Hu Analysis of Biochar Now use in Water Remediation

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Biochar Now LLC provides a biochar product that costs approximately $13,000 per ton to deploy and has produced significant positive impacts for water reclamation projects in states including Michigan and Florida. The majority of studies specific to the Biochar Now LLC product line are not publicly available, yet a sufficient body of general investigation and a specific analysis of field testing in Michigan provide an indication of Human Impact Unit (Hu) magnitude that can be used to reasonably approximate the water reclamation voluntary offset value per ton of biochar deployed. This analysis, using conservative approximations of Hu(Runoff|Iowa) of 7.45 tons per Hu and a Hu(GHG|USA) of 16.4 tons, estimates Biochar Now LLC water reclamation product applications to be worth 12.02 Hu/ton of material deployed. Using 2024 Q1 carbon credit price ranges, this analysis concludes the following:

- An appropriate guide price based on Hu equivalence for a voluntary water reclamation offset is between $109 and $273 per ton of biochar deployed,
- This guide price is between 0.8% and 2.1% of the cost to produce the intangible value accessible via RAC purchase, meaning
- A RAC buyer would receive the intangible value per ton of phosphorus removed at a 97.9% or greater discount relative to project cost.

PROJECT SUMMARY

EcoSense International, Inc. has deployed 296.35 tons of Biochar Now LLC product for the purpose of nutrient remove as a component of multiple water reclamation efforts since 2016. Typically deployed in "socks" filled with between 5-10 pounds of biochar, each sock is placed into a body of water or across a pollution point source so that pollutants are provided an opportunity to bind with the biochar contained by each sock. While there have been extensive studies regarding the potential for generic biochar to aid in the sequestration of nitrogen and phosphorus-based pollution[i,ii,iii,iv,v,vi,vii,viii] and heavy metals[ix,x], a 2023 study directly connects an auditable quantity of deployed Biochar Now LLC biochar to an independently evaluated reduction in lake pollutants.[xi]

This studly by Restorative Lake Sciences was associated with a 2023 study of the Silver Lake (Michigan) Water Basin defined through the analysis as:

> "multiple water quality parameters were measured including water temperature (measured in °C), dissolved oxygen (measured in mg/L), pH (measured in standard units-SU), conductivity (measured in micro-Siemens per centimeter µS/cm), Secchi transparency (feet), total phosphorus, soluble reactive phosphorus (in mg/L), and total Kjeldahl and inorganic nitrogen (both in mg/L), chlorophyll-a (in µg/L), and algal community composition. All chemical water samples were collected at the surface, mid-depth, and bottom using a 4-liter VanDorn horizontal water sampler with weighted messenger (Wildco® brand). Water quality physical parameters (such as water temperature, dissolved oxygen, conductivity, total dissolved solids and pH) were measured with a calibrated Eureka Manta II® multiprobe meter at middle depths of the 3 deep basin sampling sites. Total phosphorus was titrated and analyzed in the laboratory according to method SM 4500-P E. Total inorganic nitrogen was titrated and analyzed in the laboratory according to methods EPA 300.0 Rev. 2.1 and EPA 350.1 Rev 2.0... [from] three water quality

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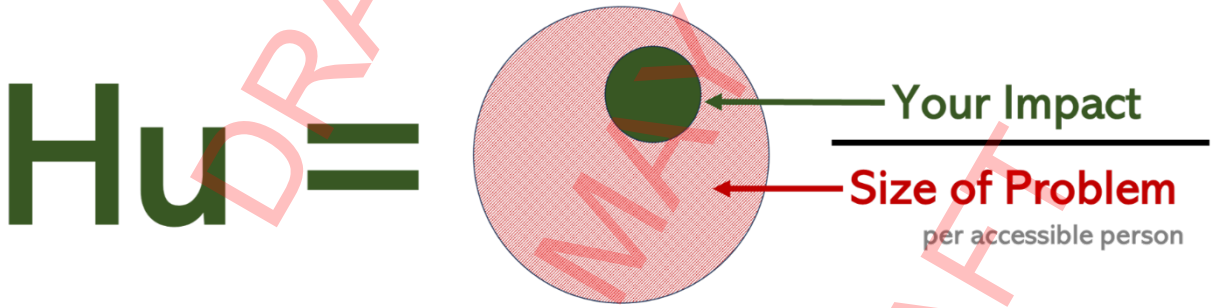
sampling locations."[xii]

The historic analysis of these water quality measures indicated sufficient need that "EarthFood Biochar filters [be] installed. These filters were permitted by EGLE and were installed in June 2023. Post biochar monitoring required all filters to be in place and have ample water flow. Qualified flow was determined on two dates prior to the seasonal removal of the filters and included August 6, 2023, and September 6, 2023." After these three months, with the project deploying approximately of 600 biochar "socks" (i.e. approximately 4,500 pounds or 2.25 tons of biochar), an "analysis of the harvested Biochar filters has revealed that approximately 1.4 tons of phosphorus were removed" from the subject lake. This result indicates that every ton of biochar deployed has the capability of removing 0.62 tons of phosphorus.

SIZE OF PROBLEM

The Size of the Problem (SOP) able to be proven through consistent replication, as presented by the above Biochar Now results, will vary as a function of affected community. For example, there is a logic to arguing that 2023 water quality could be modelled by the absence of tap water violations.[xiii] Taking this approach can demonstrate regional variations that indicate the size of water quality problems in states like Hawaii, where violations are on the order of less than 1 per 1,000,000 citizens, are far less meaningful than in states like Iowa with 284 times the violations per capita. However, the problems represented by tap water quality violation do not directly translate to the issues being solved through application of the Biochar Now product. Further, a Hu analysis valued from data gathered in an environment with less water quality issues will result in an artificially high estimate of the impact in a location where the water quality is much worse. Therefore, since the Biochar Now product is best suited for environments challenged by agricultural runoff, it is vital that the SOP be appropriate for communities struggling with those issues.



HU ESTIMATION

This evaluation ensures appropriate conservatism by approximating the size of problem using the Hu calculation for ag runoff in Iowa. This approximation predicts that one Hu of water quality improvement is equal to 7.45 tons of pollutant reduction. This can be achieved with 12.02 tons of biochar, found by dividing the Hu for ag runoff by the pounds of phosphate removed per pound of biochar, as presented in the Silver Lake annual report.[xiv] Therefore, one Hu of water reclamation is equal to 12.02 tons of deployed biochar.

ESTIMATION VALUATION AND UNCERTAINTIES

European carbon markets in the first quarter of 2024 exhibited prices that ranged between €80[xv] and €200[xvi] per ton depending on carbon type and quality. By constraining this analysis to projects located in the United States, these European market prices offer a Hu guide price of €1,312 to €3,280, or $1,424 to $3,561, when using a national average Hu per CO2 ton of 16.4.[3] These market prices demonstrate that a guide price for the water quality benefit cause by Biochar Now LLC products should be between $109 and $273 per ton of biochar deployed.

[3] Hu Guide Price is found by multiplying the Hu per CO2 of 16.4 by the appropriate minimum and maximum market value of carbon credits per ton

OPPORTUNITIES FOR REFINEMENT

This analysis uses conservative water quality Human Impact Unit improvement assumptions due to Biochar Now LLC deploying product across a wide range of regions and use cases. Despite the variation in project location, these projects are still primarily focused on restoring bodies of water negatively impacted by nutrients and ag related pollutants. This analysis should be revisited pending large deployment of product in specific regions or of alternative uses that may render the Hu(Runoff|Iowa) model either non-conservative or not representative.

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