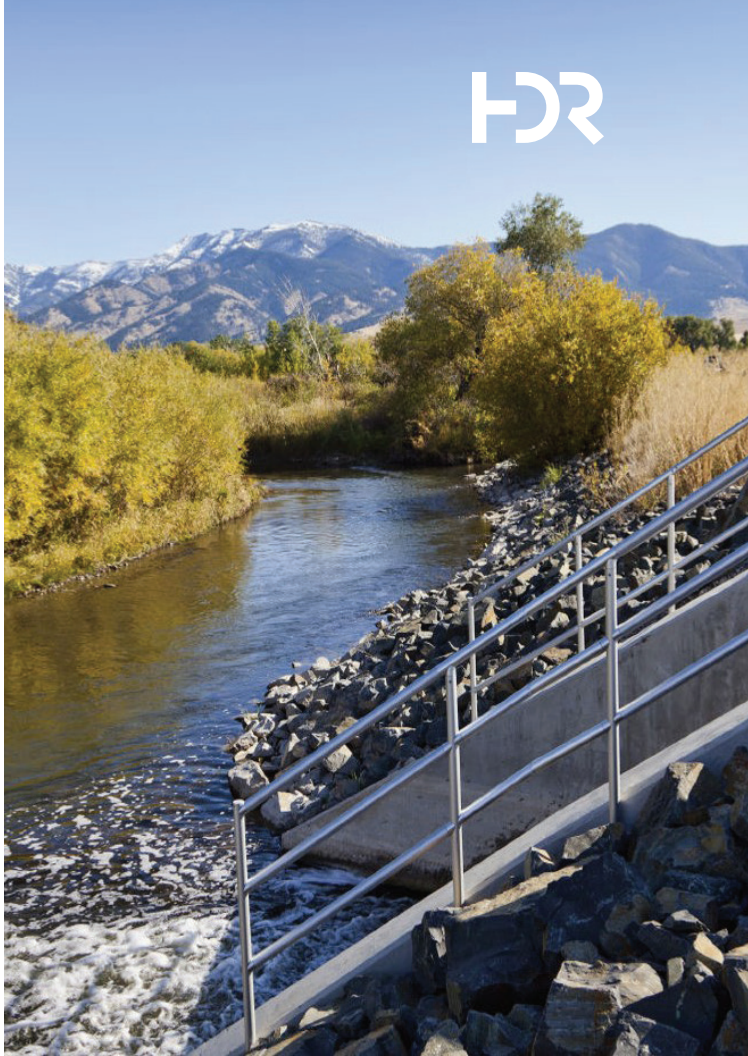
Brewing up Solutions for **Nitrogen Removal Optimization**

Many communities throughout the United States are increasingly dealing with stringent nitrogen effluent limits, leading many to invest in costly nitrogen removal infrastructure upgrades at their wastewater treatment plants. Often, one of the limiting factors within a nitrogen removal process is the availability of carbon. In these situations, communities must often inject alternative carbon sources such as microC, glycol or methanol, which can be both expensive and create hazards with respect to storage and handling.

Separately, an increased demand for craft beer and spirits has resulted in a boom in the micro-brewery and distillery industry. As with anything "micro," cost control is critical in order to ensure long-term financial viability since the volume of product is limited. One potentially significant cost to micro brewers can be the cost of treating and hauling the waste by-product to an appropriate disposal site, or paying the municipal fees associated with discharging high strength waste into a public collection system.

In 2017, HDR tasked its employees to develop innovative ideas that were judged collectively by their peers. This process enabled the creation of a pilot program in 2018 that studied the viability of using brewery and distillery waste as a cost-effective carbon source for nitrogen removal in treatment plants. Here's how we anticipate the partnerships and benefits of putting this by-product to beneficial use will play out:



Imagine a Low-Cost Reduction of Nitrogen Limits in Your Wastewater

Nearly every state in the nation already has, or will soon have, established nutrient criteria for their lakes, rivers and streams. Stricter nutrient criteria means more advanced treatment is required to meet effluent permit limits. The microbial populations in the wastewater treatment process need food in the form of carbon to remove nitrogen. In order for nitrogen levels to continue to be reduced, additional carbon needs to be added to the system. However, proprietary carbon-based products are expensive (maybe as much as $6 per gallon), are often shipped from very long distances, and in some cases are hazardous to human health.

Utilizing local sources, HDR has successfully implemented the collection and dosage of brewery wastewater into the post anoxic zone of a wastewater treatment plant, and has shown that the process can decrease effluent nitrogen levels.

BREWING

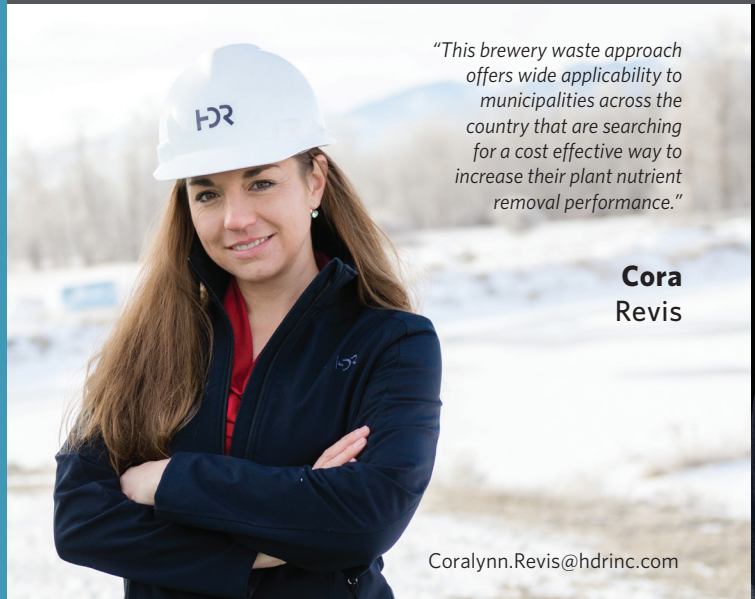
Creating Local Partnerships with Breweries & Distilleries

Microbreweries are a fast growing industry and every brewery creates a high strength waste stream that must be disposed of in some fashion. Disposal of this waste can negatively impact the environment and significantly impact the economic and financial viability of this industry.

Hauling and Storage

The HDR pilot study involved using a vactor truck to collect and transport the brewery waste to the wastewater treatment plant and the subsequent storage of the waste in a tank on-site. The breweries utilized during the study were selected in part based on the logistical feasibility of collecting waste from the brewery.

HAULING AND STORAGE



"This brewery waste approach offers wide applicability to municipalities across the country that are searching for a cost effective way to increase their plant nutrient removal performance."

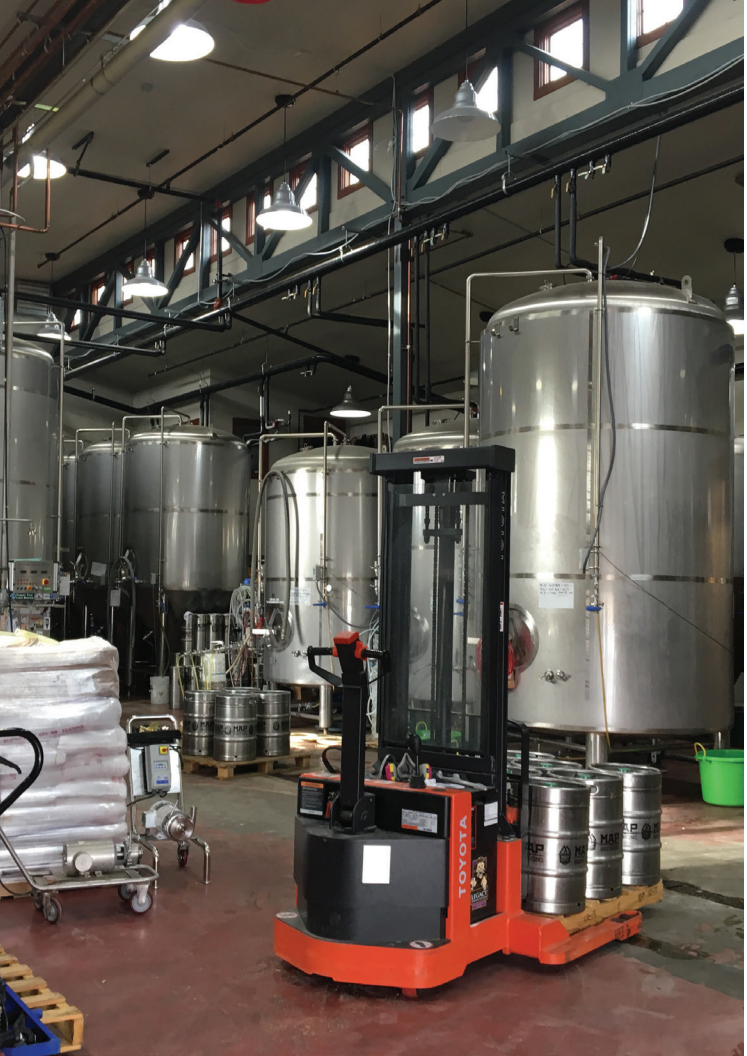
Cora Revis

Coralynn.Revis@hdrinc.com

"Our pilot study is a win-win solution for the community of Bozeman — we were able to collaborate on groundbreaking technology with our client to find an affordable solution to future stringent effluent limits, while also providing a local small business with a sustainable and affordable solution for disposal of brewery waste."

Bill Buxton

William.Buxton@hdrinc.com

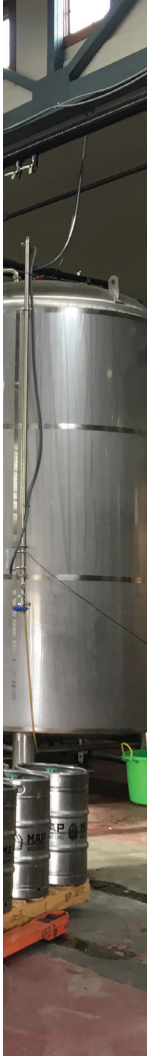


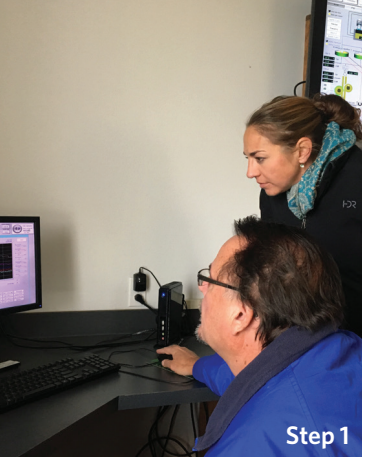
Bozeman

CASE STUDY

In the summer of 2018, HDR collaborated with the City of Bozeman to provide the engineering support behind our “Brewing up Solutions for Nitrogen Removal” pilot study.

WASTEWATER

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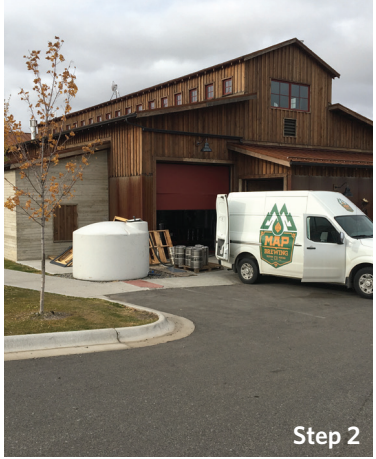
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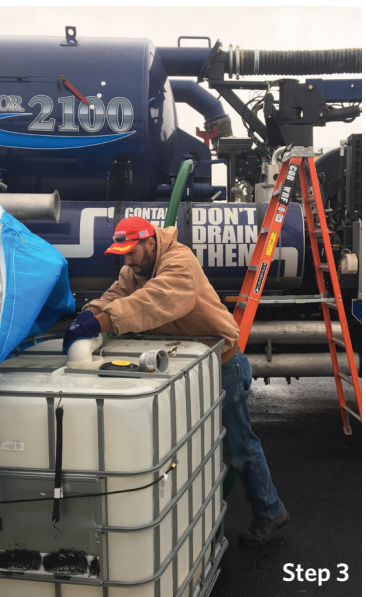
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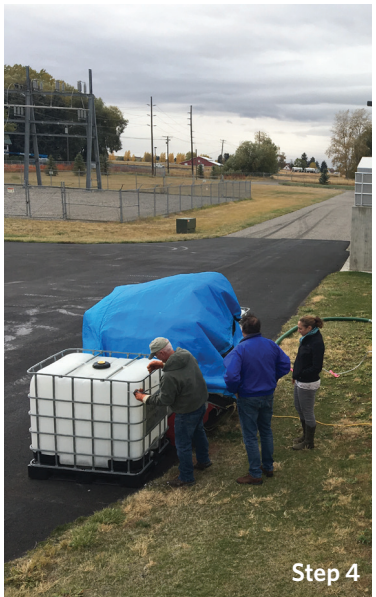
Step 4

Step 1:

Select and coordinate with a utility partner to model the treatment process (we already had the model for Bozeman's system), to determine pilot study conditions and parameters, monitoring and analysis of data in order to make changes to the process, and preparation of a pilot study report. Bozeman's plant is a 3MGD facility that achieves typical nutrient season performance in the range of 4 mg/L total nitrogen and 0.16 mg/L total phosphorus.

HDR also provided the necessary coordination between all interested parties and the Montana Department of Environmental Quality (MDEQ).

Step 2:

Coordinate with local breweries and distilleries to solicit interest in the pilot, sample and test waste product prior to process modeling, purchase and installation of a temporary storage tank and feed pump, process operation, and data collection. For this pilot, HDR collaborated with MAP Brewing in Bozeman, MT, a local craft brewery.

Step 3:

Arrange hauling of the waste product from the brewery to the City of Bozeman's wastewater treatment plant. For the pilot, the City offered to utilize a vac-truck to collect and transport the waste to an on-site storage tank at the wastewater treatment plant.

Step 4:

Dose for 1-week in a single bioreactor train for 12 hours, with a nitrate probe at the end of the train. Preliminary estimates were that 350 gallons would be needed, but in actuality 500 gallons were required for the brewery waste to be effective.

Results:

The results of the study validated the theory that injecting brewery waste to the right stage of the wastewater treatment process would lower nitrogen levels. During the dosing periods of the study, the test bioreactor was able to achieve total nitrogen concentrations of 0.5 – 2.0 mg/L lower than those achieved in the control bioreactor. There was a clear, and at times significant, reduction in nitrate concentrations in the dosed bioreactor compared to the concentrations in the control bioreactor during the testing periods. When the brewery waste ceased being dosed to the test bioreactor, the nitrate levels increased and returned to those found in the control bioreactor.

In summary, a novel and cost effective way to comply with increasingly stringent nutrient standards is offered by injecting brewery waste into the right stage of the wastewater treatment process. The results of this brewery waste project will be pertinent to nutrient standard compliance efforts across the country, and offer wide applicability in their potential to be replicated elsewhere.