

**Inland Empire Paper Company
NPDES Permit No. WA-000082-5
Permit Condition S4**

**Total Phosphorus, CBOD, & Ammonia
Best Management Practices Plan**

2021 Annual Status Report

November 1, 2021

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Total Phosphorous, CBOD, & Ammonia BMP Plan 2020 Annual Report

1.0 INTRODUCTION

Permit Condition S4, Total Phosphorous, CBOD, & Ammonia BMP Plan, of Inland Empire Paper Company's (IEP) National Pollutant Discharge Elimination System (NPDES) Permit No. WA-000082-5 includes a requirement to develop a BMP plan that delivers the following:

The goal of this BMP plan is to maintain or lower effluent concentrations of total phosphorus, CBOD, and ammonia at or below current discharge levels.

By November 1, 2012, the Permittee shall develop a BMP plan and submit it to the Department for review and approval. The objective of this plan is to identify pollution prevention and wastewater reduction opportunities for these three parameters. The plan shall include the following:

- 1. A list of members of a cross-functional team responsible for developing the BMP plan. The list shall include the name of a designated team leader.*
- 2. A description of current and past BMPs and their effectiveness.*
- 3. Identification of technical/economical evaluation of new BMPs. BMPs should include: substitution of materials; reformulation or redesign of products; modification of equipment, facilities, technology, processes, and procedures; and improvement in management, inventory control, materials handling or general operational phases of the facility.*
- 4. A schedule for implementation of economically feasible BMPs.*
- 5. Methods used for measuring progress towards the BMP goal and updating the BMP plan.*
- 6. Results from testing of any waste streams (not already required under Special Condition S3. of this permit) for total phosphorus, CBOD, and ammonia taken in support of the BMP plan.*

Thereafter, the Permittee shall submit an annual report to the Department by November 1st of every year. The annual report shall include: a) all BMP plan monitoring results for the year; b) a summary of effectiveness of all BMPs implemented to meet the BMP plan goal; and c) any updates to the BMP plan.

This permit may be modified, or revoked and reissued, to revise or remove the requirements of this Section based on information collected under this Section.

2.0 CROSS-FUNCTIONAL TEAM FOR BMP DEVELOPMENT

IEP's Engineering, Production and Management staff all play significant roles in the development and implementation of this BMP plan based on their respective disciplines, responsibilities and departments. Key individuals contributing to this effort include:

Doug Krapas – Environmental Manager and Team Leader
Ben Carleton – Technical Supervisor
David Demers – Process Technician
Donnie Ely – Production Manager
Kevin Davis – Manager of Strategic Projects
T. J. Eixenberger – Project Engineer
Darrell Payton – Interim Maintenance Superintendent
John Nelson – Interim Paper Machine Superintendent
Tenner Gerety – Interim Pulp Mill Superintendent
Kevin Rasler – President and General Manager

3.0 PAST BMP PLANS IMPLEMENTED

Since 2001, Inland Empire Paper Company (IEP) has embarked on a modernization program that has resulted in improvements to nearly every process within its facility using state-of-the art equipment. This significant investment into the phased modernization effort has raised IEP's status to one of the most modern specialty paper product facilities in the world. The following provides a summary of IEP's specific achievements that have resulted in improvements to the efficiency of its water treatment system, reduced nutrient levels in its discharge, and overall volume reduction of final effluent that IEP will ultimately need to treat using advanced technologies:

3.1 Paper Machine #5 (2001)

IEP installed a modern energy efficient paper machine that remains the newest of its kind in North America. The machine utilizes heat recovery and water reuse to minimize energy and water consumption.

3.2 Water Conservation Projects (2004-Present)

Beginning in 2004, IEP embarked on an aggressive on-going water conservation program. Numerous projects have been implemented, including: re-use of process water in various mill processes, re-use of water from the recycling of old newsprint, installation of water control devices on pump seals, and optimization of water intensive processes. Reducing the volumetric loading to the effluent treatment system increased the residence time within the system which resulted in greater treatment potential for removing CBOD, TP, and NH₃.

3.3 Conustrenner (2004)

The Conustrenner is a compact highly efficient self-cleaning fractionation filter. Approximately 1 MGD of primary treated water is diverted to the Conustrenner for reclamation and reuse in the pulp mill processes, greatly reducing freshwater needs and volumetric loading to the water treatment system.

3.4 Pump Seals (2005-2007)

Flow limiting devices were installed on mechanical seal water lines for numerous pumps around the mill. These devices greatly reduced freshwater consumption to the process streams resulting in a substantial decrease in the volumetric loading to the water treatment system.

3.5 Retention Aid Carrier Water (2012)

IEP switched from using fresh water to reclaimed process water for its retention aid carrier water. This modification reduced treated effluent flow by approximately 100 gallons/minute.

3.6 Disk Filter Shower Water (2014)

IEP's #1 Disk Filter showers were changed from fresh water to reclaimed process water. This modification reduced treated effluent flow by approximately 200 gallons/minute.

3.7 MBBR #1 (2006)

IEP installed a Moving Bed Biofilm Reactor (MBBR) for enhanced CBOD removal. As of 2021, this system treats 1-1.5 MGD and is currently achieving in excess of 45% CBOD removal and has improved the efficiency of the overall water treatment system.

3.8 MBBR's #2 and #3 (2009)

IEP further improved the efficiency of its secondary water treatment system with the installation of two additional MBBR systems, providing IEP with the maximum amount of effective secondary treatment.

3.9 Surge Control (2009)

IEP converted its existing 75-foot diameter clarifier to a surge control system to equalize hydraulic flow and CBOD loadings to its secondary treatment system. This allows more uniform loading conditions to the water treatment system thereby reducing variability in the final effluent and providing process stability.

3.10 #5 Thermo-Mechanical Pulping (TMP) Refiner Effluent Treatment (2010)

Plant effluent from the #5 TMP system is pretreated with a coagulant and a polymer before treatment through a Dissolved Air Floatation (DAF) system. The average TSS reduction across the DAF is over 90% and the average CBOD reduction is approximately 45%.

3.11 Chip Segregation (2011)

IEP receives waste wood chips for local sawmills as a raw material supply for its paper making process. Chip species are separated and used only on grades where they are most effective, resulting in improved energy efficiency and bleaching. Reducing the bleaching needs of any specific paper type results in decreased CBOD and TP loading to the water system.

3.12 Nutrient Optimization (2012-Present)

IEP's wood-based materials are deficient in nutrients such as phosphorus and nitrogen, so IEP needs to add these nutrients to its water treatment system for the health of the microorganisms that are responsible for CBOD removal. IEP has been operating at lower nutrient targets in an effort to optimize the water treatment system operations for TP and NH3.

3.13 Stock Blending (2013)

Pulp mill modifications were implemented to allow for pulp specific blending. Targeting specific pulps has improved the bleaching efficiency and reduced the amount of dissolved material (CBOD, TP) created during the reaction.

3.14 PM5 Vacuum Roll Seal (2015)

IEP installed a new style of lubrication seal strip on the paper machine vacuum roll that reduced fresh water consumption and discharge by 10 million gallons/year.

3.15 Phosphorus Nutrient Source – Phosphoric Acid (2016)

IEP's secondary treatment system is deficient in nutrients, including phosphorus, and therefore must add nutrients for the health of the secondary biological system for efficient and effective removal of CBOD that is another regulated parameter under the DO TMDL. In 2016, IEP changed its form of phosphorus feed from agricultural grade Ammonium Ortho-polyphosphate to phosphoric acid (P acid). P acid provides complete and readily available phosphorus as a nutrient to the secondary treatment system for more efficient use and enhanced control of residual phosphorus. Ammonium Ortho-polyphosphate contains phosphorus forms that are not bioavailable which contribute to elevated levels of total phosphorus in the effluent that are difficult to remove.

3.16 Nitrogen Nutrient Source – Urea (2016-2018)

IEP conducted an investigation to replace aqua ammonia as the primary nitrogen source for biological treatment. Aqua ammonia was costly and presented several logistical and safety hazards for effective dosing. Urea ammonium nitrate (UAN-32) was first selected as the replacement in 2016. Later, in 2018, urea was found to be more economically feasible and replaced UAN-32.

3.17 Speece Cone In-line Superoxygenation System (2016)

A Speece cone system was installed immediately downstream of IEP's effluent pumps to oxygenate 100% of the water that leaves the effluent pump house, including all flows to the primary clarifier, reclaimed effluent wastewater, and all water directed to surge tanks used on-site for surge control. The cone super oxygenates the water that passes through by creating an intense bubble swarm at the inlet of the cone. The geometry of the cone and the buoyant force of the bubbles do not allow any the bubbles to exit, thereby ensuring complete dissolution. An onsite oxygen generator that utilizes molecular sieve technology provides a nearly pure oxygen source from ambient air. Water conservation efforts described herein have resulted in lower effluent flows to the primary clarifier, so increased oxygenation of the wastewater offsets septic conditions and enhances CBOD removal in the primary clarifier.

3.18 Surge Control (2017)

IEP installed enhanced valves and controls on the 75 foot clarifier that is used for hydraulic flow and BOD surge control in April, 2017. These improvements dampened significant flow variations to IEP's secondary treatment system, resulting in improved nutrient feed effectiveness and enhanced wastewater treatment system performance.

3.19 Effluent Temperature Reduction (2017)

Effluent flow reductions due to many of the above projects have resulted in ever increasing temperatures to the secondary treatment system. Higher effluent temperatures can adversely affect WWTS performance by lowering biological activity in the secondary treatment system. In August 2017, the valves in the Dissolved Air Flotation (DAF) heat exchanger were increased from 4" to 6" to allow for more non-contact cooling water flow, resulting in greater cooling capacity of the effluent to the wastewater treatment system (WWTS).

3.20 Improvements to Chemical Enhanced Primary Treatment (CEPT) (2018)

Chemical trialing was conducted in the summer of 2018 to determine a suitable program for improved solids and BOD5 removal in IEP's primary clarifier. A new flocculation aid was selected that was a substantial improvement over the previous application.

3.21 Equalization Tanks (2018-2019)

Due to the many diverse grades of paper produced by IEP and the myriad of processes within the mill that can impact the WWTS, IEP installed two (2), one-million-gallon tanks to normalize flow and BOD loading through equalization. The system was commissioned in September 2018 with final modifications concluding in 2019. The tanks were initially configured pre-primary treatment, but unexpected side effects negatively impacted the downstream biological processes. Equalization is now configured post-primary treatment.

3.22 Sheet Ash Retention (2019)

IEP tested a new chemistry to retain more fiber and ash in the paper sheet, thus reducing the amount of material and CBOD discharged to the WWTS.

3.23 Effluent CBOD Analyzer (2019-2020)

Following the failure of the ZAPS water quality analyzer in 2019, a replacement unit was purchased from RealTech, Inc. and installed in 2020. The new unit has a similar operating principle by which it calculates CBOD in real time using a multi-wavelength correlation. The new unit provides superior results and more relevant information by being directly incorporated with the tertiary ultrafiltration system. This unit was placed at the end of the process to monitor discharge concentration.

4.0 CURRENT BMP PROGRESS

4.1 Improved Aeration (2019-Present)

An investigation of upset conditions in winter and spring of 2019 showed that the secondary activated sludge system was oxygen deficient, thus reducing its effectiveness for reducing CBOD. Additional surface aerators were installed in the oxidation channel which resulted in an immediate improvement to the WWTS effluent CBOD. Within a few months of this process change, the activated sludge system was achieving better effluent CBOD quality than was obtained from the pilot studies involving tertiary MBBRs prior to ultrafiltration membranes. Thus, an alternative solution to tertiary MBBRs was discovered that, when coupled with tertiary filtration, could meet the WQBEL for CBOD.

IEP continues to conduct a thorough investigation of aeration technologies to further enhance and optimize activated sludge aeration. As of November 2020, IEP has installed a total of five (5) additional surface aerators IEP continues to evaluate whether additional capital improvements to Orbal aeration are necessary based on CBOD removal, residual D.O. concentration, and maintenance requirements.

4.2 Variable Nutrient Dosing and Control (2019-Present)

Beginning in 2019, several improvements have been made to ammonia and phosphorus nutrient dosing strategies.

From 2016-2018, the dominant nutrient strategy was to find readily biodegradable substrates and dose far upstream to maximize biological activity throughout the treatment system. This resulted in many positive benefits such as the replacement of ortho-polyphosphate with phosphoric acid, the replacement of aqua ammonia with urea, a substantial improvement to MBBR treatment efficiency, and record low residual TP concentrations. These improvements proved that low residual concentrations can be achieved, but additional strategies were needed to implement real-time control and to facilitate faster reaction times.

The nutrient doses for ammonia and phosphorus were converted from single-stage to two-stage addition. The MBBRs receive the majority dose, with the expectation that very little residual will carry over to the Orbal activated sludge system. Second stage dosing was then added to the influent to the activated sludge system. This ensures that dosing changes result in quicker, more reliable feedback.

After several years of experimentation, IEP has settled on a policy of employing both feed-forward signals and feed-back signals to control nutrient dosing.

First stage dosing, upstream of the MBBRs, will be controlled by a feed-forward signal. The concentration of influent CBOD can be adequately measured with real-time instrumentation using UV/VIS absorbance. The chemical dosing pumps will then adjust nutrients to match the stoichiometric demand. IEP installed an instrument in 2021 for that purpose that is discussed further in Section 4.4 below.

Second stage dosing, after MBBRs and before activated sludge, will be controlled with feed-back signals. The concentration of orthophosphate and ammonia can be measured in real-time at the beginning and end of the activated sludge process. Based on this information, the chemical dosing pumps will adjust to ensure an adequate supply is being provided at the beginning while simultaneously maintaining a low nutrient residual at the end. Nutrient analyzers were installed in 2020 and the control program is under development. Additional detail for these online nutrient analyzers is discussed in Section 4.3 below.

4.3 Online Nutrient Analyzers (2020-Present)

Online nutrient analyzers for both ammonia and phosphorus were installed in September 2020 to support the dosing control strategy described above

The system consists of an ammonia analyzer (0.05-20 mg/L), a phosphate analyzer, and two-channel filtration equipment. The original phosphate unit (0.05-15 mg/L) proved to be ineffective for IEP's wastewater due to color interferences and the inability to accurately measure down to the desired concentration range. It was replaced in April 2021 with another unit that has superior resolution (0.005-1.0 mg/L) and a more reliable analytical method. The filtration equipment filters the outer and inner channels of the activated sludge basin and sends a continuous sample stream to both analyzers. In this manner, the entire basin is fully characterized in real-time and provides necessary feedback for effective and efficient nutrient feed.

4.4 Influent CBOD Analyzer (2021)

Following the success of the effluent CBOD analyzer, another similar unit was installed for influent CBOD monitoring in 2021. The signal from this instrument will be used as a feed forward signal for nutrient addition as described above, and also to provide high resolution insight into the ever-changing character of IEP's wastewater.

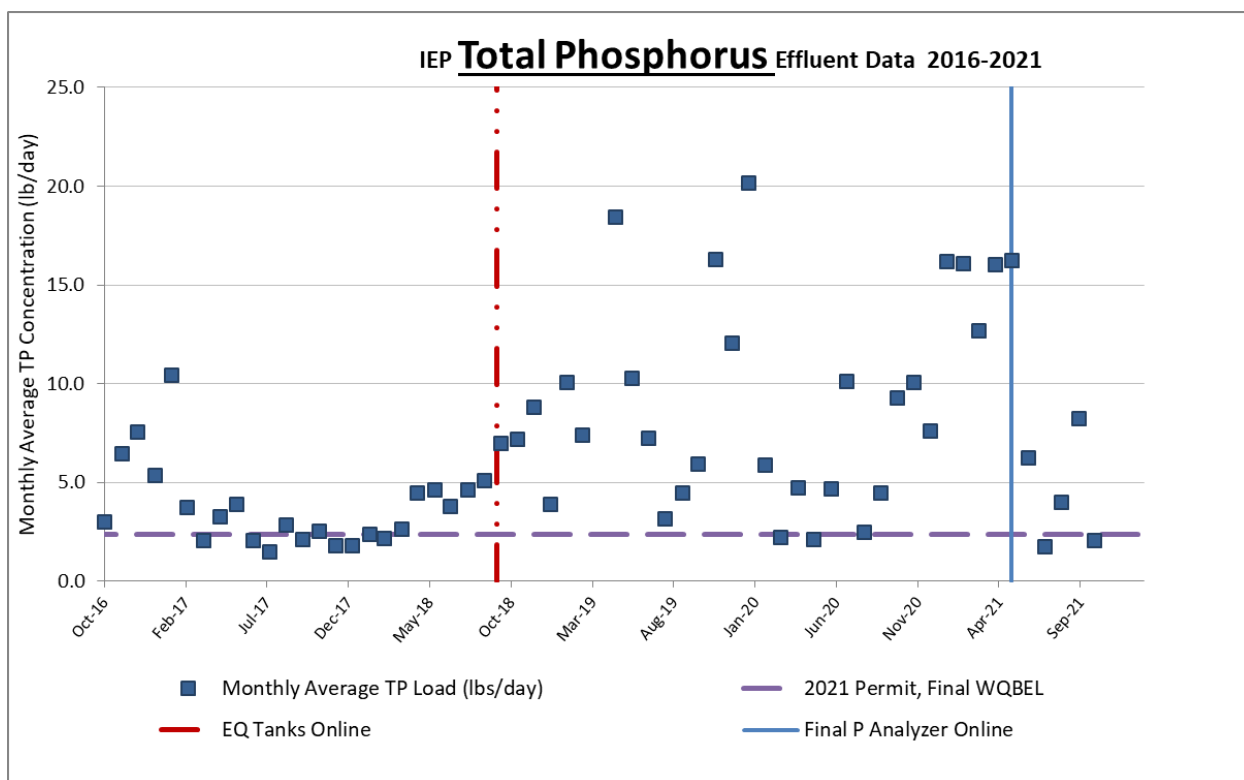
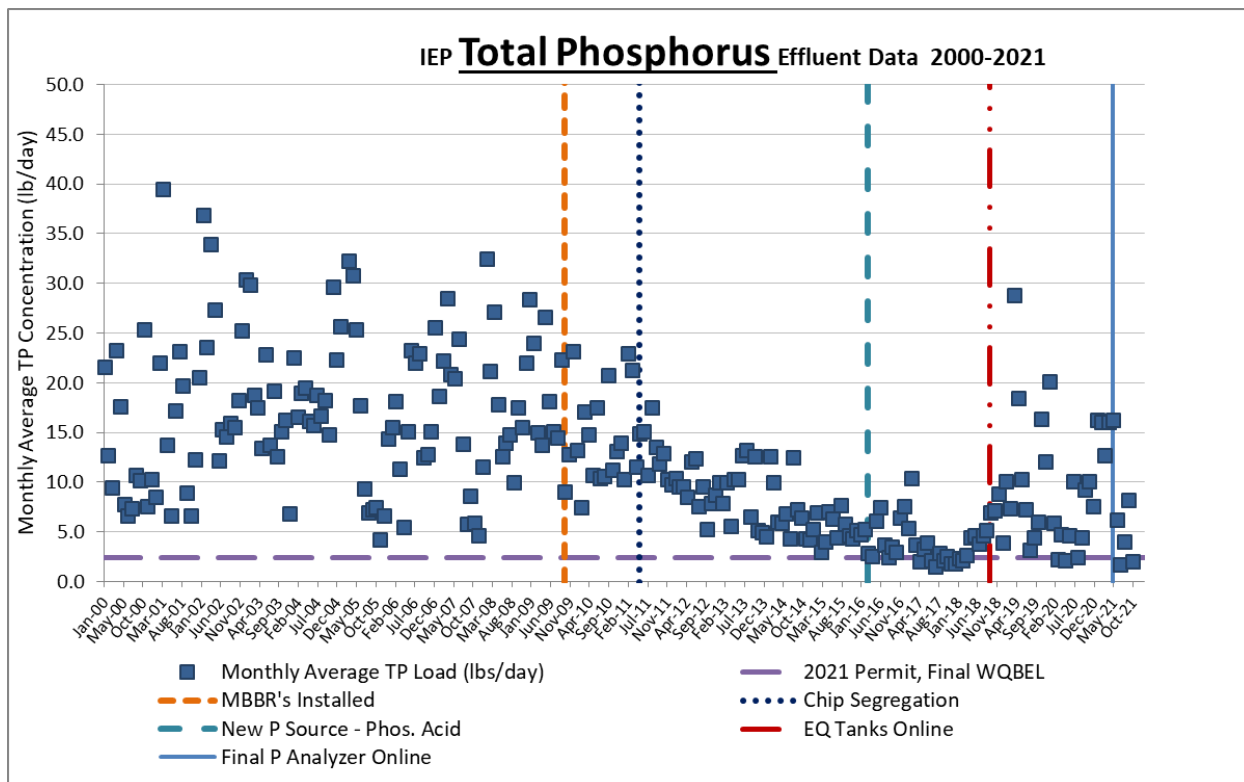
The instrument continually measuring absorbance at four wavelengths in the ultraviolet and visible (UV/VIS) spectrums and calculates the CBOD using multiple linear regression. By employing a real-time system, IEP is able to track the hourly and daily fluctuations in organic loading. Given the instantaneous flow rate and the real-time CBOD measurement, the flow rate of nutrient addition is precisely calculated to maintain a constant ratio of nutrient load to CBOD load.

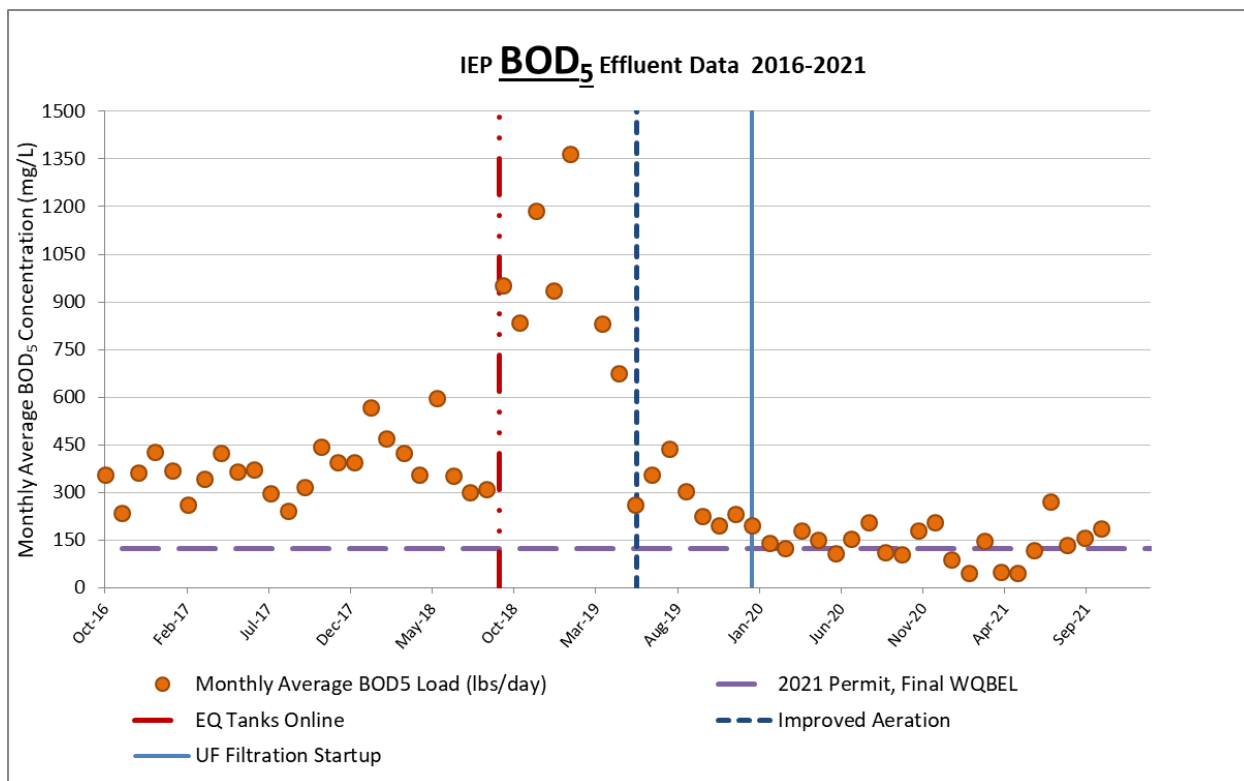
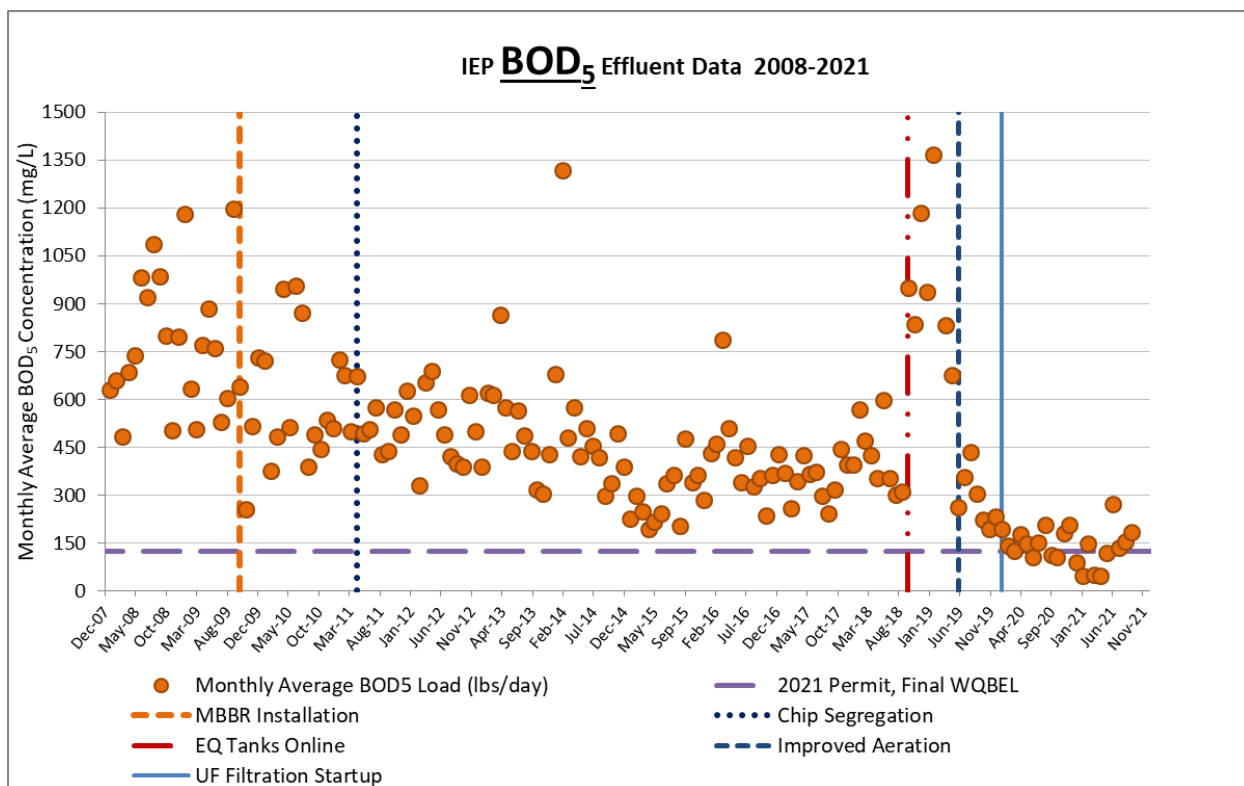
4.5 Tertiary Membrane Filtration (2020-Present)

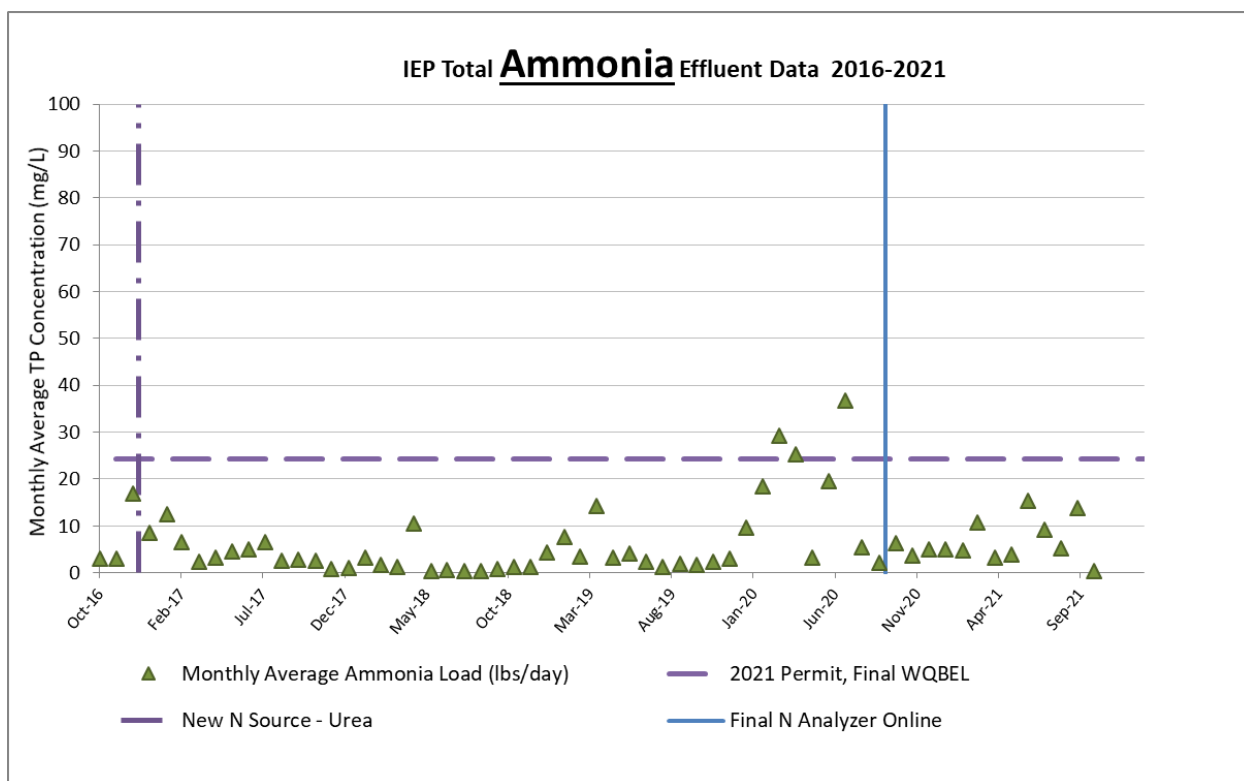
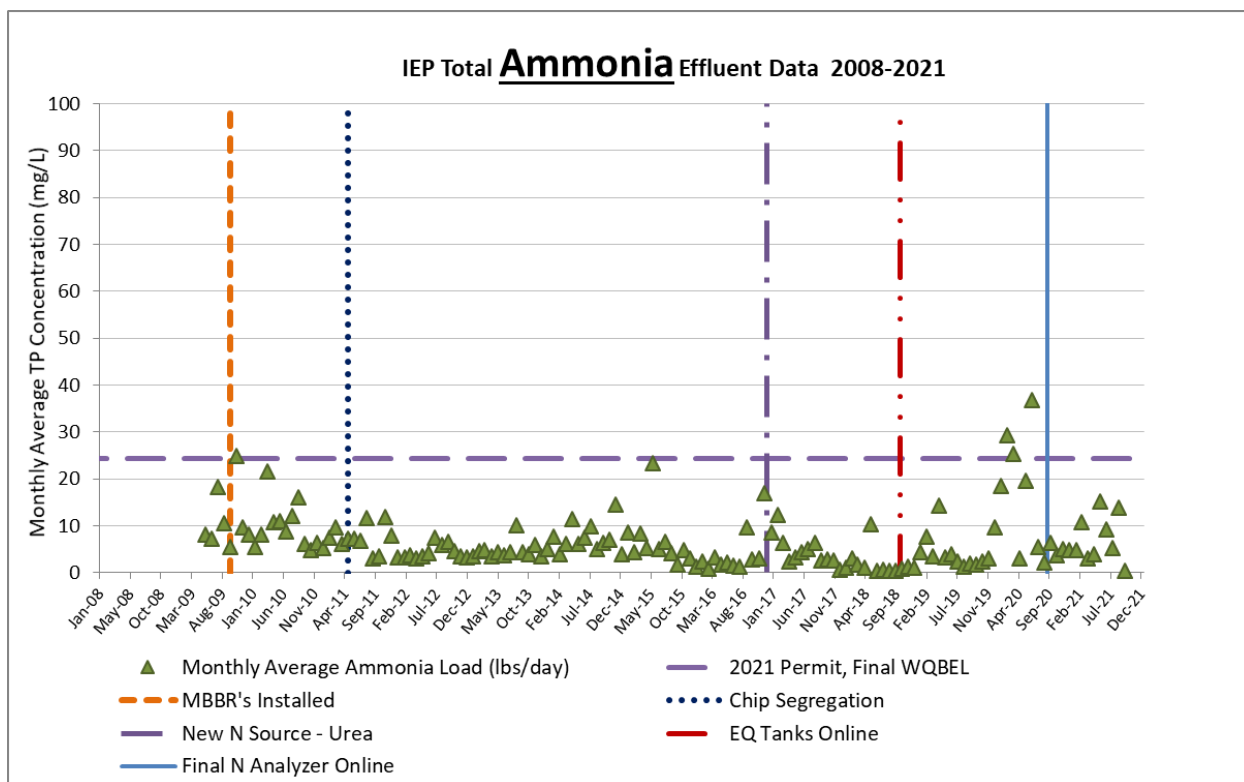
The final tertiary treatment technology selection is WesTech/Toray's ultrafiltration membrane system (UF system). This decision was the result of IEP's sixteen years of extensive experimentation with over two dozen combinations of state-of-the-art tertiary treatment technologies. IEP began startup and commissioning of the UF system in January 2020. Water quality data shows that the UF system removes all TSS including particulate forms of CBOD, TP, and NH₃. The system is expected to be fully operational by November 1, 2021. In conjunction with all of the other elements of the BMP plan and delta elimination tools, IEP has reasonable assurance to achieve the WQBELs for CBOD, TP, and NH₃ on a continual basis.

5.0 CURRENT WQBEL STATUS

Over the course of the last 20 years, IEP has made tremendous strides towards the goal of achieving the WQBELs for TP, CBOD, and NH₃. The graphs below illustrate that progress. It is expected that IEP will be consistently and reliably within the future nutrient permit limits.







6.0 PAST BMP PLANS DISCONTINUED

6.1 Trident HS– Chemical Precipitation and Filtration (2007-2015)

IEP conducted dozens of pilot studies on a wide array of potential tertiary treatment technologies beginning in 2004. The Trident HS system, which utilized chemical precipitation and multi-layer gravity filtration, seemed to have the highest potential and was selected for a larger, semi-permanent installation (1 MGD) in 2007.

After extensive research and testing, IEP was unable to achieve consistent operations due to solids overload of the filter, inconsistent solids settling, plugging of the new filter section nozzle design, and an inability to adapt to variable effluent conditions. Many of the above problems plagued the Trident system since its installation in 2007.

After eight years of unsuccessful operations, IEP abandoned any future work on this system and focused more heavily into the other technologies. The system was ultimately dismantled in 2019 to make room for the final tertiary technology selection, ultrafiltration membranes.

6.2 Orthophosphate to Total Phosphorus Ratio Correlation (2011-2016)

IEP is afforded the opportunity under its NPDES permit to evaluate and potentially modify the orthophosphate (ortho-P) to total phosphorus (total-P) ratio that was used in the DO TMDL to determine IEP's waste load allocations. Section S5, Page 17 of the NPDES Permit states:

The Department may adjust the final water quality based effluent limitations on the basis of new information on the ratio of ortho phosphorus to total phosphorus in the effluent. An adjustment to the effluent limitations based on a new ratio of ortho phosphorus to total phosphorus will be consistent with the assumptions and wasteload allocations in the Spokane River DO TMDL and, as such, does not require a modification to the DO TMDL.

After IEP switched the phosphorus nutrient source from ortho-polyphosphate to phosphoric acid, another BMP plan completed in 2016 (see Section 3.0), it was concluded that this ratio correlation was likely unnecessary to achieve the WQBEL for TP. Efforts were focused on optimizing nutrient dosing instead.

6.3 Anaerobic Treatment (2014)

Investigations into anaerobic treatment processes for CBOD removal were conducted. IEP evaluated the possibility of sending several high CBOD process streams through anaerobic treatment to reduce CBOD loading to the WWTS. Bench scale studies determined that anaerobic treatment of IEP's various process streams was ineffective for enhanced CBOD removal due to an inability to maintain an appropriate and effective bacterial culture under these conditions.

6.4 Primary Effluent Filtration (2014-2018)

IEP evaluated available technologies and the effectiveness of reducing total suspended solids (TSS) and associated CBOD from the primary clarifier effluent prior to feed to the secondary treatment system. After implementation of chemically enhanced primary treatment (CEPT) in 2018 (another BMP plan, see Section 3.0), it was concluded that the primary treatment portion of the wastewater system was sufficiently optimized.

6.5 Algevolve/Clearas– Algae-Based Nutrient Removal (2014-2017)

The large-scale Trident HS system was installed in 2007 but quickly proved to deliver inconsistent and ultimately unsuccessful results. Simultaneous with efforts to salvage the Trident project, IEP continued to pursue alternate treatment technologies. Algevolve, later renamed Clearas, proposed to achieve previously unattainable TP concentrations by employing the unique characteristics of algal metabolism. A large-scale system was installed in 2014.

Pilot testing and data collection began in May 2014. An algae culture was successfully grown in the photobioreactor, but there were few technologies capable of separating the algae from the treated wastewater. The Koch Puron submerged ultrafiltration system was selected and integrated into the system in November 2015. Later, washout of the algae culture began to occur as a result of excessive incoming solids loading from the secondary clarifier. Pretreatment of the incoming water was necessary, and the WesTech/Toray pressurized ultrafiltration system was incorporated into the process in May 2016.

Data collection and evaluation was concluded in April of 2017. The combined process was found to succeed in meeting phosphorus and nitrogen WQBELs, though the gains in nutrient reduction were largely the result of the WesTech/Toray pre-filtration unit. Further gains by the remainder of the AlgEvolve/Koch process were marginal. For this reason, coupled with technological challenges and large footprint considerations in designing a full-scale system, this process was abandoned in April 2017 in favor of other potential technologies, particularly ultrafiltration membranes. The system was dismantled in 2018 to make room for installation of the equalization tanks.

6.6 ZAPS Nutrient Monitor (2016)

In 2016, IEP purchased a ZAPS Technologies analyzer to provide real-time wastewater analysis of parameters such as CBOD5, TSS, TKN, NO2/NO3, and NH3. The analyzer was installed in IEP's flume to monitor final effluent and to be used for process improvement, including nutrient dosing feedback. The unit irreparably failed in 2019 and was replaced with a superior unit in 2020 (see Section 3.0).

6.7 Tertiary MBBR (2017)

Near the conclusion of the Algevolve/Clearas pilot project, the data suggested that ultrafiltration membrane technology was close, but not quite sufficient, to achieving the WQBELs. As the shortcomings of the algal system became more apparent, an alternative, and simpler biological process was investigated to pair with ultrafiltration. Given IEP's past success with MBBR technology, and the small footprint, a pilot trial tertiary MBBR system was operated from April to October 2017.

Similar to the results from the Algevolve/Clearas project, the vast majority of nutrient reduction was achieved with the membrane system, with the biological portion providing just enough assistance to meet the WQBELs for TP and NH₃. The WQBEL for CBOD was not achieved outright, but could have been met through a static pollutant equivalency trade (an element of IEP's Delta Elimination Plan).

IEP selected the WesTech/Toray ultrafiltration system as an element of the final tertiary treatment solution, with the assumption that a tertiary MBBR would be installed if no alternative was found. In 2019, an alternative was found by enhancing the existing biological processes (secondary MBBRs and activated sludge) through optimized nutrient addition and improved aeration. With the WQBEL for CBOD being achieved outright with no equivalency trade, it was concluded that ultrafiltration alone would be sufficient and that a tertiary MBBR was unnecessary.

6.8 MBBRs Fill Ratio Optimization (2018-2019)

A pilot study conducted in 2018 concluded that increasing the fill ratio of the existing MBBRs up to 60% could improve CBOD removal. An initial quantity of media equivalent to 5% was added to MBBR #2 in 2019, but no measurable change in CBOD removal was found. This result was contrary to expectations, and in conjunction with improvements to the activated sludge resulting in adequate CBOD reduction, this path was not pursued further.

7.0 FUTURE BMP PLAN PROJECTS

7.1 MBBR Consolidation and Process Flow Simplification

Over the years of experimentation and process upgrades, IEP has sought to find the right combination that will meet the WQBELs for nutrients. With that process nearly at completion, there are some opportunities to consolidate and simplify the process flow. IEP is considering, for example, to decommission the original MBBR #1 and move the media to the MBBRs #2 and #3. This would significantly streamline wastewater pumping and have other ancillary effects such as improved equalization control, more rapid feedback for nutrient dosing changes, and energy savings.

7.2 Water Conservation, Reclamation, and Reuse

IEP continues to investigate opportunities to reduce effluent flow through the WWTS. This will allow for additional retention time in the WWTS which should have a positive impact on the reduction of CBOD concentrations leaving the secondary treatment system. Internal investigations into water conservation, reclamation and reuse have been ongoing since 2004 as detailed in section 2.0 above. There are several motivations driving this effort, including lower capital, operating and maintenance costs associated with the installation of advanced tertiary treatment systems, and the ability to attain the mass load allocations at higher concentrations. However, IEP has encountered numerous unintended consequences with reduced water treatment including increased odor concerns, build-up of contaminants and foulants in reclaim water, interferences to chemical effectiveness, and increased costs for bleaching and other chemical processes.

After the commissioning of the tertiary ultrafiltration system, IEP will have high quality, particulate-free treated water available for reuse within the mill. To the highest extent feasible, IEP intends to divert as much water as possible for internal reuse to minimize discharge at the outfall. Individual reuse projects will be initiated on a case-by-case or as-needed basis and will likely be ongoing for many years.