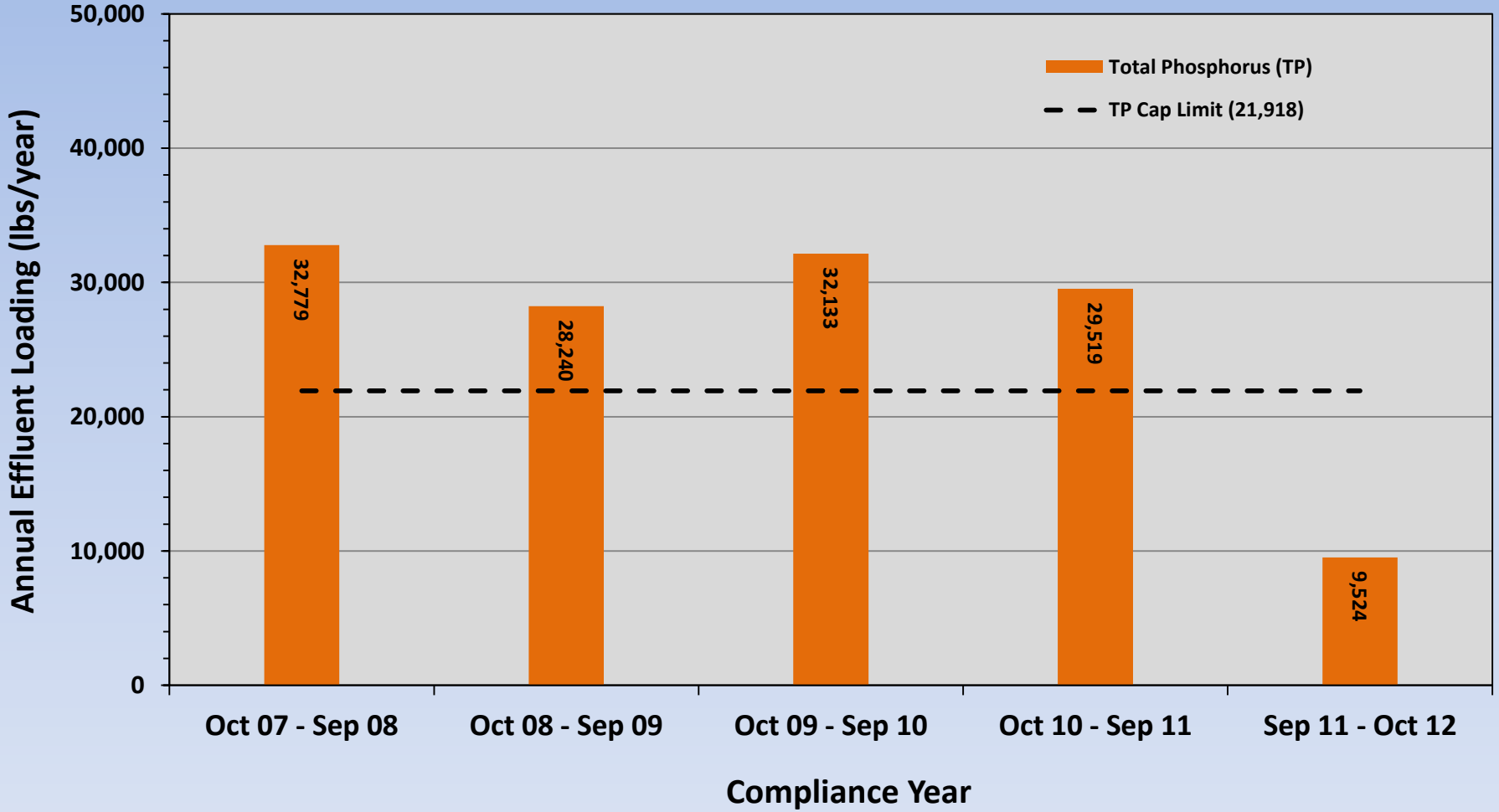
Total Effluent Nitrogen Concentration



Annual Total Nitrogen Effluent Loading



Annual Total Phosphorus Effluent Loading





DISCUSSION

Contact

Mark Glenn, P.E., DEE, D.WRE

President

GWIN, DOBSON & FOREMAN, INC.

ENGINEERS

Phone: 814-943-5214

mglenn@gdfengineers.com