March 18, 2024

Via electronic mail
Erin Burns
Regional Permit Administrator
DEC Region 5
1115 State Route 86
Ray Brook, NY 12997
comments.SaratogaBiochar2021@dec.ny.gov

Re: Comments on Saratoga Biochar Solutions Air State Facility Permit, Solid Waste Management Facility Permit and Beneficial Use Determination Petition Application No.: 5-4144-00187/00001

Dear Ms. Burns,

Earthjustice, on behalf of Clean Air Action Network of Glens Falls, and joined by the undersigned 78 statewide or nationwide organizations and coalitions, respectfully submits these Comments and requests that the Department of Environmental Conservation ("DEC") deny Saratoga Biochar Solutions LLC's ("SBS") requests for a Solid Waste Management Facility Permit ("Solid Waste Permit") and an Air State Facility Permit ("Air Permit"). Commenters also ask that DEC deny SBS's Beneficial Use Determination Petition ("BUD Petition").[1]

1. Introduction

SBS is seeking permits and approvals to build and operate a facility in an industrial park in the Town of Moreau to produce biochar through a process known as pyrolysis.[2] Once the pyrolysis facility is fully operational, SBS expects it to have "an annual throughput up to 235,200 wet tons of received biosolids"[3] which are sometimes colloquially referred to as "sewage sludge." The facility will also process up to "35,280 tons of wood waste."[4] This

[1] If DEC does not deny the permits and approvals outright as required by law, Commenters have raised substantive and significant issues pursuant to 6 NYCRR Part 621, which warrant an adjudicatory proceeding.
[2] *See, e.g.,* Sterling Env't Eng'g, P.C., Application for Air Facility Permit at 3 (Sept. 6, 2023) (hereinafter "Air Permit Application"); DEC, Draft Solid Waste Management Facility Permit, condition 12 at 3 (hereinafter "Draft Solid Waste Permit").
[3] *See* Air Permit Application at 1.
[4] *See* Air Permit Application at 1.

feedstock will be pyrolyzed—"cooked" at high heat in the absence of oxygen.[5] The finished product of pyrolysis is biochar.[6] "At full buildout, the Facility will produce up to approximately 23,520 tons of [biochar] per year."[7] SBS says it will market the biochar to be used as a fertilizer substitute and an agricultural product applied to soil.[8]

To Commenters' knowledge the proposed pyrolysis facility would be by far the largest facility for producing biosolids-derived biochar in the country. The application materials indicate that the facility will most likely produce pollutants, including Per- and Polyfluorinated Substances ("PFAS") and lead. SBS's CEO has described Moreau as "an ideal location" for the proposed pyrolysis facility, pointing to among other factors, its proximity to trucking routes.[9] But Moreau is precisely the opposite of an ideal location for this project. The proposed location for the pyrolysis facility is 0.75 miles away from a state-designated Disadvantaged Community in Hudson Falls and within two miles of another Disadvantaged Community in Glens Falls.[10] These two communities have very high pre-existing pollution burdens resulting from industrial facilities that had been sited nearby in decades past.

Based on available science and on information presented in SBS's application materials it is not clear that the facility would be able to safely operate anywhere. It is also not clear that SBS's product is safe for land application. SBS claims that the facility will have net negative GHG emissions, but even here the lifecycle analyses presented in the application materials fail to establish this. Especially as the fate of Disadvantaged Communities hangs in the balance, Commenters urge DEC to respect Environmental Rights and refrain from imposing an "involuntary experiment on some of New York State's most vulnerable residents."[11] The enclosed Comments and Appendices explain at greater length why granting the permits to SBS would be arbitrary and capricious, contrary to law, and in violation of New Yorkers' new right to clean air, clean water and a healthful environment.

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[5] Hayleigh Colombo & Jana Decamilla, *Will it Work?: Saratoga Biochar Solutions Touts 'New technology' to Clean Biosolids*, Post Star (Dec. 14, 2022), https://poststar.com/news/local/will-it-work-saratoga-biochar-solutions-touts-new-technology-to-clean-biosolids/article_cd663e48-7522-11ed-90c4-4f89724ab909.html; Alex Portal, *Infographic: How Saratoga Biochar Solutions Says It Operates and Why People Are Concerned*, Post Star (Feb. 3, 2024), https://poststar.com/news/local/business/saratoga-biochar-how-it-works-why-people-are-skeptical/article_85b6e0d6-bc87-11ee-ad45-6bc8632718a8.html.

[6] Colombo, *Will it Work?, supra* note 5.

[7] *See* Sterling Env't Eng'g, P.C., Petition for Case-Specific Beneficial Use Determination at 4 (May 15, 2023) (hereinafter "BUD Petition").

[8] *See id.* at 8–9.

[9] Dan Lundquist, *The Future is Green*, Saratoga Bus. Rep. (Feb. 27, 2024), https://saratogabusinessreport.com/index.php?option=com_content&view=article&id=29&catid=18; Hayleigh Colombo, *'The Cleanup Crew': Leaders Behind Controversial NY Biochar Business Have Ties to Troubled Nebraska Ethanol Plant, Iowa Sludge Dispute*, Post Star (Dec. 14, 2022), https://poststar.com/news/local/the-cleanup-crew-leaders-behind-controversial-ny-biochar-business-have-ties-to-troubled-nebraska-ethanol/article_569bdb78-7523-11ed-8d0d-7b4d376faf5d.html.

[10] *See* Air Permit Application at 37–38.

[11] *See* Expert Declaration of Denise Trabbic-Pointer § E (hereinafter "Appendix 1").

I. DEC Must Deny SBS's Requested Permits Because the Proposed Facility Would Disproportionately Burden DACs in Glens Falls and Hudson Falls by Increasing Co-Pollutants in Those Already Vulnerable Communities.

A. DEC Cannot Issue Permits for Activities that Would Lead to a Net Increase in Co-Pollutants in DACs in Either Hudson Falls or Glens Falls.

CLCPA § 7(3) states that agencies considering issuing permits or other approvals "shall not disproportionately burden disadvantaged communities." The CLCPA does not provide an exhaustive list of every possible way a DAC might be "disproportionately burdened" by an agency decision, but a provision of CLCPA § 2 does provide one salient example.[12] This provision requires DEC to ensure that activities undertaken to comply with regulations implementing the CLCPA "do not result *in a net increase in co-pollutant emissions or otherwise disproportionately burden*" DACs.[13] Under CLCPA § 2 a net-increase of co-pollutants of *any* amount in a DAC is plainly a disproportionate burden.

It follows that under CLCPA § 7(3) an agency cannot issue a permit for an activity that results in a net increase of any co-pollutants in a DAC. To do so would impose a disproportionate burden on the DAC in question. This stringent 7(3) standard is the only textually faithful reading of the statute because, put simply, "disproportionately burden" must mean the same thing in both CLCPA § 2 and CLCPA § 7. It is, after all, a fundamental principle of statutory construction that where "the same term is used in different parts of a statute, it is presumed to carry the same meaning throughout."[14]

The stringent CLCPA § 7(3) co-pollutant standard is also consistent with the Legislature's broader intent to ensure that DACs are protected from additional burdens during the statewide effort to meet the CLCPA's energy transition. Lawmakers understood that even small amounts of additional pollutants in some communities can be devastating, acknowledging at several points throughout the statute that DACs suffer from "cumulative" burdens.[15] In fact, the Legislature was so concerned about cumulative co-pollutants that lawmakers obligated DEC "to *reduce* emissions of toxic air contaminants and criteria air pollutants" in any DAC with a "high cumulative exposure burden."[16] Thus, DEC must either hold air pollution steady in a DAC pursuant to CLCPA § 7(3), or else take affirmative steps to reduce pollution in the DAC if the community already has a high pollution burden. But in no case may DEC authorize a net increase of co-pollutant emissions in a DAC.

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[12] CLCPA § 2 is codified at ECL Article 75, and the referenced provision is ECL § 75-0109(3)(c).
[13] ECL § 75-0109(3)(c) (emphasis added).
[14] *Petro, Inc. v. Serio*, 9 Misc. 3d 805, 810 (Sup. Ct. N.Y. Cnty. 2005); *see also Matter of Minichino v. Fox*, 81 Misc. 3d 405, 413 (Sup. Ct. Albany Cnty. 2023) ("the same words used across the statute are presumed to have the same meaning."), *aff'd*, 219 A.D.3d 1637 (3d Dep't. 2023), *denied*, 40 N.Y.3d 905 (2023).
[15] *See* CLCPA § 1(11); ECL §§ 75-0109(4)(l)(ii)-(iii), 75-0111(1)(c)(i), 75-0115(3).
[16] *See* ECL § 75-0115(3) (emphasis added).

B. <u>Hudson Falls and Glens Falls Already Have Very High Health and Pollution Burdens.</u>

DACs in Hudson Falls and Glens Falls near the proposed facility exemplify why, as a policy matter, the Legislature created a stringent co-pollutant standard under CLCPA § 7(3). These communities have unique and severe vulnerabilities. For such communities, even incremental exposures to additional co-pollutants can impose significant burdens.[17] Commenters are especially concerned about the cumulative impacts of co-pollutants that bioaccumulate, like PFAS[18] and Mercury. Siting a massive biosolids pyrolysis facility near such communities is precisely the opposite of what the Legislature intended.

1. *Hudson Falls and Glens Falls Experience High Health Burdens.*

Census tract 36115080100 is a DAC located in Hudson Falls near the site of the proposed SBS facility. This DAC has unusually high public health burdens. According to the Climate Justice Working Group's ("CJWG") interactive DAC map,[19] the DAC's average annual age-adjusted emergency department visits for COPD – an inflammatory lung disease – are higher than those in 86% of all census tracts in the state. The CJWG map also shows that a higher percentage of people in this DAC have a disability than people in 92% of all census tracts in the state.[20] Finally, the CJWG map indicates that a higher percentage of deaths in this DAC occur before the age of 65 than in the vast majority of census tracts throughout the state.[21]

The public health burdens on census tract 36113070500, a DAC located in Glens Falls near the site of the proposed SBS facility, are also unusually high. According to the CJWG interactive DAC map,[22] the DAC's average annual age-adjusted emergency department visits for COPD are higher than those in 96% of all census tracts in the state. The CJWG map also shows that the average annual age-adjusted hospitalizations for heart attacks in this DAC are higher than those in 93% of all census tracts in the state.[23] While the CJWG map does not include cancer statistics, it is notable that according to data collated by the CDC's National Cancer Institute, Warren County, where this DAC is situated, has the fourth highest incidence of cancer of all New York counties among individuals aged < 20. The data is illustrated in the table below.

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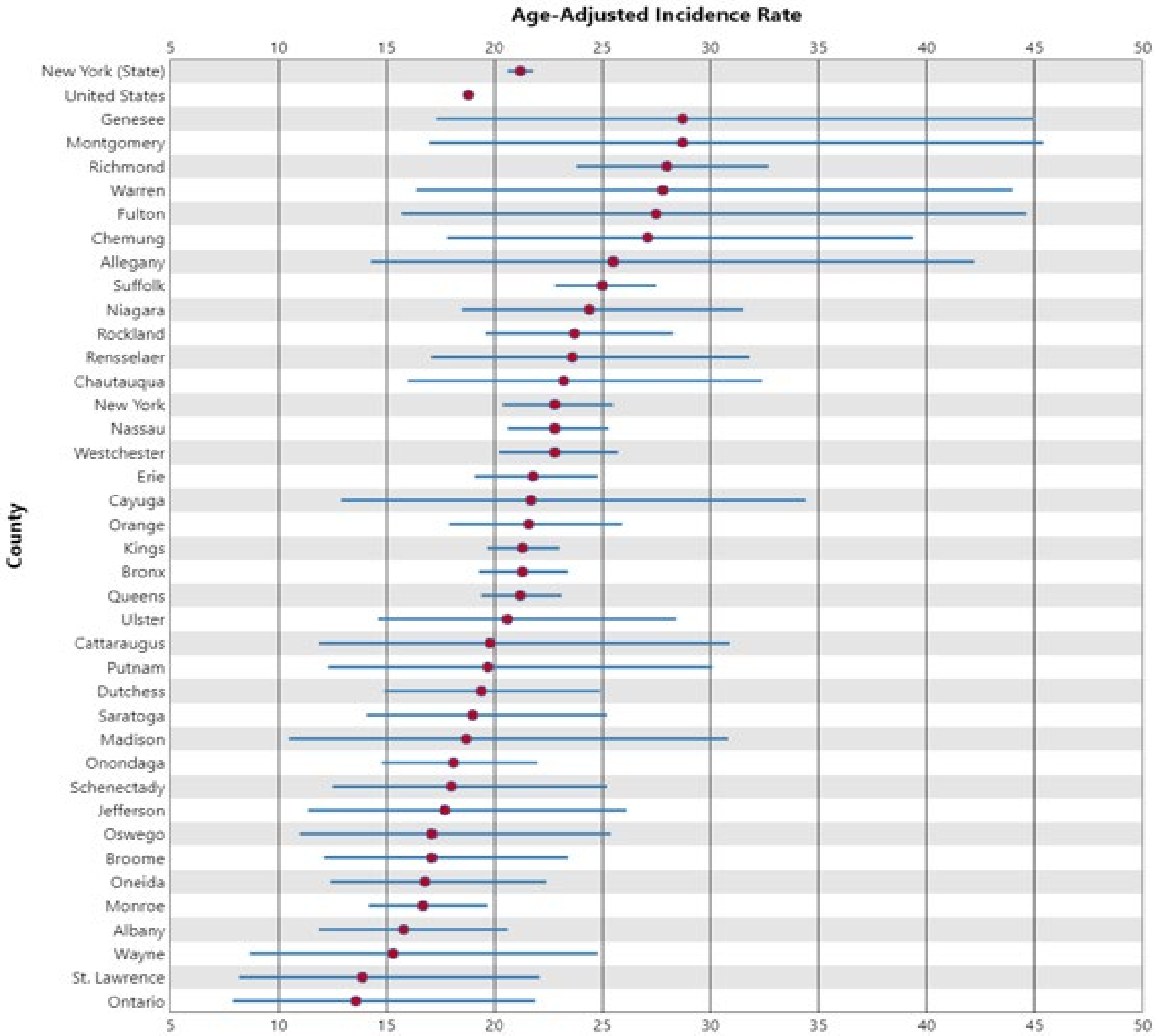
[17] *See* Appendix 1 § D.
[18] *See* Appendix 1 § C.
[19] *See* Climate Just. Working Grp., *Disadvantaged Communities Criteria Map*, Climate Act, https://climate.ny.gov/Resources/Disadvantaged-Communities-Criteria (last visited Mar. 14, 2024) (hereinafter "DAC Map").
[20] *See id*.
[21] *See id*. To be more precise, data for premature deaths in the CJWG's DAC map is from the years 2015 through 2019, and places this DAC in the 70th percentile. *See id*.
[22] *See id*.
[23] *See id*.

Incidence Rate Report for New York by County
Childhood (Ages <20, All Sites) (All Stages^), 2016-2020
All Races (includes Hispanic), Both Sexes
Sorted by Rate



Created by statecancerprofiles.cancer.gov on 02/21/2024 8:20 pm.

State Cancer Registries may provide more current or more local data.

Data cannot be shown for the following areas. For more information on what areas are suppressed or not available, please refer to the table.
Chenango, Clinton, Columbia, Cortland, Delaware, Essex, Franklin, Greene, Hamilton, Herkimer, Lewis, Livingston, Orleans, Otsego, Schoharie, Schuyler, Seneca, Steuben, Sullivan, Tioga, Tompkins, Washington, Wyoming, Yates

- Incidence rates (cases per 100,000 population per year) are age-adjusted to the 2000 US standard population (19 age groups: US Population Data File is used for SEER and NPCR incidence rates.
Rates and trends are computed using different standards for malignancy. For more information see malignant.html.

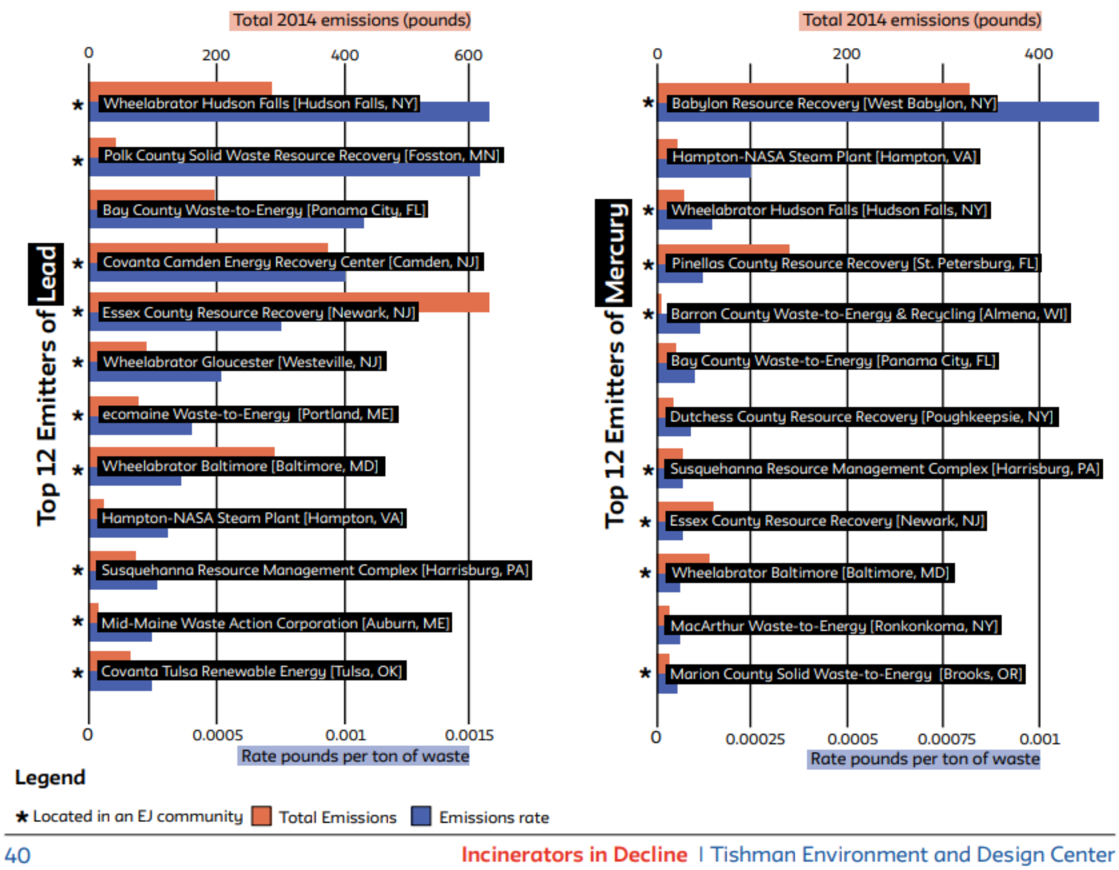
^ All Stages refers to any stage in the Surveillance, Epidemiology, and End Results (SEER) summary stage.
* Data has been suppressed to ensure confidentiality and stability of rate estimates. Counts are suppressed if fewer than 16 records were reported in a specific area-sex-race category. If an average count of 3 is shown, the total number of cases for the time period is 16 or more which exceeds suppression threshold (but is rounded to 3).

Source: SEER and NPCR data. For more specific information please see the table.
Data for the United States does not include data from Nevada.
Data for the United States does not include Puerto Rico.

When displaying county information, the CI*Rank for the state is not shown because it's not comparable. To see the state CI*Rank please view the statistics at the US By State level.

2. *Hudson Falls and Glens Falls Are Subject to High Pollution Burdens.*

These two DACs also experience unusually high pollution burdens when compared to census tracts throughout the state. For example, the CJWG's interactive DAC map indicates that a higher percentage of the Hudson Falls DAC's land area is within 500 meters of a trash incinerator than that of 96% of other census tracts in the state.[24] The Wheelabrator incinerator in Hudson falls is especially burdensome. For example, it is the number one emitter of lead per ton of waste in the entire United States according to a report released in 2019, using data from 2014.[25] The report also states that the facility is one of the top ten emitters of mercury per ton of waste burned of all trash incinerators in the country.[26]



The interactive DAC map indicates that the Hudson Falls DAC is in the 96th percentile for proximity to Regulated Management Plan sites.[27] The Glens Falls map fares even worse

[24] *See* DAC Map.

[25] Gwendolyn Craig, *Report: Hudson Falls Trash Plant Among Country's 'Dirty Dozen' Incinerators*, Post Star (May 22, 2019), https://poststar.com/news/local/report-hudson-falls-trash-plant-among-countrys-dirty-dozen-incinerators/article_233446f9-c4a7-54ca-b371-4ca9c24da9c0.html; Ana Isabel Baptista & Adrienne Perovich, Tishman Env't & Design Ctr. *U.S. Municipal Solid Waste Incinerators: An Industry in Decline,* at 40-41 (May 2019), https://www.no-burn.org/wp-content/uploads/2021/03/CR_GaiaReportFinal_05.21-1.pdf.

[26] Baptista, *supra* at 40.

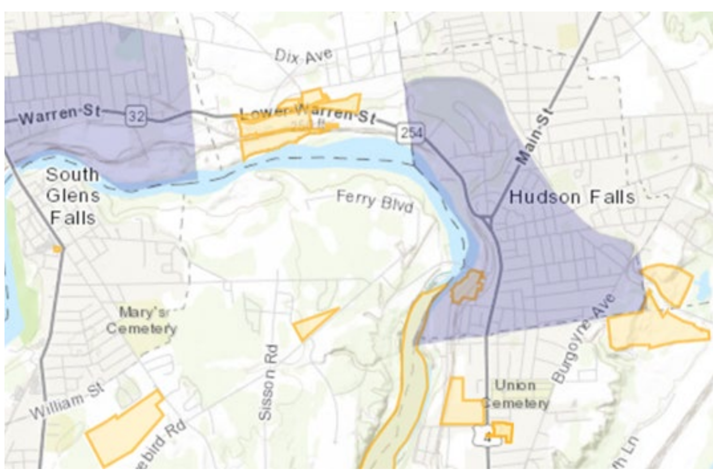
[27] *See* DAC Map.

along this metric. That DAC is in the *100th percentile* among census tracts in New York state for proximity to Regulated Management Plan sites.[28]

According to the CJWG Regulated Management Plan "facilities are those that are required by the Clean Air Act section 112(r) to file risk management plans. The regulations established a list of 72 substances because of their high acute toxicity and 60 because of their flammable or explosive potential, along with thresholds quantities for each substance."[29] The CJWG explained its rationale for tracking census tracts' proximity to these facilities as such:

> The primary concerns with [Regulated Management Plan] facilities are the accidental release of substances and fires or explosions. The sudden release of relatively large quantities of acutely toxic substances can cause serious health effects. Additionally, as with many types of industrial facilities, there may be routine releases to the air and water of the residuals after pollution control devices remove what is generally a large fraction of the waste stream. Thus, people may be exposed to some substances directly through inhalation or indirectly through water routes or via ingestion of food.[30]

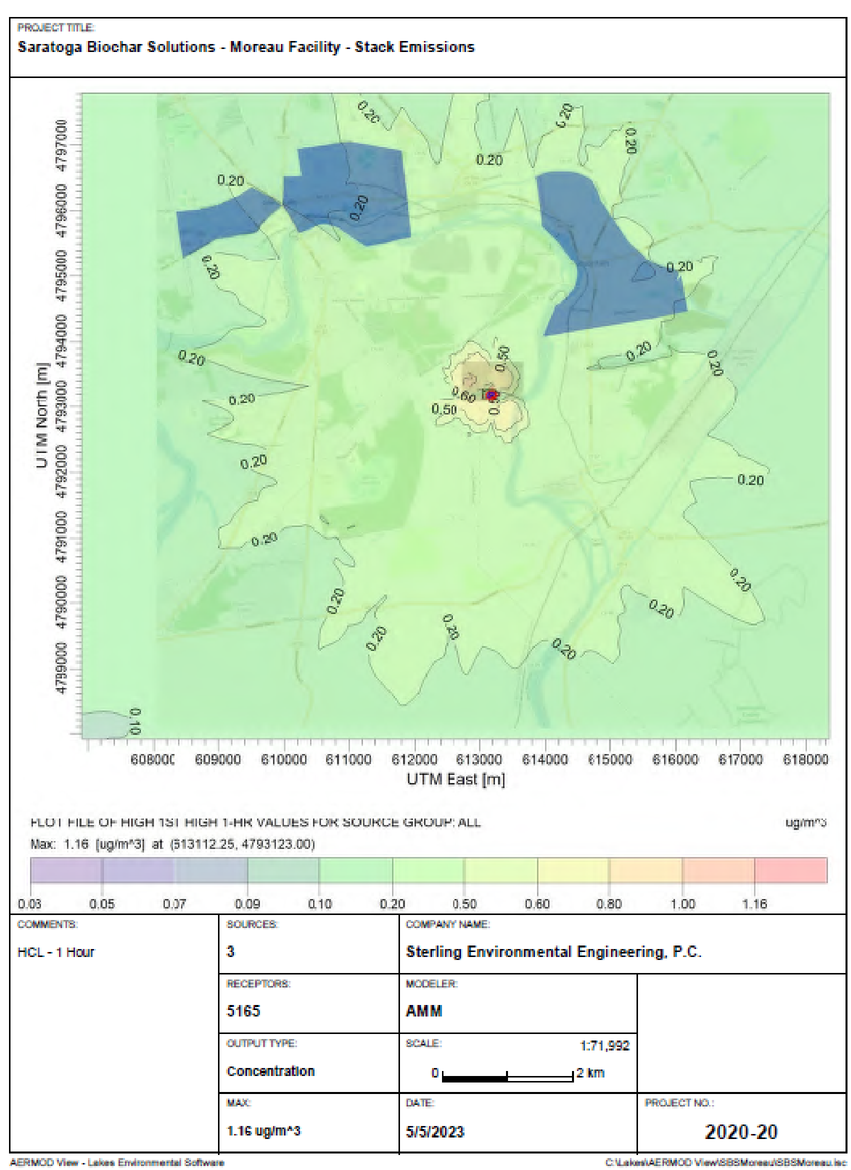
In addition to being close to Regulated Management Plan facilities, the DACs in Hudson Falls and Glens Falls are nearby to a high number of superfund sites. While the interactive DAC map only tracks remediation sites *within* DACs, the DECinfo Locator tool allows members of the public to generate their own maps illustrating remediation sites *surrounding* DACs.[31] The map below depicts the superfund sites close to the Glens Falls and Hudson Falls DACs. The DACs are shaded in purple and the superfund sites are shaded in orange:



[28] *See id* (emphasis added).
[29] *See* N.Y. Climate Just. Working Grp., Draft Disadvantaged Communities Criteria and List Technical Documentation at 33 (Mar. 9, 2022), https://climate.ny.gov/-/media/Project/Climate/Files/Disadvantaged-Communities-Criteria/Technical-Documentation-on-Disadvantaged-Community-Criteria.pdf.
[30] *Id*.
[31] *See* DEC, *DECinfo Locator*, https://gisservices.dec.ny.gov/gis/dil/.

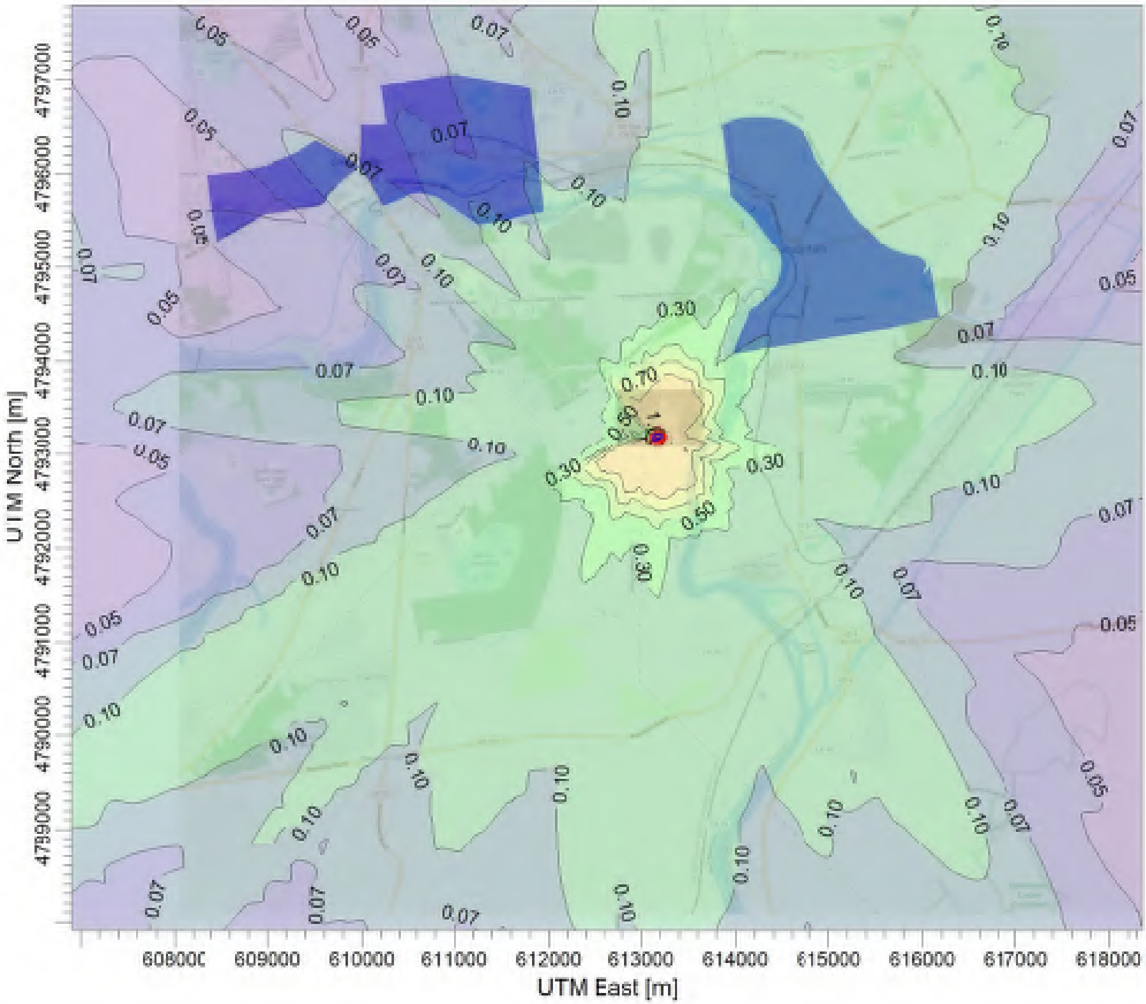
C. SBS's Air Permit Application Concedes that the Proposed Facility Will Increase Co-Pollutants in DACs in Hudson Falls and Glens Falls.

Attachments 5A through 5Q of SBS's Air Permit Application confirm that the company acknowledges the proposed facility may release co-pollutants in these two DACs in Hudson Falls and Glens Falls. These co-pollutants include, but are not limited to: PFAS, Naphthalene, Arsenic, Cadmium, Lead, Mercury, Hydrogen Fluoride, and Particulate Matter. AERMOD maps in Attachment 5 clearly illustrate the expected dispersion of co-pollutants from the proposed facility in and around three DACs. The DACs are shaded in dark blue. The DAC on the right-hand side of the maps is census tract 36115080100, which is located in Hudson falls. The DAC in the center of the maps is census tract 36113070500, located in Glens Falls. For the convenience of the reader, Commenters are incorporating into the text of this Comment a sample of three maps illustrating expected emissions of Hydrogen Chloride, PM-10, and PFOA below:



PROJECT TITLE:

Saratoga Biochar Solutions - Moreau Facility - Stack Emissions



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

Max: 3.53 [ug/m^3] at (613112.25, 4793123.00)

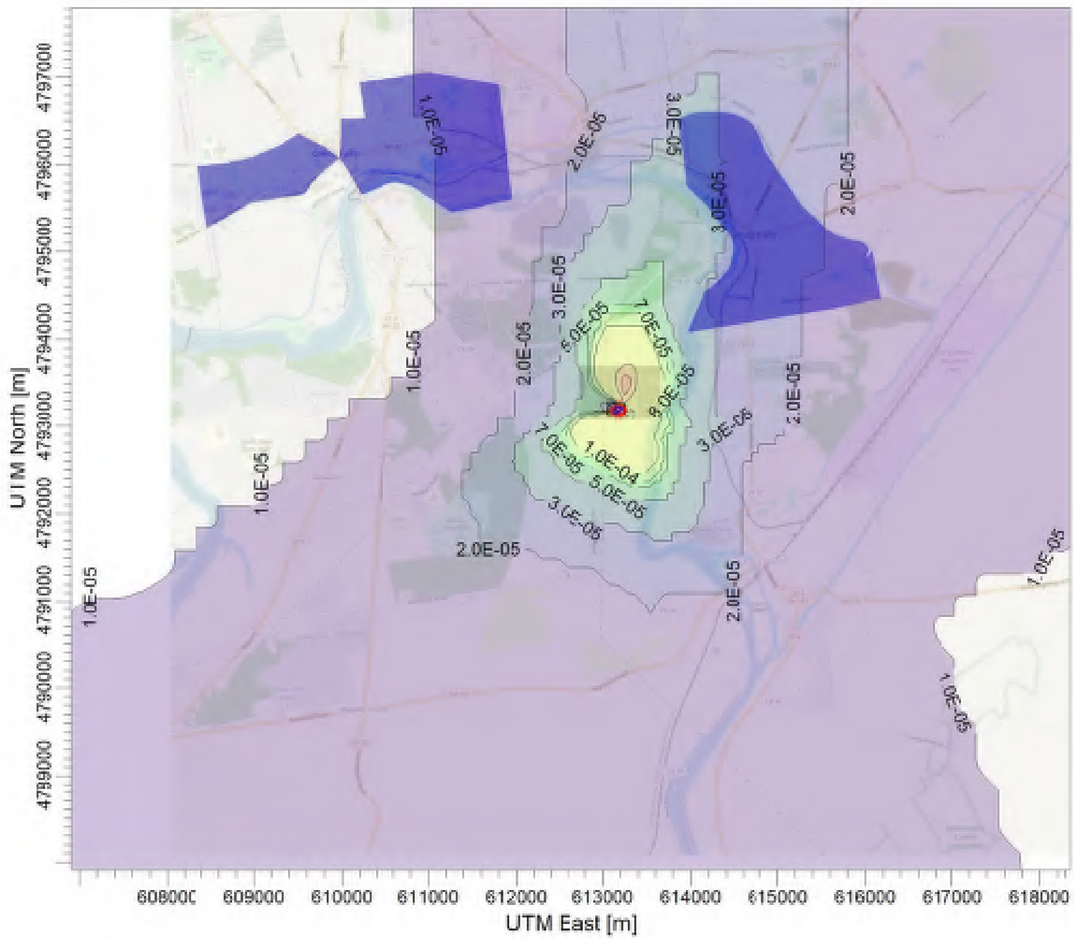
0.04 0.05 0.07 0.10 0.30 0.50 0.70 1.00 3.00 3.53

COMMENTS:	SOURCES:	COMPANY NAME:	
PM-10 - 24 Hour	3	**Sterling Environmental Engineering, P.C.**	
	RECEPTORS: 5165	MODELER: **AMM**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:71,992 (0 — 2 km)	
	MAX: **3.53 ug/m^3**	DATE: **5/8/2023**	PROJECT NO.: **2020-20**

AERMOD View - Lakes Environmental Software C:\Lakes\AERMOD View\SBSMoreau\SBSMoreau.isc

PROJECT TITLE:

Saratoga Biochar Solutions - Moreau Facility - Stack Emissions



PLOT FILE OF ANNUAL VALUES AVERAGED ACROSS 5 YEARS FOR SOURCE GROUP: ALL ug/m^3

Max: 4.7E-04 [ug/m^3] at (613249.75, 4793466.50)

1.0E-05 2.0E-05 3.0E-05 5.0E-05 7.0E-05 8.0E-05 1.0E-04 3.0E-04 4.0E-04 4.7E-04

COMMENTS:	SOURCES:	COMPANY NAME:	
PFOA - Annual	3	**Sterling Environmental Engineering, P.C.**	
	RECEPTORS: 5165	MODELER: AMM	
	OUTPUT TYPE: Concentration	SCALE: 1:71,992 (0 – 2 km)	
	MAX: 4.7E-04 ug/m^3	DATE: 5/4/2023	PROJECT NO.: 2020-20

AERMOD View - Lakes Environmental Software C:\Lakes\AERMOD View\SBSMoreau\SBSMoreau.isc

To summarize, DEC cannot grant permits or approvals for the proposed facility unless SBS can demonstrate that there will be no net increase of co-pollutants in either Hudson Falls (census tract 36115080100) or Glens Falls (census tract 36113070500). SBS has not demonstrated this. In fact, even their own modeling does the opposite.

D. SBS's AERMOD Underestimates the Magnitude of the Co-Pollutant Burden the Proposed Facility Will Create in DACs in Glens Falls and Hudson Falls.

As noted above, a plain reading of the CLCPA indicates that a net increase of co-pollutants in a DAC is a disproportionate burden, regardless of the amount of pollutants at issue. Thus, AERMOD modeling in Attachment 5 alone provides DEC with both a sufficient basis and an obligation to deny permits for the SBS project.

While SBS may claim the co-pollutant impacts in their modeling are low, that does not eliminate the imposition of a disproportionate burden. And indeed, there is a possibility that the co-pollutant emissions from the facility will be higher in magnitude than the AERMOD modeling suggests.[32] Such models are only as good as their inputs. As discussed further below, SBS has not yet sampled feedstock from any specific WWTP sending biosolids to the facility. Instead, the model uses unidentified WWTPs in Casella's operating footprint as a surrogate. SBS claims that these WWTPs are representative, but, in fact, the specific WWTPs transporting biosolids to the SBS facility might be more laden with contaminants, like Mercury and PFAS than the selection chosen by SBS.[33] If the pollutants in the feedstock are higher than assumed, the resultant co-pollutant emissions may also be higher.[34]

In addition, SBS's modeling of its thermal oxidizer's ability to destroy PFAS and Products of Incomplete Combustion present in syngas before they are released into the atmosphere is too rosy for several reasons.[35] Two are worth highlighting here, and the rest can be found in the Declaration of Denise Trabbic-Pointer.[36] First, SBS has not provided DEC with speciated emissions modeling for PFAS. For example, there is no specific AERMOD modeling provided for PFOS, which is known to be present in biosolids in WWTP's located in Casella's operating footprint. Instead of specifically providing AERMOD modeling for PFOS, SBS aggregates all PFAS expected to be present in incoming biosolids and models them as PFOA. This is problematic because SBS's own data suggests that PFOS is more heat resistant than PFOA. To put it plainly, if SBS instead used PFOS as a surrogate instead of PFOA, the expected PFAS emissions might be higher. PFOS is a more reasonable surrogate to use than PFOA because SBS's biosolids data suggests that incoming biosolids will be more contaminated with PFOS than PFOA.[37]

Second, SBS engages in similar fallacious reasoning to avoid modeling emissions for PFAS products of incomplete combustion ("PICs"). PICs are smaller PFAS compounds that are

[32] *See* Appendix 1 § E.
[33] *See id.* § A.a–A.b..
[34] *See id.* § E.
[35] *See id.* § B.
[36] *See* Appendix 1.
[37] *See id.* § A.b.

often produced when PFAS are heated at high temperatures.[38] SBS appears to assume, without real evidence, that its thermal oxidizer will destroy all PICs.[39] SBS's only support for this assumption is a study in which one PIC, CF4, was no longer detectable after PFAS was treated in a thermal oxidizer at 1490 degrees Fahrenheit.[40] However, reliance on this finding is problematic because not all PICs are equally vulnerable to thermal treatment. Some survive at much higher temperatures. The same study states that scientists were not able to completely destroy at least six PICs even at the study's maximum thermal treatment temperature of 2156 degrees Fahrenheit.[41]

The study authors also cast doubt on their findings regarding CF4 destruction. They note that reporting limits for CF4 in the study were high and that "current efforts are focused on lowering these limits of quantitation."[42] In other words, CF4 may have been present in emissions even though it was not detected by the relatively insensitive methods used in the study. It is notable that the single study contradicts EPA findings that a temperature of greater than 2,500 degrees Fahrenheit is necessary for CF4 destruction[43] – a temperature that the SBS thermal oxidizer will not reach.

E. In Light of Hudson Falls' and Glens Falls' Already Very High Health and Pollution Burdens, the Magnitude of the Co-Pollutant Burden Resulting from SBS's Facility Will Be Substantial.

Commenters also wish to draw attention to the fact that the magnitude of the burdens created by SBS may exacerbate pre-existing and cumulative burdens the Hudson Falls and Glens Falls DACs have already accrued, such as high rates of COPD and heart disease. For example, as noted in the expert analysis presented in Appendix 1, "[t]he majority of the pollutants modeled by SBS have the potential to do harm to the respiratory systems of residents in the DACs."[44] Similarly, the CJWG observes that "[n]umerous scientific studies have linked cardiopulmonary diseases, including [heart attacks], to exposure to fine particulate matter (PM)" and also adds that "there may be cardiac health co-benefits associated with reducing... combustion pollutants."[45]

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[38] *See id* § B.a.
[39] *See* Air Permit Application at 31—32.
[40] *See id.*; *see also id.* attach. 8, tbl. 3 at E.
[41] *Id*. attach. 8.
[42] *See id.* attach. 8 at E.
[43] *See* Appendix 1 § B.a (citing DEC, Notice of Incomplete Application at question 1 (July 11, 2023).
[44] *See id.* § D.
[45] *See* Draft Disadvantaged Communities Criteria and List Technical Documentation, *supra* note 29, at 48.

The analysis in Appendix 1 states that pre-existing health and pollution burdens can make what otherwise would be safe amounts of pollutants unsafe, noting that:

> The impacts of [the proposed facility's] pollutants on the respiratory system will be cumulative with hazards from various other sources of pollution (industry, workplace, automobiles) and routes of exposure (inhalation, dermal and ingestion) … people with existing respiratory issues and illnesses like COPD, asthma or emphysema, would likely be adversely affected [by lower pollutant exposures].[46]

The analysis in Appendix 1 concludes that the increase of co-pollutants modeled by SBS is "too high to be safe for communities already overburdened with health and pollution problems."[47] Although it is not necessary to demonstrate harm to public health caused by co-pollutants under CLCPA § 7(3)'s standard, drawing attention to the cumulative nature of the burdens faced by the Hudson and Glens Falls DACs underscores that the stakes of DEC's decision on SBS's permits are not merely academic. This administrative decision may be a matter of life or death for already vulnerable people in these two DACs.

F. SBS's CLCPA § 7(3) Air Emissions Analysis Is Fatally Flawed.

In Section 9.5 of the Air Permit Application, SBS engages in a cursory, fatally flawed disproportionate burden analysis for air emissions from the proposed pyrolysis facility. The analysis is fatally flawed for three reasons. First, the analysis assumes that the addition of co-pollutants in a DAC will not result in a disproportionate burden if the addition of co-pollutants is equal to or less than a DEC guidance concentration.[48] This view of CLCPA § 7(3) is incorrect. A project proponents' adherence to DEC guidance concentrations and emissions limits prescribed in other New York State laws and regulations is insufficient to satisfy the CLCPA § 7(3) standard. By enacting CLCPA § 7(3), the Legislature sought to impose additional duties on DEC and other agencies beyond those already present preexisting statutes and regulations to protect New York's most vulnerable residents from disproportionate burdens throughout the climate transition. To read the section otherwise would render its language superfluous.[49]

Second, SBS appears to believe that CLCPA § 7(3) allows a project proponent to offset a disproportionate burden in one DAC by reducing GHG emissions in other areas of the state. SBS argues that its facility will be compliant with CLCPA § 7(3), in part, because the production of biochar will allegedly result in "a net decrease in GHG emissions" which "will have a benefit on the entire State, including draft DACs."[50] But, even assuming *in arguendo*, that the purported emissions reduction benefits of the proposed facility are real, as stated above, the Legislature

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[46] *See* Appendix 1 § D.
[47] *See id.*
[48] *See* Air Permit Application at 38–39.
[49] *Matter of Lemma v. Nassau County Police Officer Indem.n Bd.*, 31 N.Y.3d 523, 528 (Ct. App. 2018) ("[S]tatutory language should be harmonized, giving effect to each component and avoiding a construction that treats a word or phrase as superfluous").
[50] *See* Air Permit Application at 39.

enacted CLCPA § 7(3) precisely to ensure that individual DACs are not saddled with new, disproportionate burdens as statewide GHG emissions decrease.

Third, SBS argues that the AERMOD model for Naphthalene emissions shows "negligible impact on the DACs" and therefore no co-pollutants from the proposed facility will disproportionately burden DACs.[51] The project proponent's use of Naphthalene as a surrogate for all other individual and combined co-pollutants emanating from the proposed facility is dubious. But more importantly, as noted above, under CLCPA § 7(3) a net-increase of a co-pollutant like Naphthalene in a DAC is impermissible regardless of the magnitude of the increase. Moreover, in light of the cumulative health and pollution burdens faced by residents of Glens Falls and Hudson Falls, it is clear that the additional pollutants released by the facility will impose significant burdens on DACs.[52]

In conclusion, SBS's facility will impose disproportionate co-pollutant burdens on DACs in Hudson Falls and Glens Falls, and therefore DEC should deny the permits and approvals sought by SBS for the proposed facility.

II. DEC Must Deny SBS's Requested Permits Because the Proposed Facility Would Disproportionately Burden DACs in Glens Falls and Hudson Falls by Discharging PFAS and Other Pollutants into the Glens Falls Wastewater Treatment Plant.

In its CLCPA § 7(3) analysis, SBS concedes that "the potential burden to the DACs from the Facility would be potential pollution exposures," but the company perplexingly fails to consider the proposed facility's water pollution impacts on surrounding DACs.[53] Now, DEC must do so in light of the potential for PFAS and other contaminants to enter the Glens Falls WWTP.

A. CLCPA § 7(3) Requires DEC to Consider the Water Pollution Burdens Resulting from Permitting Decisions.

The text of the CLCPA indicates that, when enacting § 7(3), the Legislature sought to protect DACs from a wider range of burdens than just air pollutant emissions. For example, CLCPA § 1(7) refers to broad "environmental and socioeconomic burdens as well as legacies of racial and ethnic discrimination." At a minimum, a complete CLCPA § 7(3) analysis must consider a range of pollution burdens that may result from the issuance of a permit or approval to a project proponent. For example, a permitting agency must consider the impacts a project will have on water supplies and surface waters within a DAC as part of a complete CLCPA § 7(3) analysis.

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[51] *See id*.
[52] *See* Appendix 1 §§ C, D, E.
[53] Air Permit Application at 38.

B. SBS's Facility Will Increase Water Pollution Burdens in DACs.

Here, Commenters note that the proposed facility will likely increase water pollution in DACs already disproportionately burdened by wastewater discharges. As noted in the analysis in Appendix 1 and discussed further in a subsequent section of this Comment, Commenters are especially concerned about the likelihood that SBS will discharge PFAS-laden wastewater into the Glens Falls Publicly Owned Treatment Works ("POTW"). The PFAS present in biosolids at the facility may make its way into wastewater via a number of routes:

> The facility will produce 29,456 gallons per day of wastewater. Process wastewater from the facility will include effluent from the facility's air treatment system, as well as truck wash used to clean incoming trucks containing biosolids, and possibly also water used to cool and stabilize biochar in the facility's Carbon Manufacturing Area. Each of these streams of wastewater may contain PFAS and other pollutants.[54]

It is also notable that one recent study found that the pyrolysis of biosolids generated "py-liquid contain[ing] PFAS at the µg L^{-1} level which is higher than drinking water health advisory levels" adding that "the py-liquid is difficult to handle due to being corrosive and containing other undesirable toxic chemicals."[55] Perhaps even more disturbingly, the study "illuminate[d] that pyrolysis of biosolids can cause transformation reactions that lead to specific PFAS in the effluent py-liquid found at higher levels than in the influent biosolids."[56]

SBS intends to discharge its wastewater into the Glens Falls POTW without pretreatment.[57] It is notable that the State Pollutant Discharge Elimination System ("SPDES") permit for the Glens Falls POTW contains no PFAS limits.[58] In fact, the SPDES permit says nothing at all about PFAS.[59] The POTW will not be able to treat PFAS present in the SBS facility's wastewater.[60] Thus, PFAS present in SBS's wastewater would pass through the POTW directly into the Hudson River. The aforementioned DACs in Hudson Falls (census tract 36115080100) and Glens Falls (census tract 36113070500) are located along the Hudson.

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[54] *See* Appendix 1 § G.
[55] *See* Patrick McNamara et al., *Pyrolysis Transports, and Transforms, PFAS from Biosolids to Py-Liquid* 9 Env't Science Water Rsch. Tech. 386, 392 – 93 (2023) (Appendix 1, Exhibit 1).
[56] *See id.* at 386.
[57] *See* Sterling Env't Eng'g, P.C., Response to NYSDEC Application Comments at 3 (Apr. 4, 2022) (hereinafter "SBS Response to DEC Comments"); Sterling Env't Eng'g, P.C., Facility Manual at 7 (Mar. 31, 2022) (hereinafter "Facility Manual").
[58] *See* SPDES Permit (Appendix 2).
[59] *Id*.
[60] According to the American Water Works Association, current research shows that conventional wastewater treatment systems have limited effectiveness against PFAS. *See* Am. Water Works Ass'n, *Per- and Polyfluoroalkyl Substances (PFAS) Treatment* at 1 (Aug. 12, 2019), https://www.awwa.org/Portals/0/AWWA/ETS/Resources/Per-andPolyfluoroalkylSubstances(PFAS)-Treatment.pdf?ver=2019-08-14-090249-580.

C. <u>The Glens Falls and Hudson Falls DACs Already Have High Water Pollution Burdens.</u>

The Hudson Falls and Glens Falls DACs already experience very high exposures to wastewater discharges. The two DACs rank in the 74^{th} and 70^{th} percentiles among census tracts throughout the state for the CJWG's wastewater discharge indicator.[61] The CJWG indicator "incorporates chemical toxicity and fate and transport to estimate concentrations of pollutants in downstream water bodies and derive a toxicity-weighted concentration."[62] The CJWG further explains this indicator of preexisting water pollution burdens as such:

> Water pollutants can have adverse human health and ecological effects, depending on concentrations and toxicity of the pollutant. People may come into contact dermally by engaging in recreational activities such as swimming or boating, through inhalation by volatilization of pollutants or by eating contaminated fish. If pollutants are not removed from drinking water sources, people may come into contact by drinking contaminated water. This indicator captures proximity and toxicity-weighted stream concentrations of pollutants with potential human health hazards.[63]

D. <u>Issuing SBS's Permits Would Disproportionately Burden DACs in Glens Falls and Hudson Falls by Exacerbating the Preexisting Water Pollution Burdens.</u>

The Hudson River is a Class C waterbody meaning that fishing is its best use and that the water body must be suitable for primary and secondary contact recreation (e.g., swimming, skin diving, wading, and boating).[64] Obviously, the discharge of bioaccumulative PFAS and other pollutants into this water body would jeopardize these uses. DEC should find that the water pollution burdens from the SBS facility would disproportionately burden DACs, and therefore deny the permits and approvals sought by SBS on these separate and distinct grounds as well.

III. DEC Must Deny SBS's Request for a Solid Waste Permit Because the Facility Nas Not Verified and Cannot Verify That the Glens Falls POTW Will Accept its Wastewater.

In addition to disproportionately burdening DACs under CLCPA § 7(3), discharges of PFAS-laden wastewater into the Glens Falls POTW would violate several additional laws that aim to prevent the "pass through" of pollutants discharged into POTW's. For this reason, the Glens Falls POTW is not authorized to accept the waste. And because the Glens Falls POTW is not authorized to accept the wastewater, SBS cannot verify that a receiving entity will accept the wastewater from the proposed facility. Verification that a receiving entity is able and willing to receive wastewater from the proposed facility is a condition precedent for a complete Solid Waste Permit application, and the issuance of a Solid Waste Permit according to 6 NYCRR § 360.16(c)(4)(i)(c).

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[61] *See* DAC Map.
[62] *See* Draft Disadvantaged Communities Criteria and List Technical Documentation, *supra* at 28.
[63] *See id.* at 28.
[64] *See* 6 NYCRR § 701.8; 6 NYCRR § 941.6.

A. The Glens Falls City Code Prevents the POTW from Accepting Untreated PFAS-Laden Wastewater from the Proposed SBS Facility.

The Glens Falls City Code prohibits users of its POTW from contributing "directly or indirectly, any pollutant, wastewater or other material which will … pass through the POTW without adequate treatment indirectly in violation of any applicable federal, state or local environmental regulation into the receiving waters of the Hudson River or into the sludge by-product of the POTW."[65] The City Code includes a second requirement that states that "[a] user shall not contribute, directly or indirectly" to the POTW "[a]ny wastewater containing toxic pollutants in sufficient quantity, either singly or by interaction with other pollutants, so as to potentially … constitute a hazard to humans or animals, [or] create a toxic effect in the receiving waters of the POTW."[66]

As mentioned above, SBS has indicated that it does not intend to pretreat its wastewater for PFAS or any other pollutants.[67] Accordingly, SBS's application materials contain no plans to pretreat its wastewater for PFAS. SBS's application materials also contain no plan to measure the level of PFAS in wastewater discharged from the proposed facility. One must assume that at least some biosolids-derived PFAS will be present in water used to process biosolids arriving at the facility.

It is notable that SBS has not committed to pretreating PFAS in its wastewater even though pretreatment technology exists for this purpose.[68] PFAS can be removed from wastewater using technology such as reverse osmosis or granular activated carbon.[69] But the Glens Falls POTW cannot treat the incoming PFAS, and so it will "pass through" the treatment plant and into the Hudson River.[70]

The Glens Falls City Code prevents the Glens Falls POTW from accepting this PFAS-laden wastewater. Such a pass through would violate the Glens Falls City code because it would constitute a "hazard to humans or animals."[71] The pass through would violate Glens Falls' SPDES permit, as explained in section B. The pass through would also violate the rights of individuals who use and enjoy the receiving waters to "clean air and *water*, and a healthful environment."[72] Finally, as explained further in subsection C, the pass through would violate federal regulations applicable to users of POTW's, like SBS.

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65 Glens Falls City Code § 177-50(A).
66 *Id.* § 177-50(B)(4).
67 *See* SBS Response to DEC Comments at 3.
68 *See* DEC, Division of Water Technical and Operational Guidance Series 1.3.13 at 3, https://extapps.dec.ny.gov/docs/water_pdf/2923togs1313.pdf.
69 *See* EPA, *Technologies for Reducing PFAS in Drinking Water* at 2, https://www.epa.gov/sites/default/files/2019-10/documents/pfas_drinking_water_treatment_technology_options_fact_sheet_04182019.pdf.
70 *See* Timothy L. Coggan et al., *An Investigation into Per- and Polyfluoroalkl Substances (PFAS) in Nineteen Australian Wastewater Treatment Plants (WWTPs),* 5 Heliyon 1, 2 (2019) ("PFAS have been detected in WWTP influent, effluent and solids worldwide" because "[t]ypical wastewater treatment processes are unable to remove PFAS from the final effluent.").
71 *See* Glens Falls City Code § 177-50(B)(4).
72 N.Y. Const. art. I, § 19 (emphasis added).

B. The Glens Falls POTW Cannot Allow PFAS-Laden Wastewater from the Proposed SBS Facility to Pass Through Its System Without Violating the POTW's SPDES Permit.

Even if the Glens Falls City Code allowed the POTW to accept wastewater contaminated with PFAS, the SPDES Permit for the Glens Falls POTW does not. ECL § 17-0815(3) prohibits the Glens Falls POTW from discharging "any pollutant not identified and authorized" in its SPDES permit. The PFAS in SBS's wastewater is not identified and authorized by the SPDES Permit of the POTW. Importantly, the SPDES permit requires the Glens Falls POTW to notify DEC if a significant industrial user, like SBS, "may… discharge a substance not currently authorized in [the] permit."[73] The notification must include "the quality and quantity of effluent introduced into the POTW" and "any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW."[74] The discharge from SBS "is prohibited until the Department determines" based on this information "whether a permit modification is necessary" to guarantee compliance with "water quality standards and guidance values or compliance with other provisions of ECL article 17."[75]

Thus, in order to comply with this permit provision, the Glens Falls POTW will need to submit information on the PFAS expected to be present in the proposed facility's untreated wastewater discharge to DEC. It must refuse to accept discharges from SBS until it is able to collect this information from the company. This could be a long way off as SBS's application materials contain no information on the expected PFAS levels in their untreated wastewater and since SBS has no plans to test its wastewater for PFAS. Even once the Glens Falls POTW collects this information it still cannot accept the untreated wastewater from SBS. It must then wait for DEC's determination on the necessity of a SPDES permit modification. DEC, or EPA (which is the pretreatment authority in New York) should require SBS to pretreat its wastewater before it is sent to Glens Falls POTW and modify the SPDES permit before the Glens Falls POTW can accept the wastewater. This is because the existing permit does not incorporate recently promulgated guidance values for PFOS, which apply to Class C surface waters like the Hudson River.[76] There is a reasonable potential that the PFAS discharge will cause or contribute to a violation of the guidance values, which are a numeric interpretative of the narrative water quality standard prohibiting toxic chemicals in toxic amounts in our waterways.

To summarize, multiple steps are necessary before the Glens Falls POTW would be authorized under its SPDES permit to accept untreated wastewater from SBS.

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[73] *See* Appendix 2 at 21.
[74] *See id.* at 24; *see also* 6 NYCRR § 750-2.9(a)(1).
[75] *See* Appendix 2 at 21; *see also* 6 NYCRR § 750-2.9(a)(2).
[76] *See* DEC, 2023 Addendum to June 1998 Division of Water Technical and Operational Guidance Series (TOGS) No. 1.1.1. (2023), https://extapps.dec.ny.gov/docs/water_pdf/togs111addendum2023.pdf.

C. Federal Regulations Prevent the POTW from Accepting Untreated PFAS-Laden Wastewater from the Proposed SBS Facility.

Federal law also directly prohibits SBS from discharging into the Glens Falls POTW. New York is not a delegated state for the Clean Water Act's pretreatment program.[77] This means that for any permit for a POTW with a flow of 5 million gallons per day or greater, EPA is the permit-issuing authority. Because the Glens Falls POTW's permitted daily flow is 9.5 million gallons per day, EPA has oversight over the Glens Falls POTW pretreatment program.[78]

EPA regulations state that "[a] User may not introduce into a POTW any pollutant(s) which cause Pass Through."[79] If built, the proposed SBS facility will be a "User" subject to the EPA's Pass Through prohibition.[80] The EPA regulation defines "Pass Through" to mean "a Discharge which exits the POTW into waters of the United States in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any requirement of the POTW's [SPDES] permit."[81]

Allowing SBS to discharge untreated PFAS-laden wastewater into the POTW would violate these federal regulations because, as explained in subsection B, the PFAS discharge would violate the Glens Falls POTW's SPDES permit.

D. SBS Has Not Provided Evidence in Its Application that the Glens Falls POTW Is Willing to Accept Untreated Wastewater from the Facility.

The subsections above illustrate that SBS has failed to demonstrate that the Glens Falls POTW is legally able to accept untreated PFAS-contaminated wastewater from the pyrolysis facility. In addition, SBS has also failed to demonstrate that the Glens Falls POTW is *willing* to accept the proposed facility's untreated wastewater. Specifically, SBS states that "[b]y letter dated February 18, 2022, Glens Falls has indicated that the treatment plant has adequate capacity to receive the wastewater flow from the Facility and that pretreatment is not necessary."[82] However, the February 18 letter indicated that Glens Falls might reject the wastewater if not pretreated. Having reviewed the February 18 letter, the Supreme Court in *Clean Air Action Network of Glens Falls, Inc. v. Town of Moreau Planning Board*, stated in dicta that "[t]he Court… is troubled based on the undeveloped record before it, with the conclusions reached by SBS" that the letter confirmed that no pretreatment would be required.[83]

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[77] *See* EPA, *NPDES Pretreatment Program in Region 2,* https://www.epa.gov/npdes-permits/npdes-pretreatment-program-region-2#:~:text=New%20York%20State%20is%20not,NPDES%20permitting%20on%20Indian%20lands (last updated Nov. 15, 2023).
[78] *See* 40 CFR § 403.8.
[79] *See id.* § 403.5(a).
[80] *See id.* § 403.3(i)(j).
[81] *See id.* § 403.3(p).
[82] *See* SBS Response to DEC Comments at 3.
[83] *See Clean Air Action Network of Glens Falls, Inc. v. Town of Moreau Planning. Bd.*, 79 Misc. 3d 1219(A) (Sup. Ct. Saratoga Cnty. 2023).

IV. DEC Must Deny SBS's Request for a Solid Waste Permit Because the Facility Will Allow PFAS Laden Leachate to Enter Surface Waters Without the Authorization of a State Pollutant Discharge Elimination System Permit.

6 NYCRR § 360.19(b)(2) requires SBS to "operate the facility in a manner that… does not allow any leachate to enter surface waters … except under authority of a State Pollutant Discharge Elimination System permit." Under Part 360 "leachate" simply "means any solid waste in the form of a liquid, including any suspended components, that results from contact with waste."[84]

If the SBS facility's "[i]ndustrial wastewater is discharged directly to the City of Glens Falls publicly owned treatment works (POTW)," as Part 3.1.7 of the Facility Manual states,[85] then this discharge qualifies as "leachate" for the purposes of Part 360. As discussed at length above, the SPDES permit for the Glens Falls POTW does not provide authority to discharge PFAS. Thus, SBS's PFAS-laden leachate discharged into the POTW by SBS will "enter" the Hudson River, a "surface water," outside of the authority of a SPDES permit and in direct violation of Part 360. This potential violation provides DEC with a separate and distinct obligation to deny the Solid Waste Permit.

V. DEC Must Deny SBS's Solid Waste Permit Because It Lacks Legally Required Information on Incoming Biosolids.[86]

As acknowledged in DEC's Draft Solid Waste Permit, state regulations for composting and other organics recycling facilities are applicable to the proposed SBS facility.[87] These regulations, codified at 6 NYCRR Subpart 361-3, impose strict application requirements for permits for biosolids recycling facilities. An "application must include… [a] description of *each* proposed source of waste including the name of the generator, the annual quantity of waste produced, the amount of waste to be processed, and any seasonal variations in the quantity or quality during the year … [and a] description of the quality of the waste."[88]

SBS has identified Casella Organics as the entity that will supply the biosolids to the proposed facility. SBS has also identified the quantity of waste it expects the proposed facility to process. But other than that, the company has plainly failed to comply with the other requirements of this regulation.

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[84] *See* 6 NYCRR § 360.2(a)(157).
[85] *See* Facility Manual at 7.
[86] Points raised in this section are also grounds for denying the SBS's BUD Petition pursuant to 6 NYCRR § 360.12 (d)(2)(iv).
[87] *See* Draft Solid Waste Permit, condition 1 at 2.
[88] *See* 6 NYCRR § 361-3.6(d) (emphasis added).

A. SBS's Application Fails to Identify the Sources that Will Be Supplying Biosolids to the Proposed Facility.

Most obviously, the company has failed to identify "each" WWTP that will supply biosolids to the proposed facility. In fact, SBS has not even identified *one* specific WWTP from which it intends to recycle biosolids. Instead, it has made a non-specific commitment to process biosolids from Casella Organics' operating footprint. In its BUD Petition SBS simply states the Casella Organics "service area contemplated includes the Hudson Valley, western Massachusetts, western Connecticut, New York City, and Long Island."[89] Meanwhile, the Facility Manual states "[t]he primary service area for biosolids includes regional wastewater treatment plants within New York State and western New England west of the Connecticut River as sourced and contracted by the Facility's contracted waste hauler."[90] The Solid Waste Permit Application itself is silent on the specific source or sources of the biosolids for the proposed facility.[91]

B. SBS's Application Fails to Provide Required Information on the Quantity and Quality of Biosolids Produced by Sources Supplying the Proposed Pyrolysis Facility as Well as Seasonal Variations in the Waste.

Since SBS failed to name a single specific WWTP source of biosolids in its application materials, it also could not provide DEC or Commenters with any information on "the annual quantity of waste produced" by a single WWTP.[92] SBS also was unable to provide information in its application materials about "any seasonal variations" in biosolids quality from any specific WWTP that will supply the proposed facility.[93]

The absence of information about biosolids quality in SBS's permit materials is especially troubling to commenters. The Engineering Report claims to provide "[r]epresentative compositional data for biosolids feedstock" to be recycled at the facility.[94] But a look at Appendix E of the Engineering Report reveals an almost three-year-old Soil Control Lab composition bench test on biosolids that appear to be from Illinois—outside of Casella Organics' operating footprint.[95] The Air Permit Application provides some representative data on a handful pollutants, including PFAS, in biosolids collected from municipalities within Casella's operating footprint, but no specific data from a single source confirmed to supply biosolids to the facility.[96]

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[89] *See* BUD Petition at 4.
[90] *See* Facility Manual at 2.
[91] *See* Sterling Env't Eng'g, P.C., Application for a Solid Waste Management Facility Permit (Oct. 29, 2021) (hereinafter "Solid Waste Permit Application").
[92] *See* 6 NYCRR § 361-3.6(d)(6)(i).
[93] *See id.*
[94] *See* Sterling Env't Eng'g, P.C., Engineering Report at 13 (Mar. 31, 2022) (hereinafter "Engineering Report").
[95] *See id.*, app. E (stating "Sample Identification: Zion Dried Biosolids").
[96] *See* Air Permit Application at 21-24, 30.

C. <u>SBS's Failure to Provide the Required Information Is Especially Problematic Because It Violates the State's Policies to Control PFAS.</u>

The lack of specificity about biosolids sources is problematic in part because – as the PFAS table in the Air Permit Application shows – there is wide variation in the levels of PFAS present in the biosolids sampled from source to source and from year to year (and also presumably also from season to season).[97] It is crucial that DEC and Commenters have an opportunity to review analytical data on biosolids from *specific* WWTP's that *will* be supplying the proposed facility *before* any Solid Waste Permit is issued. In fact, this is precisely what DEC's own policies require with respect to PFAS in biosolids.

In Division of Materials Management Program Policy 7 ("DMM-7"), DEC outlines an Interim Strategy for the Control of PFAS Compounds entering NYCRR Subpart 361-3 biosolids recycling facilities, like SBS's proposed facility.[98] DMM-7 states that DEC "*will* reduce the risk associated with biosolids recycling by setting criteria that will identify biosolids that are impacted by industrial PFAS."[99] To reduce this risk DMM-7 requires facilities that accept biosolids to "sample *each* biosolids source (water resource recovery facility) and submit the results to DEC."[100] The facility accepting biosolids must provide DEC with "*the name* of the biosolids source(s)" and lab analyses of the levels PFOS and PFOA in the sampled biosolids sources.[101] "For proposed facilities that are not yet permitted on August 1, 2023," such as the proposed SBS facility, "analyses must be submitted *with the permit application*."[102]

In Conditions 5 and 7 of the Draft Solid Waste Permit DEC appears to acknowledge that DMM-7 applies to the proposed SBS facility. These Conditions require SBS to sample and analyze incoming biosolids for PFOA and PFOS prior to the facility's startup, as DMM-7 requires. However, providing this analytical data to DEC and the public *after* the close of the notice and comment period is unacceptable. DMM-7 is unambiguous: "analyses must be submitted *with the permit application*."[103] DEC should not have issued a Notice of Complete Application for SBS's permit prior to the receipt of this analytical data, and it must not grant a Solid Waste Permit before this data is provided to the public for Notice and Comment.

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[97] *See id.*at 30.
[98] *See* DEC, DMM-7/ Biosolids Recycling in New York State – Interim Strategy for the Control of PFAS Compounds at 3 (Sept. 7, 2023) (hereinafter "DMM-7") (emphasis added).
[99] *See id.*at 2 (emphasis added).
[100] *See id.*at 3 (emphasis added).
[101] *See id.* at 3 (emphasis added).
[102] *See id.* at 3 (emphasis added).
[103] *See id.*at 3 (emphasis added).

D. Granting the Solid Waste Permit in the Absence of the Required Information Would Be Arbitrary and Capricious as Well as Unconstitutional.

Commenters remind DEC that "[a]n agency's failure to follow its own procedures or rules in rendering a decision is arbitrary and capricious."[104] Moreover, the right to clean air, clean water and a healthful environment enshrined in the New York Constitution will be prejudiced if DEC fails to provide the public with the opportunity to closely review and comment upon this analytical data on biosolids. [105] Without an opportunity to review the data, the public has no ability to ensure that there are no flaws in SBS's analyses. The public also lacks the opportunity to fully evaluate risks to their health and the environment from PFAS contamination. DEC needs to provide these opportunities to the public in order to allow individuals living in communities around the facility to make informed decisions about whether and how to respond to risks to their air, water, and environment.

VI. DEC Must Deny a Case-Specific Beneficial Use Determination for SBS's Biochar Product Because Sewage Sludge-Derived Biochar Is Unsafe.

DEC must deny SBS's Petition for a BUD for the company's biochar. SBS's petition states "[t]he beneficial use is a marketable commodity that is an effective substitute for commercial chemical fertilizers that are routinely used in agriculture."[106] But SBS has failed to demonstrate that biochar "will not significantly adversely affect public health and the environment" when used as an agricultural amendment. SBS has also failed to demonstrate that "heavy metals or other pollutants present in the waste are present at acceptable concentrations for the proposed product or use."[107]

A. SBS Has Not and DEC Cannot Demonstrate that Biochar Derived from Biosolids Will Be Free From Contaminants in Quantities that Present Serious Risks to Human Health and the Environment.

As explained in Appendix 1 of these comments at greater length, biosolids-derived biochar is not safe, and the data provided by SBS to DEC does not address Commenters' scientifically-supported concerns about the product's safety.[108] Available data suggests that sewage-sludge derived biochar is likely to be contaminated with a number of dangerous pollutants, including: heavy metals; emerging contaminants, like PFAS; and organic contaminants, like polyaromatic hydrocarbons ("PAH").[109] This contamination is in part the result of the fact that "[b]iosolids contain a broader range of emerging contaminants than any other pyrolysis feedstock."[110]

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[104] *See Matter of Duverney v. City of New York*, 57 Misc. 3d 537, 542, (Sup. Ct. N.Y. Cnty. 2017) (citation omitted); *McCollum v. City of New York*, 61 Misc. 3d 378, 380-81 (Sup. Ct. Kings Cnty. 2018), *aff'd*, 184 A.D. 3d 838 (2d Dept. 2020); *see also Hoosier Env't Council v. Nat. Prairie Indiana Farmland Holdings*, *LLC*, 564 F. Supp. 3d 683, 714 (N.D. Ind. 2021).
[105] *See* N.Y. Const. art. I, § 19
[106] BUD Petition at 1.
[107] 6 NYCRR § 360.12(d)(3)(vi)-(vii).
[108] *See* Appendix 1 § A.
[109] *See id.*
[110] *See id.* § A.a.

SBS's own data demonstrates that biosolids-derived biochar subject to pyrolysis still contains PFAS.[111] SBS is likely to respond to this point by arguing that the finished biochar contains lower levels of PFAS and other contaminants than the raw biosolids feedstock. There are at least three problems with this argument. First, there remains a degree of scientific uncertainty regarding the ability of pyrolysis to remove a significant or sufficient amount of PFAS and other contaminants, like nonylphenol, chlorinated aromatic fractions and specific veterinary antibiotics, from finished biochar.[112] Second, research suggests that at least some toxic heavy metals become *more* concentrated in finished biochar than they were in feedstock.[113] Third, pyrolysis has the potential to create *new* contaminants in biochar, like carcinogenic PAH's.[114] SBS's BUD Petition either does not provide a sufficient response to the concerns above, or – as in the case of PAH contamination – fails to address them at all.[115]

The concern about PAH is worth underscoring once more as it has not been given its due by SBS. The concern also arose during email correspondence between Earthjustice and Dr. Andrea Beste, an agricultural scientist and member of the European Commission's Expert Group for Technical Advice on Organic Production. In the correspondence, attached for DEC's benefit as Appendix 5, Dr. Beste writes:

> There is a permanent potential for pollutants in pyrolyzed vegetable charcoal. In pyrolysis technology, organic material is carbonized at temperatures > 350°C and oxygen contents of< 2%. The higher the temperatures, the more stable the char. During this process of pyrolysis, a variety of aromatic organic substances are always formed, regardless of the starting materials. These include a number of pollutants that are difficult to break down, such as polycyclic aromatic hydrocarbons (PAHs) in particular, which are carcinogenic and mutagenic. These pollutants cannot be removed because they are too strongly bound to the material. For the same reason, measuring methods do not detect them or do not detect them sufficiently, which is why measured values and certificates have little informative value about the actual pollutant load.[116]

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[111] *See id.* § A.b.
[112] *See id*. § A.c.
[113] *See id.* § A.d. Even Myles Gray, Program Director at the United States Biochar Initiative, a group that promotes the biochar industry, conceded that "[i]t is true that some heavy metals… remain in the biochar" during a legislative hearing on the SBS facility. *See* February 7, 2024 Hearing Transcript.
[114] *See* Appendix 1 § A.e.
[115] Notably, SBS's had a duty to include "analytical data concerning the chemical and physical characteristics of the… proposed product." *See* 6 NYCRR § 360.12(d)(2)(iv), (vii).
[116] *See* E-mail chain between Michael Youhana, Sr. Assoc. Att'y, Earthjustice, to Andrea Beste, Agricultural Scientist, Inst. for Soil Conservation and Sustainable Agriculture (Appendix 5) (Correspondence has been partially redacted to protect the privacy of the individual who referred Earthjustice to Dr. Beste, as well as remove Dr. Beste's contact information); *see also* Jose M. De la Rosa et al., *Effect of Pyrolysis Conditions on the Total Contents of Polycyclic Aromatic Hydrocarbons in Biochars Produced From Organic Residues: Assessment of Their Hazard Potential*, 667 Science Total Env't 578 (2019).

B. DEC Must Look to the Judgment of the European Commission that Sewage-Sludge Derived Biochar Is Unsafe for Land Application.

The land application of biosolids-derived biochar has not yet been subject to any regulatory scrutiny in New York. A WestLaw search reveals that not a single statute or regulation in New York mentions "biochar." There also appear to be no regulations or statutes in New York that specifically govern the pyrolysis of biosolids or sewage sludge. Moreover, biochar and biosolids pyrolysis are never mentioned in the State's Solid Waste Management Plan.

The underdeveloped regulatory landscape for biochar in New York, and in particular for biochar produced from biosolids, does not leave DEC with much specific in-state guidance to look to ensure that SBS can safely produce biochar or that farmers can safely use it. Absent more tailored guidance, the regulatory framework DEC has in place to control the use and disposal of biosolids cannot simply be grafted onto biochar. To simply treat biochar like biosolids would ignore biochar's distinctive chemical characteristics and risks to human health and the environment.

DEC does not need to reinvent the wheel here. Rather than iteratively reviewing the risks and benefits of the land application of biosolids-derived biochar through a process of trial and error that endangers New Yorkers, Commenters recommend that DEC consider the judgments made by other regulatory bodies that have considered the environmental impacts of biochar. There is, thankfully, a credible regulatory model DEC can look to in the European Union. Scientists and regulators in that jurisdiction have scrupulously weighed the benefits and risks of using biochar as an agricultural supplement for many years and have promulgated biochar-specific regulations accordingly.

> In 2021, the European Commission, a legislative-regulatory body of the European Union, promulgated a regulation that prohibits the sale of sewage sludge-derived biochar as an "EU fertilising product." The relevant portion of the regulation states: "An EU fertilising product may contain pyrolysis… materials obtained through the thermochemical conversion under oxygen-limiting conditions of exclusively one or more of the following input materials… except… sewage sludge."[117]

[117] *See* Commission Delegated Regulation, 2021 O.J. (L 427), at Annex 1, CMC 14 § 1(a) (Appendix 4, Exhibit 1) (hereinafter "EU Rule").

Upon issuing this EU Rule, the European Commission released an explanatory statement responding to stakeholder comments on a draft version of the regulation.[118] The Commission noted a "recurrent concern" expressed by some commenters that with the exclusion of sewage sludge from the list of acceptable biochar feedstocks "the opportunity of recovering nutrients from this important waste stream is missed."[119] The Commission responded to this concern by stating:

> This list includes those waste streams for which sufficient information exists on the possible risks and the safety parameters to be checked. Sewage sludge is and should remain excluded from the list because it is, for the moment, unclear whether contaminants of emerging concern, such as pharmaceuticals, contained therein are completely eliminated following the processing methods for pyrolysis… The intention with this Regulation is to cover those materials… for which solid scientific data attests their safety and agronomic efficiency.[120]

The Commission's exercise of studied precaution is exemplary, and it would be arbitrary and capricious for the DEC to ignore this other agency's studied judgment.

C. <u>DEC is Constitutionally Obligated to Deny the Requested BUD.</u>

Commenters believe that New Yorkers should be entitled to at least the same level of environmental and public health protections as Europeans. Indeed, the New York State Constitution requires DEC to exercise an abundance of caution to avoid trampling New Yorkers' new right to a healthful environment.[121] DEC is bound to interpret 6 NYCRR § 360.12(d) stringently and in a manner that avoids infringing the constitutionally protected Environmental Rights of New Yorkers.[122]

It is worth recalling that New York's Environmental Rights Amendment was passed in the wake of failures to regulate emerging contaminants like PFAS in places throughout the state such as Hoosick Falls and Newburgh.[123] Granting SBS's BUD Petition has the potential to do precisely the opposite of what the drafters of this Constitutional amendment intended—to sow environmental contaminants across New York. Commenters, once again, underscore that SBS is not seeking to establish a small-scale pilot project. Commenters' concerns are heightened by the

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[118] *See* Explanatory Memorandum for Commission Delegated Regulation 2021/2088(Appendix 4, Exhibit 2).
[119] *See id*. at 2.
[120] *Id*.
[121] *See* N.Y. Const. art. I, § 19.
[122] *See Fresh Air for the Eastside, Inc. v. State*, WL 18141022 at *12 n.18 (Sup. Ct. 2022) (noting legal scholars' contention that with the passage of N.Y. Const. art. I, § 19, "[i]nterpretation of… regulations will now apply these environmental norms") (quoting The Impact of the Green Amendment - A New Era of Environmental Jurisprudence by Prof. Nicholas A. Robinson. Elisabeth Haub School of Law at Pace University).
[123] *See* Rebecca Bratspies & Katrina Fischer Kuh, *New Yorkers' Env't Rights are Under* Attack, Bloomberg Law (June 24, 2022), https://news.bloomberglaw.com/environment-and-energy/new-yorkers-environmental-rights-are-under-attack.

fact SBS intends to introduce an especially large amount of sewage sludge-derived biochar into the stream of commerce. SBS plans to produce up to 23,520 tons of sewage sludge-derived biochar per year.[124] Without full assurance that the company's biochar product does not contain PFAS or other contaminants, the prejudice to New Yorkers' constitutional rights would be widespread and significant.

VII. SBS's End Use Marketing Plan Fails to Demonstrate Sufficient Demand for its Biochar Produced and Raises Doubts that the Company Will Manage Biochar as a Commodity.

In order to grant the BUD Petition DEC must determine that the biosolids accepted at the proposed SBS facility "will be managed as a commodity and intended to function or serve as an effective substitute for an analogous commercial product or raw material."[125] DEC must also determine that "a market exists or is reasonably certain to be developed for the proposed quantity and use of the" biosolids received by the facility and the biochar produced.[126] In turn, SBS must demonstrate "that there is a known or reasonably probable market for the intended use of the quantity and type of waste and of all proposed products."[127]

A. <u>DEC Cannot Determine that a Market Exists for SBS's Biochar.</u>

SBS's End-Use Marketing Plan raises doubts that SBS has met these legal standards. The End Use Marketing Plan concedes that "[s]pecific end-users for the [biochar] itself are currently unknown and may never be known in its entirety."[128] SBS suggests that this lack of information about whether its product is actually likely to be used in large quantities is fine because "SBS is developing several relationships with distributors already" who will take charge of marketing to most end users.[129]

To substantiate this claim SBS attaches two Letters of Interest to distribute biochar from Agro-Shield and BioEnergy Innovations Global, Inc. Neither letter constitutes an "agreement to purchase the proposed product."[130] Each potential distributor stresses that their letter is "not a legally binding agreement."[131] Moreover, the letters do not establish that "a market exists… for the proposed *quantity*" of SBS's biochar.[132] The facility has been designed such that "[e]ach process line will produce up to approximately 7,840 dry tons of" biochar per year, and once the facility is fully built out "approximately 23,500 tons" of biochar per year.[133] The distributors' letters only express interest in a fraction of this output. AgroShield expressed interest in a

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[124] *See* BUD Petition at 4.
[125] *See* 6 NYCRR § 360.12 (d)(3)(iii).
[126] *See id*. § 360.12 (d)(3)(v).
[127] *See id*. § 360.12 (d)(2)(vi).
[128] *See* Saratoga Biochar Solutions, Carbon Fertilizer Marketing & Distribution Plan at 3 (May 15, 2023) (hereinafter "End-Use Marketing Plan").
[129] *See id.* id.at 3 – 4.
[130] *See* 6 NYCRR § 360.12 (d)(2)(vi)(a).
[131] *See* AgroShield, Letter of Intent at 2 (Mar. 15, 2022); BioEnergy Innovations Glob., Inc., Letter of Intent at 2 (Mar. 18, 2022).
[132] *See* 6 NYCRR § 360.12 (d)(3)(v) (emphasis added).
[133] *See* Air Permit Application at 6.

minimum of only 1000 tons of biochar in the first year.[134] Similarly, BioEnergy Innovations Global, Inc. of only 1000 tons a year.[135]

SBS claims that it will continue to develop relationships with distributors during the one year and six months over which the proposed facility is constructed and ramps up production.[136] But the fact that SBS has only been able to procure these two letters of interest in the two years and four months since the company submitted the Solid Waste Permit Application to DEC raises doubts that a market for 23,500 tons of biosolids-derived biochar exists. DEC's own Draft BUD appears to acknowledge that doubts remain. Condition 5 solicits information from SBS on the quantity of the product the company intends to produce for beneficial use. Of course, this condition is legally unacceptable as the applicable regulations plainly state that the quantity must be identified by DEC prior to approving the BUD Petition.[137]

B. The Application Raises Doubts that SBS's Biochar Will Be Managed as a Commodity Intended to Serve as a Substitute for an Analogous Commercial Product.

For its part, SBS seems somewhat untroubled by the lack of certainty that it will be able to sell the biochar as an agricultural substitute. The company states that "a beneficial use determination… is highly desired, but not required as SBS does not rely on profit from [biochar] sales for operating and financing the Facility."[138] SBS's nonchalance can be attributed in part to a scheme to sell carbon credits that is integral to the End-Use Marketing Plan.[139] Under the scheme, a waste management company by the name of Casella Organics accepts the unsold biochar for composting or beneficial use, while SBS sells carbon credits for any GHG emissions sequestered by the unsold biochar—possibly to out of state companies, like Microsoft.[140] Thanks to this carbon credit scheme SBS believes that it is "in an advantageous situation whereby we can attribute some profit to [biochar] even when the product is disposed of."[141] This carbon credit scheme naturally raises doubts that SBS intends to manage its biochar "as a commodity… intended to function or serve as an effective substitute for an analogous commercial product or raw material."[142]

Commenters also note that the carbon credit scheme itself is riddled with problems. First, it is unclear if Casella will be able to accept the unsold biosolids for beneficial use.[143] Second, as noted elsewhere in these Comments, sales of carbon credits undermine SBS's argument that the proposed project is consistent with CLCPA § 7(2).[144] Third, even if the plan to sell carbon

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[134] *See* AgroShield, *supra* at 2.
[135] *See* BioEnergy Innovations Glob., Inc., *supra* at 1.
[136] *See* End-Use Marketing Plan at 4.
[137] *See* 6 NYCRR § 360.12 (d)(2)(vi), (3)(v).
[138] *See* End-Use Marketing Plan at 1.
[139] *See id.* at 1-3.
[140] *See id.* at 1, 3.
[141] *See id.* at 3.
[142] *See* 6 NYCRR § 360.12 (d)(3)(iii).
[143] *See* Sterling Env't Eng'g, P.C., Response to Notice of Incomplete Application at 2 ¶¶ 2-3 (May 17, 2023) (acknowledging that the unsold biochar may need to be landfilled).
[144] *See* Expert Declaration of Emily Grubert § A (Appendix 3) (hereinafter "Appendix 3").

credits is permissible under the CLCPA, SBS may not qualify for out-of-state carbon credit sales in the first place.[145]

VIII. SBS's GHG Analysis Under CLCPA Section 7(2) Is Flawed and Cannot Reliably Demonstrate Net Negative Emissions.

SBS touts the proposed facility as a climate "solution" that will reduce GHG emissions in New York state, but its calculations are based on inaccurate assumptions that artificially inflate the project's purported GHG benefits. In addition, DEC must consider SBS's indication that it plans to sell carbon credits out of state, which would mean that they could not claim any emission reductions associated with those credits for the purpose of CLCPA consistency and could contribute to out of state emissions leakage that the CLCPA specifically seeks to avoid.

A. SBS Cannot Claim Emissions Reductions in New York if It Sells Carbon Credits.

SBS's marketing and distribution plan, submitted as part of its petition for a Beneficial Use Determination, states that the company is actively seeking to sell carbon credits associated with claimed emission reductions from its facility.[146] Indeed, sale of carbon credits on the voluntary offset market appears to be a key part of SBS's business strategy and projected revenue.[147] If SBS sells credits associated with its claimed GHG reductions to other parties, DEC cannot factor those claimed GHG reductions into its own CLCPA consistency analysis, because that would entail double-counting. In addition, if SBS sells those credits to entities out of state, as is likely, it would lead to out-of-state emissions leakage contrary to the CLCPA's directives.

First, despite its life cycle analysis and projections of carbon credit sales of up to $2 million per year, SBS's project may not qualify for carbon credits out of state due to New York's unique CO2 equivalency accounting. New York, pursuant to the CLCPA, uses of a 20-year global warming potential to calculate CO2e intensity for methane, unlike the 100-year timeline used more generally by other states and entities.[148] Using the 100-year global warming potential, estimated GHG emissions associated with landfilling biosolids (which emits methane) become *lower* than SBS's own estimated carbon intensity, eliminating the company's ability to claim emission reductions from its operation.[149] This may jeopardize the company's ability to operate profitably and stay in business.

Assuming SBS can sell carbon credits to out-of-state actors, DEC cannot then count the associated emission reductions as occurring in New York for the purpose of a CLCPA consistency analysis. Sale of carbon credits to another company allows that company to continue to emit the equivalent amount of GHGs. Because sale of credits allows an equivalent amount of GHG emissions to occur, DEC should not count any actual emission reductions in New York that are associated with credits sold to other parties. And in fact, sale of credits out of state is contrary to the intent of the CLCPA, which specifically seeks to avoid emissions leakage, defined as "a reduction in emissions of greenhouse gases within the state that is offset by an

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145 *See* Appendix 3 § B.
146 BUD Petition, app. D.
147 *Id*.
148 *See* ECL § 75-0101(2).
149 Appendix 3 at ¶ 11-12.

increase in emissions of greenhouse gases outside of the state."[150] By proposing to sell carbon credits to likely out-of-state actors, SBS would simply be transferring its avoided GHG emissions out of state.

B. The Life Cycle Analysis Contains Additional Flaws.

Under CLCPA Section 7(2), DEC must evaluate whether issuance of a permit to SBS would be "inconsistent with, or will interfere with, the attainment of the statewide GHG emission limits" set by the statute.[151] To make such an evaluation, applicants for air permits are required to submit full, detailed analyses of the project's projected potential and actual GHG emissions as set forth in DEC's internal program policy.[152] In its State Air Facility Permit Application, SBS attached as Attachment 7 its consultant's "Carbon Intensity Analysis," a life cycle analysis of GHG impacts of its proposed facility.[153] It also discusses that analysis, and its own determination that the project is consistent with the CLCPA, in Section 9 of the application.[154] In addition, SBS claims in its Solid Waste Management Facility Engineering Report that its facility process "potentially achieves a negative carbon footprint."[155] DEC should not rely on SBS's insufficiently detailed life cycle analysis for several reasons, discussed below.

As a preliminary matter, for the purpose of a CLCPA analysis, SBS should examine emissions related to New York state. Here, it claims to be reducing emissions that would otherwise result from management of biosolids. However, due to SBS's failure to identify the source of the biosolids it intends to process, and its vague description that it will source biosolids not only from New York wastewater treatment plants but also western Massachusetts and western Connecticut,[156] it is impossible to verify what portion of avoided emissions would even be from New York sources in the first place. DEC should factor this uncertainty into its evaluation of SBS's CLCPA analysis.

The analysis submitted by SBS is incomplete because it fails to account for a key segment of the life cycle of SBS's proposed product – the use of the biochar. The biochar is intended to be used in land application. However, as SBS's own analysts concede, the GHG implications of land application of biochar are highly uncertain.[157] Land application of biochar could actually increase GHG emissions associated with soils, depending on the feedstock of the biochar, characteristics of the soil, and other factors.[158] Without information on the impact from land application, it is impossible to have a full and accurate life cycle analysis for SBS's project.

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[150] ECL § 75-0101(12) (defining "leakage"); *see also id.* §§ 75-0103(13)(k) (directing the Climate Action Council to devise mechanisms to minimize leakage), 75-0109(3) (directing DEC to design regulations to minimize leakage).
[151] CLCPA § 7(2).
[152] *See* DEC, DAR-21 The Climate Leadership and Community Protection Act and Air Permit Applications (Dec. 14, 2022), https://extapps.dec.ny.gov/docs/air_pdf/dar21.pdf.
[153] *See* Air Permit Application, attach. 7.
[154] *See id.* § 9 at 33.
[155] Engineering Report ¶ 2.5 at 3.
[156] BUD Petition at 4.
[157] Air Permit Application, attach. 7, at 3.
[158] Appendix 3, ¶ 14.

SBS's analysis makes unjustified assumptions about the business-as-usual scenario for processing biosolids, inflating its estimate of GHG emissions from that scenario and therefore also inflating likely emission reductions associated with the SBS facility. SBS claims that biosolids in New York, in the absence of its facility, generate in-state emissions of 1.99 net MT of CO2e per dry ton from landfilling. However, this calculation fails to incorporate the fact 21% of New York's biosolids are subject to alternative management practices that have significantly fewer methane emissions, like composting and anaerobic digestion, rather than landfilling.[159] The likely GHG intensity of the business-as-usual scenario is therefore likely to be less than the 1.99 net MT of CO2e per dry ton that SBS uses as a comparison for its own projected GHG intensity.[160]

SBS's life cycle analysis also fails to account for the portion of its feedstock that is made up of wood waste, which it intends to mix with biosolids for pyrolysis, when calculating the alternative "business-as-usual" scenario. Wood waste alternative management emissions are much lower than emissions from landfilling biosolids, and factoring in that portion of the feedstock would likely bring the GHG intensity of the business-as-usual scenario *below* SBS's estimate of its own GHG intensity.[161]

Additionally, SBS plans to power its facility in part by combusting the gas generated during the pyrolysis process, which it calls "syngas." Combustion of the syngas will generate various air pollutants, as described in the State Air Facility Permit Application. SBS characterizes the syngas, a "low-methane gas produced by the pyrolysis reaction,"[162] as "renewable energy"[163] and does not appear to include any GHG emissions from use of syngas in its emissions calculations.[164] However, characterization of syngas combustion in pyrolysis as carbon neutral is not in line with the CLCPA, which excludes any waste-to-energy projects, including pyrolysis, from qualifying under its offset program.[165] In other words, the CLCPA does not consider energy created from the burning of waste products – such as the syngas generated from pyrolysis of biosolids here – to qualify as "avoided emissions" or as carbon neutral. This indicates a clear disfavor of waste-to-energy, including pyrolysis, in the state climate law.

IX. The Pyrolysis Facility Risks Polluting a Nearby Aquifer.

"The owner or operator of a facility must prevent waste from being deposited in or entering surface waters or groundwater."[166] Commenters note that the project site is also near an aquifer, and that they have concerns that said aquifer may be affected by leaks and other pollution from the facility thereby jeopardizing residents' constitutional rights to clean water.[167]

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[159] *Id.* ¶ 16.
[160] *Id.* ¶¶ 19–20.
[161] *See id.* ¶¶ 21–23.
[162] BUD Petition at 3.
[163] Air Permit Application at 5.
[164] *See* Air Permit Application, attach. 7, tbl.2 at 4 (breaking down various parameters for calculation of facility's carbon intensity including natural gas but not syngas).
[165] *See* ECL § 75-0109(4)(g)(i).
[166] *See* 6 NYCRR § 360.19; *see also* § 361-3.6(e).
[167] See Appendix 1 §§ A, C, G; *see also* N.Y. Const. art. I, § 19.

X. The Facility May Not Have Adequate Safeguards to Protect the Environmental Rights of Workers.

Commenters are also concerned that the application materials do not describe sufficient safeguards to ensure the protection of workers from environmental and other harm.[168] Workers at industrial facilities, like SBS, are a potentially exposed or susceptible subpopulation. As is such DEC should take extra care to ensure that their constitutional rights to clean air and water, and a healthful environment are not infringed upon.

XI. Odors and Emissions from the SBS Facility Would Unreasonably Interfere with the Comfortable Enjoyment of Life or Property of Individuals Closest to the Facility.

DEC may not grant an air permit to a facility that will "unreasonably interfere with the comfortable enjoyment of life or property."[169] Commenters note that odors from waste management facilities may also prejudice the constitutional Environmental Rights of persons in New York.[170] Notwithstanding SBS's arguments to the contrary, there is "a high likelihood" that odors from SBS's facility would unreasonably interfere with the comfort and enjoyment of life of the communities surrounding the proposed project given the low odor thresholds of the proposed facility's assessed emissions.[171] Similarly, there are residences in Moreau extraordinarily close to the facility – for example within a 1000 foot radius – that would face particularly severe emissions exposures.[172] Granting permits to this facility would violate the Environmental Rights of those residents because the emissions exposures for at least some of these very-close-by residents are too high to be safe.[173]

XII. SBS Has Failed to Demonstrate that the Facility's Potential to Emit Is Below Major Facility Thresholds.

SBS has applied for an Air State Facility permit. However, under DEC's air permitting program SBS must apply for a Title V permit if its facility is a "Major Facility."[174] A facility is a "Major Facility" if it has "the potential to emit, in the aggregate, 10 tpy or more of any hazardous air pollutant" or "25 tpy or more of any combination of such hazardous air pollutants (including any fugitive emissions of such pollutants)."[175] SBS has failed to demonstrate that the proposed facility is not a "Major Facility."

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[168] *See* Appendix 1 § F.
[169] *See* 6 NYCRR § 211.1.
[170] *See Fresh Air for the Eastside, Inc. v. State*, 2022 WL 18141022, *10 (Sup. Ct. Monroe Cnty. Dec. 20, 2022).
[171] *See* Appendix 1 § H.
[172] *See* DEC, Public Hearing Transcript February 7, 2024 (stating that one resident's home is "[n]ine hundred and sixty-five point three one feet to 24 be exact"). Perplexingly, these residences are not included in Air Permit Application Figure 3.
[173] *See* 6 NYCRR § 211.1; N.Y. Const. art. I, § 19.
[174] *See* 6 NYCRR § 201-6.1(a)(1).
[175] *See* 6 NYCRR § 201-2.1(b)(21)(ii).

SBS says that its proposed facility will not cross the aforementioned "Major Facility" emissions thresholds "[b]ased on the calculations provided in Attachment 4."[176] However, Attachment 4 does not demonstrate that the SBS facility is not a "Major Facility."

A. <u>The Calculated Potential to Emit Hazardous Air Pollutants Is Not Based on Biosolids Feedstock from a Specific WWTP that Will Supply the SBS Facility.</u>

The calculations in Attachment 4 are based on "bench scale testing with representative biosolids."[177] In other words, the calculations are not based on testing of biosolids from a single, identifiable WWTP that will supply the SBS facility with feedstock.[178] Because the levels and types of contaminants in biosolids can vary widely from WWTP to WWTP this lack of specificity calls into question the reliability of the calculated potential to emit in Table 4.

B. <u>The Calculated Potential to Emit Hazardous Air Pollutants May Underestimate the Amount of Hazardous Air Pollutants in Wood Waste.</u>

It is also unclear from Attachment 4 whether and to what extent SBS assumed wood waste feedstock would be laden with contaminants. If SBS assumes that incoming wood waste feedstock is free from contaminants, then its numbers cannot be relied upon because "contaminant and concentration levels vary significantly according to wood waste type and source." [179] SBS states that wood waste accepted at the facility could consist "of land clearing debris and/or unadulterated wood, wood chips, or bark from logging operations, pulp and paper production, and wood products manufacturing."[180] A thoroughgoing analysis would speciate estimated emissions based on the precise type of wood waste SBS accepts as "wood waste should not be viewed as a single material flow."[181]

C. <u>The Calculated Potential to Emit Hazardous Air Pollutants Does Not Provide Figures for the Exhaustive List of Hazardous Air Pollutants That May Be Emitted from the SBS Facility.</u>

Applicants for air permits are required to provide estimated emissions for all regulated air pollutants and contaminants that may be generated by their proposed facility in their permit applications.[182] Dozens of hazardous air pollutants and toxic compounds are listed in in DEC's air permitting regulations.[183] Yet, for unexplained reasons SBS only provides estimates of the proposed facility's potential to emit a small fraction of these hazardous air pollutants in Attachment 4.[184] Because one of the Major Facility emissions thresholds is "25 tpy or more of

[176] *See* Air Permit Application at 12.
[177] *See id*.
[178] *See supra* Comments § VI.
[179] *See* Giorgia Faraca et al., *Resource Quality of Wood Waste: The Importance of Physical and Chemical Impurities in Wood Waste for Recycling*, 87 Waste Mgmt. 135 (2019); *see also* Appendix 1 § H.
[180] *See* Air Permit Application at 3.
[181] *See* Faraca et al., *supra*.; *see also* Appendix 1 § H.
[182] *See* 6 NYCRR §§ 201-5.2(b)(8), 201-6.2(d)(3)(i).
[183] *See* 6 NYCRR §§ 200.1(ag), 201-9.1.
[184] *See* Air Permit Application, attach. 4.

any combination of such hazardous air pollutants" a comprehensive account of all hazardous air pollutants likely to be emitted from the proposed SBS facility is required under the law.[185]

It is apparent from the face of Attachment 4 that no such comprehensive estimate of the proposed facility's potential to emit hazardous air pollutant emissions has been provided to DEC. For example, SBS did not model expected "cyanide compounds" emissions from the facility even though at least one study found that a significant amount of hydrogen cyanide is emitted when oil and gas produced as a byproduct of pyrolyzed sewage sludge is combusted.[186] In addition to failing to model some pollutants altogether, SBS failed to produce speciated modeling for volatile organic compounds emitted from the proposed facility. Thus, it is unclear to Commenters whether SBS considered the facility's potential to emit specific hazardous pollutants, like benzene.[187]

Absent an explanation for why SBS only modeled emissions for a limited number of hazardous air pollutants Commenters cannot be sure that that SBS's emissions fall below the 25 tpy threshold.

D. DEC Must Closely Scrutinize SBS's Estimated Potential to Emit Naphthalene from the Proposed Facility.

Commenters note that the expected potential to emit naphthalene from the facility borders the 10 tpy threshold. Therefore, even marginal tweaks to the SBS's modeling could make the difference between a requirement to obtain a Title V permit or not. Commenters therefore urge DEC to take an especially close look at the assumptions underlying SBS's estimated potential to emit naphthalene from the facility.

XIII. Commenters Request DEC's Response to Concerns Regarding the Suitability of the Applicant.

DEC may deny a Solid Waste Permit "based upon the unsuitability of the… applicant."[188] In making such a determination DEC may consider whether the owner or operator has been determined to have violated provisions of another state's environmental laws or "the owner or operator provides materially false or inaccurate information or statements in the permit application."[189] Before reaching a determination on the suitability of the applicant, DEC must fully evaluate the role of SBS president, Bryce Meeker, in AltEn LLC, a company that operated another facility found to be in violation of environmental rules in Nebraska.

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[185] *See* 6 NYCRR § 201-2.1(b)(21)(ii).

[186] *See* Hui Chen et al., *Emissions From Sewage Sludge Pyrolysis Oil and Gas Combustion and Influence of ZnCl2/KOH*, 66 Energy Procedia 49, 51 (2015).

[187] Hung-Lung Chiang et al., *Pyrolysis Kinetics and Residue Characteristics of Petrochemical Industrial Sludge*, 50 J. Air & Waste Mgmt. Ass'n 272 (200). (study of pyrolysis of petrochemical industry WWTP sludge finding that "[a]s the sludge pyrolysis temperature was raised from 673 to 873K, benzene, toluene, ethylbenzene, meta- and para-xylene, styrene, and ortho-xylene concentration of the exhaust gas were detected").

[188] 6 NYCRR § 360.16(e).

[189] *Id*.

A WestLaw search confirms that AltEn was "determined" to be "in violation of the Nebraska Environmental Protection Act" by the Nebraska Department of Environmental Quality.[190] According to one enforcement document, AltEn was the "operator of the biochar unit at 1344 County Road 10, Mead, Nebraska 68041." The enforcement document states that "opacity of emissions from [the facility owner's] biochar emission stack, which is operated by AltEn, were determined to have an average opacity of 30.4%" even though the applicable requirement set the percentage at 20% or less. The enforcement document also states that regulators "documented smoldering of biochar product during a facility tour" leading the regulator to issue a Notice of Violation to the facility owner for "[c]ausing or allowing an open fire without" without permission. The enforcement document includes a Compliance Order, which required AltEn to "[c]onduct emission testing on the biochar unit for PM10, CO, mass of VOC, and speciated HAPs while operating under worst-case conditions."

Commenters have questions regarding the nature and duration of Mr. Meeker's ties to this facility. Attachment 2 of SBS's Solid Waste Permit Application includes a "Record of Compliance" dated November 1, 2021.[191] The Record of Compliance includes a questionnaire.[192] Item 8 asks whether any officers of SBS had served as directors of a corporation during a time when the corporation violated another state's laws. SBS responded to Item 8 in the negative.

8. Has the applicant, and if the applicant is a corporation, has any officer, director, or large stockholder (owner of 25 percent or more of not publicly-traded stock) of the corporation, within the last ten (10) years, been:

a. found in an administrative, civil or criminal proceeding to have violated any provision of the Environmental Conservation Law (ECL), any related order or determination of the Commissioner, any regulation promulgated pursuant to the ECL, the condition of any permit issued thereunder, or any similar statute, regulation, order or permit condition of any other state or federal government agency?

☐ Yes ☑ No

b. an officer, director or large stockholder (owner of 25% or more of not publicly-traded stock) of a corporation which-during the time such person was an officer, director or large stockholder-was determined in an administrative, civil or criminal proceeding to have violated any provision of the Environmental Conservation Law (ECL), any related order or determination of the Commissioner, any regulation promulgated pursuant to the ECL, the condition of any permit issued thereunder, or any similar statute, regulation, order or permit condition of any other state or federal government agency?

☐ Yes ☑ No

On December 14, 2022 the *Post Star*, a Glens Falls daily newspaper, stated Mr. Meeker "was affiliated" with a Nebraska ethanol plant run by a company called AltEn LLC. [193] More specifically, the article indicates that Mr. Meeker "spent 2013 to 2019 as director of corporate development for E3 LLC… a company affiliated with" the AltEn LLC ethanol plant.[194] The article also states that the plant was "shut down… in 2021 for pollution, groundwater contamination and failure to comply with operation and maintenance requirements."[195] According to the article, the closure of the ethanol plant followed "years of environmental complaints and violations."[196]

Two weeks after the publication of this investigative article, DEC sent Saratoga Biochar a Notice of Incomplete Application asking SBS to complete the aforementioned "Record of

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[190] Appendix 6, Exhibit 1.
[191] *See* Solid Waste Permit Application, attach. 2.
[192] *See id*.
[193] *See* Colombo, *The Clean-up Crew, supra* note 9.
[194] *See id.*
[195] *See id.*
[196] *See id*.

Compliance" a second time.[197] On March 8, 2023, during a meeting with an attorney for SBS, DEC requested "a statement from Bryce Meeker with a summary of his activity for AltEn."[198]

On March 21, 2023, an attorney for SBS transmitted the requested statement to DEC.[199] In the March 21 statement, Mr. Meeker wrote that "Earth, Energy, and Environment, LLC" (Commenters assume that this company is E3 LLC) was "the parent company of AltEn, LLC."[200] Mr. Meeker acknowledged that he was "paid by both entities" between 2013 and 2019.[201]

However, Mr. Meeker states that he worked for the two companies only "as an independent contractor third-party consultant."[202] Mr. Meeker further states "[a]t no point in time did I receive or hold any ownership, stock, or decision-making authority in either company."[203] Mr. Meeker also provides a terse description of his work on behalf of Earth, Energy, and Environment, LLC, stating only that he "consulted… on financial modeling for prospective business opportunities."[204]

The March 21 letter is not entirely consistent with the *Post Star* report and other publicly available information and therefore raises several specific questions:

- No mention is made of Mr. Meeker's reported "director" title at E3 LLC in the March 21 letter to DEC. Was Mr. Meeker a director of E3 LLC?
- Mr. Meeker's LinkedIn states that he served as a director at an "Alter Energy Group" from 2011 to 2013.[205] Are "Alter Energy Group" and AltEn LLC the same company?
    - If the answer is "no" what is the nature of the relationship, if any, between Alter Energy Group and AltEn LLC?
- Did Mr. Meeker have a "director" title at AltEn LLC?
- Why did SBS respond to Item 8 of the November 1, 2021 "Record of Compliance" with a "no" rather than with an explanation of the nature of Mr. Meeker's relationship with E3 LLC and/or AltEn LLC?
- In the March 21 letter Mr. Meeker states that he "consulted… on financial modeling for prospective business opportunities" for E3 LLC.[206] However, the December 14, 2022

[197] DEC, Notice of Incomplete Application (Dec. 28, 2022) (Appendix 6, Exhibit 7).
[198] E-mail from Charles Dumas, Lemery Greisler LLC, to Aaron Love, DEC (Mar. 21, 2023, 4:01:22 PM)(Appendix 6, Exhibit 9).
[199] Letter from Bryce Meeker, SBS LLC, to DEC (Mar. 21, 2023) (Appendix 6, Exhibit 8).
[200] *See* Appendix 6, Exhibit 8; *see also E3 Biofuels, LLC v. Biothane, LLC*, 2013 WL 1148445, *3 (D. Neb. Mar. 19, 2013) (stating that a company with a similar name, E3 Biofuels LLC, "own[ed] 30% of the stock of AltEn, LLC.").
[201] Appendix 6, Exhibit 8.
[202] *Id.*
[203] *Id.*
[204] *Id.*
[205] *See* Appendix 6, Exhibit 6 (This exhibit is a screenshot of a portion of Mr. Meeker's LinkedIn page).
[206] Appendix 6, Exhibit 8.

Post Star article describes a wider scope of work on behalf of E3 LLC. Specifically, the article states that Mr. Meeker was charged with "expanding bio-refining capacity," "business development," "business strategy," and "deal origination."[207]

- Is this *Post Star* reporting accurate?

- If the answer is "yes" what was the full scope of Mr. Meeker's work and role at E3 LLC?

- The March 21 letter provides no description of the services Mr. Meeker rendered to AltEn LLC for payment. Commenters note that Mr. Meeker is listed as a "point of contact" for AltEn LLC in two United States Department of Agriculture documents.[208]

  - What services Mr. Meeker render to AltEn LLC?

- The December 14, 2022, *Post Star* article quotes Mr. Meeker as stating that he "built a plant up in Nebraska for a refinery… to process waste."[209] The article suggests that the plant referenced by Mr. Meeker was the same AltEn LLC facility found to be in violation of Nebraska environmental rules.[210]

  - Did Mr. Meeker have any role in building up the AltEn LLC facility in Mead, Nebraska? What was the nature of that role?

- Did Mr. Meeker have any role in overseeing, participating in, or otherwise facilitating the operation of the AltEn LLC facility in Mead, Nebraska? What was the nature and duration of those roles?

- Did Mr. Meeker provide any strategic business advice to the owners or operators of the AltEn LLC regarding how to respond to environmental complaints and violations?

[207] *See* Colombo, *The Clean-up Crew, supra* note 9.
[208] *See* Appendix 6, Exhibit 5.
[209] *See* Colombo, *The Clean-up Crew, supra* note 9.
[210] *See id*.

- A 2022 report states that tests by the Nebraska Department of Environment and Energy revealed that biochar made at the AltEn LLC facility from "neonicotinoid-contaminated distillers grain" had elevated levels of pesticides.[211] The report also stated that AltEn LLC "had accepted pesticide-treated corn seed for multiple years to process into ethanol."[212] US Department of Agriculture documents dated July 16, 2015 and April 5, 2019 list AltEn LLC as a buyer of damaged or salvage grain and also list Mr. Meeker as a point of contact.[213]
    - Did Mr. Meeker play any role in AltEn LLC's purchase of contaminated distillers grain?

Commenters have also attached a collection of enforcement documents dating back to 2016 filed against AltEn in Appendix 6. Commenters respectfully request that DEC carefully review the enforcement documentation provided in Appendix 6 and provide a response to Commenters' questions and concerns related to the suitability of the applicant.

Respectfully submitted,

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Clean Air Action Network of Glens Falls
Natural Resources Defense Council
Grassroots Environmental Education

[211] Chris Clayton, *AltEn Owner Tries to Sell Toxic Biochar*, DTN Progressive Farmer (Jan. 19, 2022), https://www.dtnpf.com/agriculture/web/ag/news/business-inputs/article/2022/01/19/biochar-sale-halted-state-regulators; *see also* Carey Gillam, *'There's a red flag here': how an ethanol plant is dangerously polluting a US village*, The Guardian (Jan 10, 2021), https://www.theguardian.com/us-news/2021/jan/10/mead-nebraska-ethanol-plant-pollution-danger ("The company, called AltEn, is supposed to be helpful to the environment, using high-starch grains such as corn to annually churn out about 25m gallons of ethanol, a practice regulators generally hail as an environmentally friendly source for auto fuel... But unlike most of the other 203 US ethanol plants, AltEn has been using seed coated with fungicides and insecticides, including those known as neonicotinoids, or "neonics", in its production process"); Diana Kruzman, *How a Nebraska ethanol plant turned seeds into toxic waste*, Grist (Apr. 21, 2022), https://grist.org/health/how-a-nebraska-ethanol-plant-turned-seeds-into-toxic-waste/.
[212] *Id*.
[213] *See* Appendix 6, Exhibit 5.

Energy Justice Network
Just Zero
NY Renews Coalition (370+ organizational members)
Sierra Club, Atlantic Chapter
Alliance for a Green Economy (AGREE)
New York Civil Liberties Union (NYCLU)
New York Public Interest Research Group (NYPIRG)
Citizen Action of New York
Northeast Organic Farming Association of New York (NOFA-NY)
Clean+Healthy
People for a Healthy Environment
Mothers Out Front New York
New York Clinicians for Climate Action
No Safe Level: The NYS Coalition to End Sewage Sludge Spreading
FrackBustersNY
Church Women United in New York State
PFOA Project NY
Campaign for Renewable Energy
Zero Waste New York
Seneca Lake Guardian
Riverkeeper, Inc.
WE ACT for Environmental Justice
Catskill Mountainkeeper
Clean Air Coalition of Western New York
Long Island Progressive Coalition
WESPAC Foundation, Inc.
All Our Energy
Capital Region Interfaith Creation Care Coalition
Don't Trash the Catskills
Solidarity Committee, Capital District
Westchester Alliance for Sustainable Solutions (WASS)
Third Act Upstate New York
Rivers & Mountains GreenFaith
Sustainable Finger Lakes NY
The Climate Reality Project, Finger Lakes Greater Region NY Chapter
Network for a Sustainable Tomorrow
Committee to Preserve the Finger Lakes
Concerned Citizens of Allegany County
The Climate Reality Project, Capital Region Chapter
Zero Waste Capital District
Move Past Plastic
Bring Your Own U.S. Reduces
Saratoga County Democratic Committee
Sustainable Saratoga
Hands Off the Hudson
Not Moreau
Promote Fort Edward
Newburgh Clean Water Project
Clean Air Coalition of Greater Ravena-Coeymans
Washington County Democratic Committee
Warren County Democratic Committee
People of Albany United for Safe Energy (PAUSE)
Lights Out Norlite
NYC Friends of Clearwater
Brookhaven Landfill Action and Remediation Group
Cornell on Fire
Zero Waste Dutchess
North Bronx Racial Justice
United for Action, NYC
Bronx Climate Justice North
South Asian Fund for Education Scholarship and Training, Inc.
Rensselaer Environmental Coalition
Zero Waste Ithaca
Mothers Out Front Tompkins
It’s Easy Being Green
Citizen's Climate Lobby, Brooklyn
Cameron Committee for a Safe Environment (CCSE)

Fridays for Future, Capital District
KingstonCitizens.org
North County Earth Action
Peckham Action Group
Uptown Progressive Action
Columbia County Reduces Waste – Bring Your Own Initiative
Fossil Free Tompkins
Campaign for Renewable Energy
HabitatMap

Appendix 1

DECLARATION OF DENISE TRABBIC-POINTER

Qualifications

1. My name is Denise Trabbic-Pointer. I am a Chemical Engineer with a BS and MS in Hazardous Materials Management, a career EHS professional and a Certified Hazardous Material Manager Emeritus. I retired in January 2019 after 42 years with DuPont. The last 7 years of my career were with a spin-off company, Axalta Coating Systems, as their Global Environmental Competency Leader.

2. Since May 2019, I have been the Sierra Club – Michigan Chapter, Toxics & Remediation Specialist, and volunteer nationally as a technical resource for communities impacted by releases of toxics to air, water and/or soil. My Curriculum Vitae is available upon request.

3. This declaration contains my expert opinions, which I hold to a reasonable degree of scientific certainty. In preparing this declaration, I have reviewed materials made public by the New York State Department of Environmental Conservation ("DEC") regarding the proposed Saratoga Biochar Solutions ("SBS") Pyrolysis Facility, to be located in Moreau, NY. Specifically, I have reviewed the SBS September 6, 2023, permit application and the New York State Department of Environmental Conservation (NYSDEC); Division of Air Resources, January 2024 Draft Permit, ID: 5-4144-00187/00002; also the March 31, 2022 SBS Facility Manual; the SBS May 15, 2023 Beneficial Use Determination Petition for Reuse of Biosolids; the SBS Engineering Report dated March 31, 2022; SBS April 4, 2022 response to the NYSDEC's Request for Additional Information regarding their Petition for Case-Specific Beneficial Use Determination, the SBS June 13, 2022, revised Air State Facility Permit Application Narrative in response to NYSDEC comments received by email dated April 14, 2022; the SBS February 27, 2023 (revised April 13, 2023) addendum to the permit application, including AERMOD emissions model results; and, the SBS April 11, 2023 Public Participation Plan Report.

4. My review included documents related to the application submittal such as technical reports, various studies related to the effectiveness of pyrolysis as it relates to biosolids as the feedstock, maps, figures, data, process diagrams, and other related information. I also reviewed various studies and technical papers referenced throughout this report, which were not included in SBS's application package.

5. Based on this review and my education, training, and experience, I have developed the opinions presented in this declaration. My opinions are based on my application of professional judgment and expertise.

Summary of Opinions

6. In my expert opinion, DEC's issuance of the draft permits for the SBS's facility or its issuance of a beneficial use determination for SBS's biochar product would present unreasonable risks to human health and the environment.

A. Sewage Sludge-Derived Biochar is Not Safe.

a. Biosolids contain a broader range of emerging contaminants than any other pyrolysis feedstock.

7. To understand why SBS's product presents risks to human health and the environment it is important to understand the nature of the feedstocks the company is proposing to use to produce biochar. Specifically, SBS proposes to use biosolids, sometimes referred to as sewage sludge, composited by Casella from various New York ("NY") wastewater treatment plants ("WWTPs") as feedstock. The received biosolids will be blended with wood products prior to processing. Wood waste will be obtained from many local sources, including pulp and paper productions.

8. Using these feedstocks is problematic as they are highly likely to be laden with a wide variety of harmful pollutants and emerging contaminants, such as PFAS. SBS itself has already acknowledged that WWTP biosolids will likely contain per- and polyfluoroalkyl substances ("PFAS") compounds.[1] According to the EPA, pulp and paper mills and their WWTP residuals are also known as significant sources of PFAS.[2]

9. Biosolids carry with them additional potentially harmful pollutants in addition to PFAS. This fact is widely acknowledged by reputable governmental agencies and scientific institutions. For example, in the document *EPA Unable to Assess the Impact of Hundreds of Unregulated Pollutants in Land-Applied Biosolids on Human Health and the Environment*, the US Environmental Protection Agency (EPA) Office of Inspector General states that "potentially harmful and unregulated pollutants are present in biosolids such as pharmaceuticals, steroids and flame retardants."[3] The Office of Inspector General also notes that EPA identified 352 pollutants in biosolids "include[ing] 61 designated as acutely hazardous, hazardous or priority pollutants in other programs."[4]

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[1] PFAS are linked to a variety of adverse health effects, including cancer, elevated cholesterol, obesity, immune Suppression, pre-eclampsia, impaired liver and kidney function, and endocrine disruption. See U.S. Dep't Health & Hum. Servs., *Toxicological Profile for Perfluoroalkyls* (May 2021), https://www.atsdr.cdc.gov/toxprofiles/tp200.pdf.

[2] PFAS have been used by pulp, paper, and paperboard facilities as an additive or coating to impart certain surfactant qualities to finished paper products. PFAS are primarily used by facilities that manufacture food contact papers and packaging (e.g., fast food wrappers, take-out containers, bakery bags, popcorn bags, pizza boxes), but also have limited applications for specialty paper products (e.g., carbonless forms, masking paper). *See* U.S. Env't Prot. Agency, *Multi-Industry Per- and Polyfluoroalkyl Substances (PFAS) Study – 2021 Preliminary Report* at 7-1 (Sept. 2021), https://www.epa.gov/system/files/documents/2021-09/multi-industry-pfas-study_preliminary-2021-report_508_2021.09.08.pdf (citation omitted).

[3] U.S. Env't Prot. Agency, *EPA Unable to Assess the Impact of Hundreds of Unregulated Pollutants in Land-Applied Biosolids on Human Health and the Environment* at 25 (Nov. 15, 2018), https://www.epaoig.gov/sites/default/files/2018-11/documents/_epaoig_20181115-19-p-0002.pdf.

[4] *Id*. at 12.

The Office of Inspector General observes that "EPA scientists working on biosolids told us that without completing risk assessments on all of the pollutants found in biosolids they cannot say whether biosolids are safe" to spread on land.[5]

10. The European Commission's Joint Research Centre, a research body of the European Union, has produced its own stark warning about this pyrolysis feedstock:

> Sewage sludge may contain a set of organic pollutants, including not only persistent organic pollutants (PAHs, dl-PCB, PCDD/F), but also a broad set of organic emergent pollutants such as phthalates (e.g. di (2-ethylhexyl) phthalate (DEHP)), surfactants present in cleaners and detergents (e.g. linear alkylbenzene sulphonates (LAS) and nonylphenols (NPE)), personal care products, pharmaceuticals and endocrine-disrupting compounds (sulphonamides, galaxolide, etc.) and polymers used to bind solid particles in solid-liquid separation processes… The spectrum of emerging contaminants in sewage sludge is extensive (Petrie et al., 2015), and much broader than for any of the eligible input materials for pyrolysis & gasification materials.[6]

b. SBS's pilot study failed to remove all PFAS from biosolids even under favorable conditions.

11. SBS contends that the pyrolysis process at its facility will remove pollutants from these feedstocks such that the finished biochar is safe to apply to agricultural land, but its evidence in support of this claim is wanting. In particular, the application does not demonstrate that pyrolysis at the proposed SBS facility will entirely remove PFAS, a family of thousands of heat-resistant, highly toxic emerging contaminants from the finished biochar product. SBS's own pilot test demonstrates the opposite: biochar subject to pyrolysis still contains PFAS.

12. SBS conducted a small-scale pyrolysis pilot test on biosolids from the North Shore Water Reclamation District's Zion Wastewater Treatment Plant located on the north shore of Chicago.[7] It is notable that this pilot test was run on out-of-state biosolids, which can hardly be said to be representative of the biosolids supplied to SBS by Casella from WWTP's in New York and Western New England.[8] The application materials SBS has made available for public review do not provide a description of the pilot equipment that was used. What little data SBS does provide on the pilot test is very worrying. Specifically, by SBS's own admission the pyrolysis pilot test was unable to destroy 28%

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[5] *Id*. at 25.
[6] Dries Huygens et al., Joint Research Centre, *Technical Proposals for Selected New Fertilising Materials Under the Fertilising Products Regulation* at 58 (2019), https://publications.jrc.ec.europa.eu/repository/handle/JRC117856 (hereinafter "Join Research Centre Paper").
[7] Sterling Env't Eng'g, P.C., Application for Air Facility Permit at 29 (Sept. 6, 2023) (hereinafter "Air Permit Application").
[8] Sterling Env't Eng'g P.C., Facility Manual at 2 (Mar. 31, 2022) (hereinafter "Facility Manual").

of the PFOS present in the biosolids.[9]

13. Data presented in Table X of SBS's air permit application indicates that, while biosolids collected from municipalities within Casella's operating contain footprint variable levels of PFOS, they sometimes contain very large concentrations. For example, data provided by Casella on biosolids sampled in 2019 demonstrates that these biosolids contained maximum concentrations of 77 ppb of PFOS.[10] If SBS successfully replicated the conditions of its pilot test at scale, biochar containing 28% of the total PFOS present in these sampled biosolids would still contain 21.5 ppb of PFOS. Here, it should be stressed that because PFOS bioaccumulates even exposure to a very small amount of PFOS can be harmful to public health.

14. Alarming, as the Casella-provided data in Table X of the air permit application is, it may downplay the amount of PFAS likely to be present in biosolids processed at the facility. A 2017 DEC sampling and analysis of biosolids from eight (8) wastewater treatment plants (WWTPs) in New York. The geometric mean and maximum levels of each PFAS compound found in the 8 WWTP's biosolids are shown below in Trabbic-Pointer Declaration Table I.[11]

Trabbic-Pointer Declaration Table I - Biosolids Results from 8 New York WWTPs			
PFAS Name	**Abbr.**	**Geometric Mean of Biosolids (ppb)**	**Max of Biosolids (ppb)**
Perfluorobutanoic acid (PFBA)	PFBA	8.68	48.1
Perfluoropentanoic acid (PFPeA)	PFPeA	2.11	4.41
Perfluorohexanoic acid (PFHxA)	PFHxA	5.51	14.5
Perfluoroheptanoic acid (PFHpA)	PFHpA	0.84	1.35
Perfluorooctanoic acid (PFOA)	PFOA	4.62	13.3
Perfluorononanoic acid (PFNA)	PFNA	4.75	26.6
Perfluorodecanoic acid (PFDA)	PFDA	10.71	39.3
Perfluoroundecanoic acid (PFUnA)	PFUnA	5.53	13.9
Perfluorododecanoic acid (PFDoA)	PFDoA	6.26	30.3
Perfluorotridecanoic Acid (PFTriA)	PFTriA	2.09	3.49
Perfluorotetradecanoic acid (PFTeA)	PFTeA	2.34	6.89
Perfluorobutanesulfonic acid (PFBS)	PFBS	3.34	5.66
Perfluorohexanesulfonic acid (PFHxS)	PFHxS	3.54	10.5
Perfluoroheptanesulfonic Acid (PFHpS)	PFHpS	1.31	1.69
Perfluorooctanesulfonic acid (PFOS)	PFOS	23.06	94.7
Perfluorodecanesulfonic acid (PFDS)	PFDS	3.16	6.7
	Total PFAS	**96.61**	**232.45**

[9] Air Permit Application at 29.
[10] *Id*. at 30.
[11] Data supporting Trabbic-Pointer Table I is from Excel spreadsheet "NYWEAedits_Biosolids_Lab_Results.2017-10-19.Data.xlsx" secured from May 5, 2022 Freedom of Information Law request; *see also* Tracy Frisch et al., Sierra Club Atlantic Chapter, *Sewage Sludge "Fertilizer" Contaminates Farms With Toxic* PFAS (June 2023), https://www.sierraclub.org/atlantic/report-sewage-sludge-fertilizer-contaminates-farms-toxic-pfas.

15. The data in Trabbic-Pointer Declaration Table I indicates that levels of PFAS in New York biosolids are similar to those in other states like Michigan and Maine where there is an abundance of data available. The data paints a more comprehensive picture of the wide range of PFAS likely to be present in New York biosolids processed in the SBS facility. It also suggests that average and maximum levels of PFAS from facilities throughout New York can be even higher than those reported by Casella.

16. It is also important to note that scalability is a critical issue. SBS's pilot test was run on a small amount of biosolids. It is technically far easier to remove PFAS from such a small batch than from a large one because in order for pyrolysis to effectively break down PFAS and other contaminants in biosolids or sewage sludge, heat has to be applied evenly throughout the batch of biosolids.

17. No one has been able to solve this problem on a large scale to date. The proposed SBS facility would handle over 700 tons per day, processing large batches of sewage sludge at a time. To my knowledge, no other pyrolysis facility in the country has attempted to manage this much sewage sludge. I am not aware of a biochemist and environmental engineer who believes that PFAS removal via pyrolysis at this massive scale is feasible.

c. Studies also indicate that pyrolysis cannot remove all PFAS from biosolids-derived biochar.

18. The scientific literature also raises doubts about the ability of pyrolysis to remove PFAS from biosolids to the degree claimed by SBS. For example, one 2015 study found that "total residual concentrations of PFOA and PFOS" in sewage sludge derived biochar "did not decrease significantly after pyrolysis" at 700°C.[12]

19. SBS attempts to support its claim that pyrolysis will remove PFAS from biochar with reference to a publication from the 2021 Water Environment Federation ("WEF") Residuals and Biosolids Conference.[13] The levels of PFAS in feedstock biosolids reported in this publication are much lower than has commonly been found in municipal WWTP biosolids across the US and considerably lower than what is currently known about PFAS levels in New York WWTP biosolids. Thus, it is not a model from which a regulator can draw conclusions regarding the safety of biochar produced at the full-scale pyrolysis facility proposed by SBS.

20. In addition, the WEF publication is problematic on its own terms for several reasons. First, the analytical method used to assess PFAS in biosolids and the pilot test biochar was a Canadian Method E3506 and not a common method used or recommended in the US. Methods like ASTM D7968-17 and EPA 1633 are much more supportable through multi-lab certifications and have lower method detection limits than E3506. That WEF

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[12] Jin Hyo Kim et al., *Residual Perfluorochemicals in the Biochar From Sewage Sludge* 134 Chemosphere 435, 435 (2015).
[13] Todd Williams, Jacobs, *Removal and Transformation of PFAS from Biosolids in a High Temperature Pyrolysis System - A Bench Scale Evaluation* (May 2021), *in* Water Env't Fed'n.

chose an idiosyncratic method, which has the potential to undercount the amount of PFAS remaining in biochar after pyrolysis is hardly surprising. WEF is actually the sewage sludge industry's main trade, lobby, and public relations organization. Companies like Veolia and Casella and organizations like NEFCO support them. It is not an objective scientific institution.

21. Second, the results in Tables 1 and 3 of the WEF publication do not include the PFAS compound method detection limits. This is essential to knowing what PFAS levels actually were in the feedstock and final biochar and whether the pyrolysis unit is effective in destroying PFAS.

22. It is important to note that, even given these problems and methodological limitations, the WEF study still found levels of PFAS in the various media during and following pyrolysis and emission controls.

d. SBS has failed to demonstrate that its biochar will be free from heavy metals which present unreasonable risks to human health and the environment.

23. The European Commission's Joint Research Centre has expressed concern that pyrolysis will be unable to remove heavy metals from sewage sludge, stating that:

> Research findings from the last decade indicate that pyrolysis & gasification materials derived from sewage sludge will not meet the limit values for toxic metals (especially Cd, Cu, Pb, Ni, Zn) at PFC level… Heavy metals are predominantly recovered in the solid matrix (char) during the pyrolysis/gasification process, and thus hardly any metal removal takes place during the pyrolysis/gasification process… Instead, non-volatile toxic metals become more concentrated in pyrolysis & gasification materials, and no post-pyrolysis/gasification processes are described to remove the inorganic contaminants.[14]

24. Astoundingly, Appendix J of SBS's Beneficial Use Determination application dismisses the heavy metals risks of biosolids-derived biochar, stating that "[m]ost high concentrations of heavy metals are derived from woodwaste feedstock such as chrome-arsenic treated or lead painted demolition wood. Biosolids are rarely a problem."[15]

25. Appendix J provides test results for heavy metals levels in a biochar sample sent to an organization called Soil Control Lab. It is important to note that Appendix J does not state where the feedstock used to produce said biochar came from. There is no evidence in the application that the feedstock was sourced by a WWTP in Casella's operating

[14] Joint Research Centre Paper at 59.
[15] *See* Sterling Env't Eng'g, P.C., Petition for Case-Specific Beneficial Use Determination app. J (May 15, 2023) (hereinafter "BUD Petition").

footprint. It is therefore possible that the biochar tested was made from a sewage sludge feedstock with unusually low levels of contaminants.

26. Nevertheless, the Soil Control Lab report in Appendix J fails to demonstrate that the sampled biochar is free of levels of heavy metals or that the heavy metals levels in the biochar are low enough to be safe to living things.

27. Heavy metals in the soil can enter groundwater through leaching and osmosis. Excessive heavy metals can harm the environment and human health. Agricultural activities are one of the main sources of heavy metals pollution in groundwater.[16] The indicia used by Soil Control Lab to assess whether levels of metals in the SBS pilot test biochar are acceptable do not account for potential harm to surface water or groundwater and do not take into account the ability of metals to be taken up by the plants that humans and animals will later eat.

28. Soil Control Lab uses deeply flawed and outdated Federal Rule 503 Standards to determine whether the tested biochar contains safe levels of heavy metals.[17] The biggest problem with the 503 Rule Standards is that they only require an inquiry into the levels of nine metals, while biochar may very well contain many more hazardous heavy metal compounds. For example, biosolid feedstock may include such metals as antimony, beryllium, boron, thallium, tin, and titanium.[18] I would also be concerned by a wide array of additional harmful metals that might be in the feedstock such as manganese, zinc, cobalt, and chromium (including Chromium VI).

29. My concern about heavy metals in the feedstock is heightened – not diminished – by SBS's decision to include wood waste into the mix. Using wood waste is another uncontrolled variable where there is no way to know if the wood waste will include pressure treated wood.[19] According to the EPA, Wood preservatives containing chromated arsenicals include preservatives containing chromium, copper and arsenic.[20] Since the 1940s, wood has been pressure treated with chromated arsenicals to protect wood from rotting due to insect and microbial agent attack and wood-boring marine invertebrates—a fact even Soil Control Lab appears to acknowledge.

30. Finally, the pH of the Soil Control Lab test results is troubling. Published literature indicates that a pH > 7 increases the bioavailability of heavy metals.[21] The Soil Control Lab results indicate the biochar pH, without wood, is already above 7 at 7.57.

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[16] *See* Yuanzheng Zhai et al., *Distribution, Genesis, and Human Health Risks of Groundwater Heavy Metals Impacted by the Typical Setting of Songnen Plain of NE China*, 19 Int'l Journal Env't Rsch. Pub. Health 3571 (2022).
[17] 40 CFR § 503.
[18] *See* U.S. Env't Prot. Agency, *Targeted National Sewage Sludge Survey Sampling and Analysis Technical Support* (Jan. 2009), http://www.epa.gov/sites/default/files/2018-11/documents/tnsss-sampling-anaylsis-tech-report.pdf.
[19] *See* Nicole M. Robey et al., *Metals Content of Recycled Construction and Demolition Wood Before and After Implementation of Best Management Practices*, 242 Env't Pollution 1198 (2018).
[20] U.S. Env't Prot. Agency, *Overview of Wood Preservative* Chemicals, https://www.epa.gov/ingredients-used-pesticide-products/overview-wood-preservative-chemicals (last updated June 13, 2023).
[21] Ling Xiang et al., *Potential Hazards of Biochar: The Negative Environmental Impacts of Biochar Applications*, 420 Journal of Hazardous Materials 126611, Table 1 (2021).

31. A more appropriate way to assess potential health impacts of using biochar for land application would be to evaluate samples of biosolids from WWTP in Casella's operating footprint against EPA's Generic Regional Screening Level tables and to include metals that are not on the Rule 503 as cumulative hazards.[22]

32. Soil to groundwater (aka groundwater/surface water interface (GSI)) Regional Screen Levels are much lower than the Rule 503 limits and these levels better represent the potential harm that the metals can do if they enter water. Most farm fields have tiled drainage to swales and ditches where nutrients and hazardous contaminants like heavy metals can enter surface waters. This becomes even more important in the case of the proposed location for the SBS facility where the underlying aquifer has been characterized as a "principal aquifer" in SBS's full Environmental Assessment Form. A principal aquifer is a regionally extensive aquifer or aquifer system that has the potential to be used as a source of potable (drinkable) water.

33. Because SBS plans to bag some of their final biochar product, the company will also have to meet Annual Pollutant Loading Rate ("APLR") metals limits, which are much lower than the Cumulative Pollutant Loading Rate limits listed in Federal Rule 503. The Soil Control Lab Results indicate levels of metals in the pilot test biochar that are much higher than Rule 503 APLR limits.

e. It is likely that SBS's biochar will contain a wide range of other contaminants in addition to PFAS and heavy metals that present unreasonable risks to human health and the environment.

34. As mentioned above, PFAS and heavy metals are not the only potentially harmful contaminants that are often present in biosolids and sewage sludge. Just as with PFAS and heavy metals, there is a good chance that a number of these other contaminants will also be difficult, if not impossible, to remove from the feedstock through pyrolysis.

35. For example, the European Commission's Joint Research Centre notes that:

> Limitations in the potential of dry and wet pyrolysis/gasification processes to remove organic pollutants have been observed for organic contaminants like nonylphenol, chlorinated aromatic fractions and specific veterinary antibiotics… Whereas high temperatures can effectively transform contaminants in the gaseous phase, these could also potentially be re-adsorbed on the organic carbon and soot particles that show a high adsorption potential for contaminants (e.g. on fly ash particles present in some pyrolysis & gasification materials.[23]

[22] U.S. Env't Prot. Agency, *Regional Screening Levels (RSLs) – Generic Tables*, https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables (last updated Dec. 11, 2023).

[23] Joint Research Centre Paper at 58.

36. The pyrolysis process may even create pollutants that become embedded in the finished biochar. For example, subjecting biosolids to pyrolysis may create polyaromatic hydrocarbons ("PAHs") in the biochar. PAH's are carcinogenic chemicals. While acknowledging some uncertainty in the published literature, an advisory report from academics in Aarhus University notes that: "[t]he concentration of PAH produced [in biochar] seems to be increasing with higher [pyrolysis] temperatures" above 500°C.[24] Authors of another study noted that:

> PAHs can be released from biochar and pose a potential threat, particularly in the case of repeated biochar application in soils. A lack of comprehensive studies also exists on biochar aging in the context of the bioavailability of PAHs. It is therefore very important, given the current stage of the development of biochar production technology and use, to monitor and regulate the bioavailable content of PAHs in biochars, especially those used for fertilization and food production purposes.[25]

B. PFAS and Products of Incomplete Combustion Will be Emitted From the Proposed SBS Facility.

a. The proposed multi-stage thermal oxidizer does not reach temperatures high enough to destroy all PFAS compounds and products of incomplete combustion.

37. When biosolids are subject to pyrolysis the pollutants removed from the finished biochar do not simply disappear. Rather, many of the pollutants contained therein become gaseous. SBS has proposed a multi-stage thermal oxidizer to control pollutants in these gaseous emissions. In essence, a thermal oxidizer heats up emissions released from the biosolids during pyrolysis. SBS suggests that the thermal oxidizer will be hot enough to destroy any harmful pollutants, like PFAS, present in the emissions released from the pyrolysis process.

38. Unfortunately, PFAS is much more difficult to destroy than SBS's simple narrative would suggest. As the EPA notes, the energy required to break all the carbon-fluorine bonds in PFAS can require temperatures in excess of 1450 °C (2642 °F).[26] The thermal oxidizer proposed by SBS will not reach this high temperature. As a result, I am concerned that the thermal oxidizer will not completely destroy PFAS in emissions

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[24] Lars Elsgaard et al., Danish Ctr. Food Agriculture, *Knowledge Synthesis on Biochar in Danish Agriculture* at 70 (Sept. 2022), https://dcapub.au.dk/djfpublikation/djfpdf/DCArapport208.pdf.
[25] Paulina Godlewska et al., *The Dark Side of Black Gold: Ecotoxicological Aspects of Biochar and Biochar-Amended* Soils, 403 Journal Hazardous Materials 123833, 123835 (2021).
[26] *See* U.S. Env't Prot. Agency, , *Per- and Polyfluoroalkyl Substances (PFAS): Incineration to Manage PFAS Waste Streams* at 1 (February 2020), https://www.epa.gov/sites/default/files/2019-09/documents/technical_brief_pfas_incineration_ioaa_approved_final_july_2019.pdf; *see also* John Horst et al., *Understanding and Managing the Potential By-Products of PFAS Destruction*, 40 Groundwater Monitoring & Remediations 7, 20-21 (2020) (noting that temperatures up to 900 degrees Celsius (1,652 degrees Fahrenheit) are likely insufficient to destroy PFAS in water); N.Y. Dep't Env't Conservation, Notice of Incomplete Application at question 1 (July 11, 2023).

leaving the pyrolysis facility's stack. Incomplete destruction of PFAS compounds can result in the formation of smaller PFAS products, or products of incomplete combustion ("PICs"), which may not have been researched and thus could be a potential chemical of concern.[27]

39. To be more specific, the thermal oxidizer includes 1) a reducing zone that must be maintained at a manufacturer's recommended minimum temperature of 2,300 degrees F (1,260 degrees C) with a residence time of 0.5 seconds,[28] 2) a conditioning zone that must be maintained at a manufacturer's recommended minimum temperature of 1,650 degrees F (899°C),[29] and 3) an oxidizing zone that must be maintained at a manufacturer's recommended minimum temperature of 1,800 degrees F (982 °C) with a residence time of 1 second measured in continuous in 1-hour blocks.[30]

40. SBS assumes that all PFAS are mineralized/destroyed in the reducing zone. To support this contention, SBS points to a June 2023 publication by EPA scientists, which reviewed the safety and efficacy of PFAS incineration in a trial study at EPA's Rainbow research combustor.[31] This study does little to support company's assertion, but rather indicates that PFAS products of incomplete combustion will still be emitted to ambient air.

41. The authors of the study used EPA method OTM-45 to measure the destruction of PFAS from AFFF compounds, and also nontarget analysis of OTM-45 extras to identify about 10 fluorochemicals as breakdown products. These include fluoroform, pentafluoroethane, 1H-hepafluoropropane, and 1H perflouroheptane, which are greenhouse gases with long residency times in the atmosphere.

42. The authors of the study made the particularly important observation that PFAS breakdown and byproduct formation was highly temperature dependent, with notable performance declines below experimental temperatures below 1000 °C—higher than the temperatures in the conditioning and oxidizing zones of SBS's thermal oxidizer.

43. The study showed the formation of PICs at lower temperatures. For example, at 870 °C monitors measured 15 breakdown products at concentrations ranging from 0.4 to 903 mg/m3.

44. It is true that the temperature in the reducing zone is higher than the 1000 °C threshold identified in the study. SBS appears to believe that because this first phase of the thermal oxidizer reaches this temperature, all PFAS will be destroyed before the temperature drops. But this is a faulty assumption. The fact that emissions are immediately cooled in the conditioning and oxidizing zones after passing through the reducing zone for 0.5 seconds is concerning. Put simply, there is a good chance that PFAS are not subject to

[27] *See* U.S. Env't Prot. Agency, *supra; see also* John Horst et al., *supra*.
[28] DEC, Draft Air State Facility Permit Condition Item 19.2 at 18 (hereinafter "Draft Air Permit").
[29] *Id.* Condition Item 14.2 at 13.
[30] *Id.* Condition Item 13.2 at 12.
[31] *See* Erin P. Shield et al., *Pilot-Scale Thermal Destruction of Per- and Polyfluoroalkyl Substances in a Legacy Aqueous Film Forming Foam*, 3 ACS ES&T Eng'g 1308 (2023).

high temperatures long enough in the reducing zone to ensure their complete destruction. The temperature drop in the subsequent two zones is likely to rescue some PFAS from destruction.

45. Observations in the June 2023 study are consistent with these concerns. The study points to some PFAS's "potential for hysteresis" – which is to say some PFAS do not immediately respond to high temperatures.[32] There is a lag before they breakdown even when heat is high. Relatedly, the study points to the importance of "residence times" (i.e. the time under which PFAS is subject to high heat) as an important factor in PFAS destruction.[33]

46. For this reason, EPA tested a variety of incineration aimed for a residence time of 3 seconds under ideal conditions[34] that are unlikely to be replicated under real-world operating conditions where temperature depressions can sometimes occur. By contrast, as mentioned above the SBS draft permit proposed residence time is only 0.5 seconds in the reducing zone and 1 second in the oxidizing zone. There is no requirement in the draft permit for residence time in the conditioning zone. Even standard commercial hazardous waste incinerators are required to maintain gas phase temperatures of 980-1200 °C for a longer period of time (2 seconds).

47. DEC should not simply hope for the best that all PFAS are destroyed by SBS's system. As another study puts it eloquently:

> [T]o determine the extent of mineralization, a fluoride mass balance across all phases is required… total organic fluorine analysis would reveal how much of the PFAS removal from biosolids is due to transformation to other PFAS and will also reveal which phase the transformation products reside. Although difficult, it is imperative to develop and employ these methods on the gas phase to determine the impact of pyrolysis on PFAS in the environment, including in the air.[35]

b. When considering whether the proposed facility presents risks to human health and the environment, DEC should not give too much weight to SBS's claims about the destruction efficiency of the proposed thermal oxidizer.

48. SBS suggests that its thermal oxidizer diminishes the risk emissions from the facility present to human health and the environment because the facility supposedly has a high "destruction efficiency."[36]

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[32] *Id.* at E.
[33] *Id.* at C.
[34] *See* Erin P. Shields et al., *supra* app. Supporting Information.
[35] *See* Patrick McNamara et al., *Pyrolysis Transports, and Transforms, PFAS 11rom Biosolids to Py-Liquid* 9 Env't Science Water Rsch. Tech. 386, 393 (2023).
[36] *See* Air Permit Application at 31.

49. But this argument is misleading. In the aforementioned June 2023 study, EPA scientists note "that [destruction efficiency] alone may not be the best indication of total PFAS destruction, and additional PIC characterization may be warranted."[37] The authors add that "[w]hile high destruction efficiencies (DEs), >99.99%, are deemed acceptable for most hazardous compounds, many PFAS can be converted to other PFAS at low temperatures resulting in high DEs without full mineralization and the potential release of the remaining fluorocarbon portions to the environment."[38]

   c. *Even if the thermal oxidizer was able to operate at temperature high enough to destroy PFAS the facility lacks adequate controls to ensure that the thermal oxidizer and other pollution control systems at the facility always operate as intended.*

50. As mentioned above, under real-world operating conditions a thermal oxidizer's temperature can vary from time to time. A well-designed thermal treatment facility needs adequate monitoring equipment to ensure that temperatures in a thermal oxidizer do not drop such that increased amounts of PFAS are released into the atmosphere.

51. I worry that the facility's thermal oxidizer lacks adequate equipment to ensure that it will be able to maintain high temperatures. Equipment necessary to ensure that a thermal oxidizer is properly functioning would include a continuous temperature measurement recording device that is able to provide no less than one reading every 15-minutes for at least 90% of the operating time during an operating calendar day.

52. This continuous temperature measurement would need to be coupled with continuous duct flow measurement devices to assure that PFAS are subject to heat and other pollution controls for the minimum residence times required to prevent the pollutants from escaping the facility.

53. A safe thermal oxidizer control system would also need to include, at a minimum, the installation of sample ports for measuring input to and output from the system. These sample ports should be able to adequately measure the level of PFAS leftover as temperatures leftover rise and fall throughout the facility.

54. Finally, a safe facility would need interlock systems to shut down connected processes if control equipment operating conditions and limits required to fully destroy PFAS, PICs, and other harmful pollutants are not being met (e.g., temperature, flow, pressure differential, retention time, flame-out) should be installed to shut down emitting processes in order to avoid uncontrolled emissions.

55. I want to reiterate that these failsafe systems would not be sufficient to ensure PFAS destruction. Rather they would be necessary to ensure that the proposed pyrolysis facility operates in accordance with its intended design at all times, assuming it was able to

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[37] Erin P. Shield et al., *supra* at A.
[38] *Id*.

subject PFAS to high heat for sufficient periods of time to achieve its complete destruction. The more fundamental problem remains that SBS has not met this preliminary burden. The company has not demonstrated that the facility will be able to heat PFAS at high enough temperatures for a long enough period of time to totally destroy these harmful chemicals.

C. The Failure of the Thermal Oxidizer to Destroy All the PFAS Released From Biosolids During Pyrolysis Could Lead to Devastating Cumulative Impacts on Human Health and the Environment.

56. As mentioned above, the failure of the thermal oxidizer to reach and sustain temperatures that destroy PFAS will lead to PICs reforming inside the thermal oxidizer chamber and stack. These PICs will be released to ambient air and deposited on surrounding soil and surface water.

57. Deposition of PFAS compounds to land from products of incomplete combustion from industrial and commercial incinerators and thermal oxidizers is a well-known problem. When PFAS and PIC emissions form a stack deposit on land these chemicals can contaminate nearby soil as well as drinking, ground, and surface waters. Such environmental contamination has occurred in places like Merrimack, NH, near a St Gobain facility; Cordova, IL, near a 3M facility; and Cohoes, NY, near the Norlite facility.

58. The proposed location of the SBS facility raises particularly high concerns about groundwater contamination. SBS's Full Environmental Assessment Form for the facility contains a Supplemental Submission, which indicates that an aquifer lies under the proposed project site.[39] As mentioned above, the aquifer is described as a Principal Aquifer.

D. SBS's Own Modeling Demonstrates That Proposed Pyrolysis Facility Will Emit Harmful Air Pollutants – Including but Not Limited to PFOA – Which Present Risks to the Health of Disadvantaged Communities.

59. AERMOD modeling performed by SBS indicates that pollutant emissions – including PFOA emissions – will reach disadvantaged communities ("DACs"). Specifically, portions of Hudson Falls and Glens Falls.[40]

60. In my expert opinion, this modeling strongly suggests that SBS's facility will present serious health risks to DACs in Hudson and Glens Falls, which already experience high health burdens.

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[39] Saratoga Biochar Solutions, *NYS DEC Air State Facility Permit Application and Solid Waste Management Facility Permit Application Public Participation Document Repository*, https://saratogabiochar.com/ppp/ (last visited Mar. 7, 2024) (hereinafter "Public Participation Document Repository").
[40] *See* Air Permit Application attach. 5A – 5Q.

61. The majority of the pollutants modeled by SBS have the potential to do harm to the respiratory systems of residents in the DACs. The impacts of these pollutants on the respiratory system will be cumulative with hazards from various other sources of pollution (industry, workplace, automobiles) and routes of exposure (inhalation, dermal and ingestion).

62. I compiled data from the SBS AERMOD attachments regarding emissions that will reach each DAC. I then performed a cumulative exposure Hazard Index ("HI") on this data. A HI is the ratio of the potential exposure to a substance and the level at which no adverse effects are expected.

63. Typically, if the HI is calculated to be less than 1, then no adverse health effects are expected for healthy individuals because of exposure. However, even HI's of less than one can raise health risks under certain circumstances. For example, young children, the elderly, and people with existing respiratory issues and illnesses like COPD, asthma or emphysema, would likely be adversely affected at a Hazard Index of less than 1. Similarly, in the workplace it is typical to set an HI of less than 0.5 as an action level where engineered controls, adding personal protective equipment (PPE), and/or other methods would be employed to protect workers due.

64. DAC's in Hudson Falls and Glens Falls face disproportionately high rates of COPD and other health burdens. Like workers in chemical facilities these two communities also face disproportionately high pollution burdens. Accordingly, an HI of slightly less than 1 is unlikely to be sufficiently protective of these two DACs. Rather, I would suggest that an HI of less than 0.5 is a more appropriate target for DACs in Glens Falls and Hudson Falls.

65. According to my calculations, the long-term HI for Hudson Falls from the SBS Facility's emissions is 0.615, which is too high to be safe. Hudson Falls HI is > 0.5. The short-term HI for Hudson Falls is 0.82. For Glen Falls the short-term HI is 0.84.

66. The Hazard Index (HI) was calculated by dividing the SBS-assessed contaminant level reaching DACs divided by the lowest of 2 air emissions screening levels for either or both short (1-hour) and long term (annual) exposures. NYSDEC uses AGC = annual and SGC = 1-hour instead of screening levels. EPA Regional Screening Levels are only applicable to long-term exposure. The calculation is concentration (Cn) divided by the screening level (SLn). Therefore HI = (C1/ SL1) + (C2/ SL2) + (Cn/ SLn).

67. In summary, for both Hudson Falls and Glens Falls, the HI from the SBS facility's emissions is above 0.5 and very close to 1. These HI's are too high to be safe for communities already overburdened with health and pollution problems.

68. I am also concerned about the HI's for residences closes to the facility than the DAC's, which likely have HI's greater than 1.

69. It is important to note that these high HIs are only for exposure through inhalation. The HIs do not include possible health impacts in the DACs resulting from ingestion or dermal contact. If emissions from the SBS facility were to deposit to soil and surface water, there could be additional cumulative exposures through ingestion (e.g. impacts to drinking water) and dermal contact (e.g. swimming, contact with soil).

E. In Practice, Harmful Pollutants May Be Emitted From the Facility at Higher Rates Than Those Modeled by SBS.

70. There is a possibility that in practice the emissions from the SBS's stack will be even more harmful to surrounding communities than the modeled emissions in SBS's AERMOD attachments. Several uncertainties about the proposed SBS facility are worth reiterating here.

71. First, there are problems with SBS's assumption that the proposed thermal oxidizer will destroy PFAS released from the proposed facility's stack. Second, to my knowledge no company in the US has attempted to subject such large quantities of biosolids to pyrolysis. Third, SBS has not identified specific WWTP that will be the source of its biosolids and it has not tested those biosolids to determine the quantity of pollutants contained therein.

72. Each of these three factors (efficacy of the thermal oxidizer, quantity of biosolids processed, and quality of biosolids processed) could have major ramifications on the safety of the facility's emissions. In short, SBS is proposing to take Moreau and the surrounding communities into uncharted waters, and so modeling carries with it many uncertainties.

73. DEC appears to acknowledge this uncertainty in its Draft Air Facility Permit. For example, the agency has proposed to require SBS to run operational tests at scale and months thereafter to apply for a modification of permit operating conditions to "ensure compliance with all the applicable air pollution control requirements" related to PFOA and other air pollutants.[41] Thereafter the draft permit requires periodic tests on emissions from the stack every five years to see if the facility is still able to control some harmful pollutant emissions.[42]

74. Many of these conditions aiming to deal with uncertainties regarding the SBS project are too weak or too vague on their face to give me much comfort. For example, the stack tests are far too infrequent to ensure the safety of a novel facility. There is no requirement for SBS to adopt a specific EPA test method, such as OTM 45. There is no requirement for SBS to monitor emissions of a specific list of PFAS other than PFOA.

75. But even were DEC to draft tighter conditions in a State Facility Permit, there would remain a fundamental problem with the project. In effect, this permit would allow SBS to

[41] Draft Air Permit Condition Items 11.2 & 20.2 at 11, 19.
[42] *See, e.g., id*. Condition Items 29.1 & 29.2 at 28 – 29.

run an experiment on the safety and efficacy of a newfangled waste recycling facility right near disadvantaged communities. This strikes me as a fundamentally unethical, involuntary experiment on some of New York State's most vulnerable residents. Approving such an experiment seems to me to be precisely the opposite of what an environmental regulatory body should be doing.

F. The Proposal Put Forth in SBS's Air Permit Application Does Not Do Enough to Describe Safeguards Important for the Protection of Worker Health And Safety.

76. SBS does not describe ventilation systems that will be protective of workers' health and safety. To avoid employee complaints and illnesses and to avoid violations of OSHA standards, SBS should follow OSHA guidelines and bring in an engineering firm that is familiar with industrial operations and ventilation design to assure protection of workers health and safety.

77. The draft Air Facility Permit prepared by DEC also fails to describe ventilation systems sufficiently protective of worker health and safety. Under the draft permit "[a]ll exhaust air is treated through engineered air pollution control devices" for particulate, ammonia, sulfur dioxide and odor control.[43] In addition, the Air Facility application includes the following statement: "[t]he drying process accounts for approximately 83% of the heat energy needed for the [SBS] Facility and is expected to be supplied from the syngas generated in the pyrolysis process as renewable energy"[44]

78. But neither of these documents explain whether a general ventilation system with make-up air will be provided in the manufacturing building. There is no available information in the application materials that speaks to make-up and/or fresh air coming from outside the manufacturing building. Additionally, no information in the application materials explains how SBS will heat or cool the building.

79. As the OSHA Technical Manual explains:

> Exhaust ventilation systems require the replacement of exhausted air. Replacement air is often called make-up air. Replacement air can be supplied naturally by atmospheric pressure through open doors, windows, wall louvers, and adjacent spaces (acceptable), as well as through cracks in walls and windows, beneath doors, and through roof vents (unacceptable). Make-up air can also be provided through dedicated replacement air systems. Generally, exhaust systems are interlocked with a dedicated make-up air system.[45]

80. Proper ventilation and temperature control are possible health issues for employees and also a potential safety issues in the event of an emergency. There should be emergency

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[43] *See id*.
[44] Air Permit Application at 5.
[45] U.S. Dep't Labor, *OSHA Technical Manual (OTM) Section III: Chapter 3*, Occupational Safety & Health Admin., https://www.osha.gov/otm/section-3-health-hazards/chapter-3 (last visited Mar. 7, 2024).

ventilation to quickly clear the building in the event of a large combustible dust release. The local Fire Marshal should be consulted.

81. I am also troubled by the fact that I have found no information in the application materials outlining whether SBS considered re-entrainment of contaminants back into the manufacturing or office/control portions of the facility.

82. With the exception of a dust hood located above the wood grinder and dust ports for dust removal in the conveyor system, there is no design information on how particulate matter will be effectively captured and carried to control equipment. There are numerous activities in the described process where fugitive particulate matter will be emitted including, the wood grinder, where cyclone fines are emptied, silo off-loading, and the bagging area. This is a potential exposure issue for employees with a potential for a build-up of combustible dust. An engineer competent in local exhaust ventilation ("LEV") in an industrial setting where volumes of PM emitting raw materials and product will be moved, should be consulted and LEV systems added where needed.

83. I am also concerned with the relative lack of attention paid to combustible dusts in the application materials. The proposed facility processes and materials management will generate combustible dust. Combustible dust may include materials that are in the physical states of powders, flakes, fines, fibers, etc. Combustible dusts can include most solid organic materials (such as sugar, flour, grain, wood, etc.) carbonaceous materials (e.g., charcoal, soot). Included on the OSHA list of Combustible Dusts is "[c]harcoal, wood."[46] "Combustible dusts are fine particles that present an explosion hazard when suspended in air under certain conditions. A dust explosion can cause catastrophic loss of life, injuries, and destruction of buildings.[47]

84. SBS should perform a Combustible Dust Hazard Analysis of the feedstock, intermediate, and final products. NFPA standards include provisions for performance of a dust hazard analysis ("DHA") when there is a potential combustible dust at a facility. These analyses are helpful to employers in making informed decisions regarding housekeeping procedures, administrative controls, engineering controls, personal protective equipment specifications, employee training needs, and other safety related issues. This means that it is critical for the new facility to include adequate LEV systems with effective capture hoods. More information is available at the OSHA Combustible Dust National Emphasis Program, Directive Number: CPL 03-00-008, Effective Date: 01/30/2023.

G. The Facility's Wastewater Discharges Presents Risks to Human Health and the Environment.

[46] U.S. Dep't Labor, *Combustible Dust: An Explosion Hazard*, Occupational Safety & Health Admin., https://www.osha.gov/combustible-dust (last visited Mar. 7, 2024).
[47] *See* U.S. Dep't Labor, *OSHA Fact Sheet Hazard Alert: Combustible Dust Explosions* (May 2015), https://www.osha.gov/sites/default/files/publications/osha3791.pdf.

85. SBS proposes to send process wastewater to the Glens Falls WWTP. The facility will produce 29,456 gallons per day of wastewater.[48] Process wastewater from the facility will include effluent from the facility's air treatment system, as well as truck wash used to clean incoming trucks containing biosolids, and possibly also water used to cool and stabilize biochar in the facility's Carbon Manufacturing Area.[49] Each of these streams of wastewater may contain PFAS and other pollutants. The Glens Falls WWTP is likely not equipped to properly filter PFAS.

86. The Glens Falls WWTP currently sends their biosolids to the Wheelabrator WTI incinerator in Hudson Falls, NY. As discussed above in Section 3(b), this increases the risk of emissions from the incinerator depositing products of incomplete combustion like PFAS to surrounding soil and surface water. This places the nearby Hudson Falls community, an already designated disadvantaged community, at greater risk of cumulative exposure to airborne contaminants. Increased deposition of PFAS to the Hudson River also adds to the potential cumulative impact of people ingesting drinking water that uses the Hudson River as their drinking water source.

87. It is also a possibility that deposition of PFAS from the incinerator might impact underlying groundwater. The Full Environmental Assessment Form in the February 2022 Supplemental Submission indicates that the aquifer underlying the proposed facility is a Principal Aquifer, which is defined as a regionally extensive aquifer or aquifer system that has the potential to be used as a source of potable (drinkable) water.[50] The best example of such an observable fact is the 3M in Cordova, IL.

H. Odors From the Proposed Facility and Incoming Trucks Will Be Burdensome to Surrounding Communities.

88. Page 8 of SBS's March 7, 2022 Environmental Assessment Form (EAF) indicated that the project may result in odors for more than one hour per day. It is clear that given the low odor thresholds of the assessed emissions from the proposed facility (e.g., Sulfides, Acetic Acid, SO2, HCL, H2S) and based on SBS's own admission that there is a potential for odors for more than one hour per day, that there is a significant possibility the odors will burden communities near and downwind of the facility. So too will odors from incoming biosolids trucks.

[48] *See* Facility Manual at 7.
[49] *See* Facility Manual at 6 – 7; *see also* Air Permit Application at 5.
[50] Public Participation Document Repository, *supra*.

89. DEC should take into consideration the amount of time and cost that will be incurred by the Division of Air Resources ("DAR") responding to numerous odor complaints before approving the SBS permit application.

Denise Trabbic-Pointer 03/14/2024

Denise Trabbic-Pointer Date

Exhibit 1

Excerpts from Joint Research Centre Report

European Commission

JRC SCIENCE FOR POLICY REPORT

Technical proposals for selected new fertilising materials under the Fertilising Products Regulation (Regulation (EU) 2019/1009)

Process and quality criteria, and assessment of environmental and market impacts for precipitated phosphate salts & derivates, thermal oxidation materials & derivates and pyrolysis & gasification materials

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2019

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Abstract

The European Commission has recently revised the EU legislation on fertilisers, expanding its scope to secondary-raw-material-based fertilising products, and resulting in the publication of the new EU Fertilising Products Regulation ((EU) 2019/1009). This report explores a possible legal framework for the manufacturing and placing on the market of specific safe and effective fertilising products derived from biogenic wastes and other secondary raw materials. Specifically, three categories of fertilising materials have been evaluated:

- precipitated phosphate salts & derivates;
- thermal oxidation materials & derivates;
- pyrolysis & gasification materials.

The report contains technical proposals on eligible input materials, process conditions, quality requirements as well as quality management system requirements. The proposals might form the basis for the legal requirements that those candidate materials shall comply with if they become regulated under the new legislative framework. Additionally, the report assesses the possible impacts in order to shed a light on the added value that these fertilising materials could provide for food security, food safety, environmental protection, and the European fertilising and agricultural sector.

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Therefore, the primary focus of the abovementioned pieces of **legislation is on the emissions to the atmosphere, rather than on the characteristics of the solid material (i.e. soot, fly and bottom ashes, charred materials, etc.) remaining in the boiler or combustion plant**. As a matter of fact, the current fate of these materials after combustion involves their use in non-agricultural sectors (e.g. construction materials or landfilling). For their use in an EU fertilising product that is not subject to further management controls and restrictions, a detailed assessment of the risks associated with human health and the environment should therefore be performed.

Certain materials, such as plant-based residues from agriculture and forestry, **are inherently low in organo-chemical pollutants which is why stringent time-temperature profiles are not required to ensure the destruction of pollutants in the material, or proportionate considering the limited risk of emissions of certain persistent organic pollutants**.

Most residue management regulations use the organic C as a key parameter indicating the degree of organic contaminant removal as organic carbon serves as a reactive surface for the adsorption of possible contaminants, such as volatile and persistent organic pollutants (Vehlow et al., 2006). Due to the incomplete combustion of organic matter and the possibility of using biomass with a high chloride content, **organic pollutants**, such as volatile organic carbon and polychlorinated biphenyls, can be formed and can remain in the combustion residue. In addition, information on the possible environmental risks related to the possible presence of **water-soluble and insoluble organic contaminants is lacking**. Biomass ashes can contain organic aromatic structures, condensed refractory biomass and char-like particles, and some biomass ashes thus show similarities to the materials obtained from pyrolysis and gasification processes.

The proposal is therefore the following:

- The **strict time-temperature profiles** with temperatures > 850 °C shall only apply to all eligible input materials, other than **certain plant-based materials**.
- To limit the CMC ‘thermal oxidation materials & derivates’ to materials that are oxidised in such a way that the **total organic carbon content of the slags and bottom ashes is less than 3%, regardless of the input material applied.** This implies that partially oxidised materials shall not be allowed for this CMC and that ashes from certain plant-based materials should also meet this criterion. Possibly, such ashes with a higher organic C content shall be subject to further re-burning to levels below < 3%. Biomass that is combusted or gasified under (oxygen-limiting) conditions that results in the presence of **unburnt organic matter** (organic C content > 3%) could possibly also make an entry in the CMC ‘**pyrolysis & gasification materials**’. The testing regime of the latter category is somewhat different to that for ‘thermal oxidation materials & derivates’ because of the need for additional testing on specific contaminants (e.g. dl-PCBs, volatile organic carbon).

5.2.9 Sewage sludge as an input material for pyrolysis & gasification materials

The proposal has been made by the STRUBIAS subgroup to include sewage sludge as an input material for pyrolysis & gasification materials.

Sewage sludge may contain a set of organic pollutants, including not only persistent organic pollutants (PAHs, dl-PCB, PCDD/F), but also a broad set of organic emergent pollutants such as phthalates (e.g. di (2-ethylhexyl) phthalate (DEHP)), surfactants present in cleaners and detergents (e.g. linear alkylbenzene sulphonates (LAS) and nonylphenols (NPE)), personal care products, pharmaceuticals and endocrine-disrupting compounds (sulphonamides, galaxolide, etc.) and polymers used to bind solid particles in solid-liquid separation processes. Given the potential risks associated with these substances, **there are significant public and governmental concerns related to the recycling of sewage sludges in the European food chain**. **The spectrum of emerging contaminants in sewage sludge is extensive (Petrie et al., 2015), and much broader than for any of the eligible input materials for pyrolysis & gasification materials.** Whereas some of the above-mentioned contaminants can certainly be degraded under oxidative conditions at high temperatures, the necessary techno-scientific evidence that demonstrates their removal under oxygen-limiting and reducing conditions is lacking. It is known that stringent time-temperature pyrolysis profiles (>550°C, > 20 min) induce a weight loss in pyrolysis & gasification materials due to burning out of organic compounds (Deydier et al., 2005a; Koutcheiko et al., 2007; Ro et al., 2010; Marculescu and Stan, 2012), but **the knowledge base of studies that assessed the proportional removal of specific organic pollutants is limited and restricted to only a few organic pollutants.** Therefore, the precautionary principle should apply. Limitations in the potential of dry and wet pyrolysis/gasification processes to remove organic pollutants have been observed for organic contaminants like nonylphenol, chlorinated aromatic fractions and specific veterinary antibiotics (Weiner et al., 2013; Ross et al., 2016; vom Eyser et al., 2016). Moreover, the mechanisms, nature and soil residence times of any decay products that could be formed remain unclear, and possibly metabolites can have differential toxicity from the parent compound (Weiner et al., 2013; Ross et al., 2016; vom Eyser et al., 2016). Whereas high temperatures can effectively transform contaminants in the gaseous phase, these could also potentially be re-adsorbed on the organic carbon and soot particles that show a high adsorption potential for contaminants (e.g. on fly ash particles present in some pyrolysis & gasification materials; Mätzing et al., 2001). As indicated in the latest draft of the Best Available Techniques (BAT) Reference Document for waste incineration under the Industrial Emissions Directive (IED, 2010/75/EU) (European Commission, 2017b), **the pyrolysis of sewage sludge is a rather new method and not a widely proven technique for the treatment of waste materials.** The limited degree of technological maturity in combination with the wide spectrum of operational pyrolysis and gasification configurations induces possible risks of solid materials escaping exposure to high temperatures for this CMC, and thus insufficient organic pollutant removal levels. Thus, there is no adequate and long-term experience that indicates the suitability of pyrolysis methods to ensure the effective removal of the broad spectrum of organic pollutants that could be present in waste materials like sewage sludge (European Commission, 2017b).

Given that the solid residue quality is dependent on the process temperature (European Commission, 2017b), **the inclusion of sewage sludge on the positive input material list would also involve a possibly complex compliance scheme for this CMC, stringent time-temperature profile conditions to ensure a breakdown of bulk organic composites, or a combination of both**. Because of the heterogeneous nature of organic compounds, the compliance cost would considerably increase (e.g. GC-MS measurements). Moreover, it may be challenging for the STRUBIAS subgroup to agree on the identity of the organic compounds that should be included in the compliance scheme as well as on safe limit values for many of these emerging organic compounds.

Research findings from the last decade indicate that pyrolysis & gasification materials derived from sewage sludge will not meet the limit values for toxic metals (especially Cd, Cu, Pb, Ni, Zn) at PFC level (He et al., 2010; Hossain et al., 2010; Gascó et al., 2012; Méndez et al., 2012; Van Wesenbeeck et al., 2014; Lu et al., 2016). Heavy metals are predominantly recovered in the solid matrix (char) during the pyrolysis/gasification process, and thus hardly any metal removal takes place during the pyrolysis/gasification process (Tomasi Morgano et al., 2018). Instead, non-volatile toxic metals become more concentrated in pyrolysis & gasification materials, and no post-pyrolysis/gasification processes are described to remove the inorganic contaminants. While this is an often reported argument to exclude sewage sludge as an input material, the JRC believes that cost-effective compliance schemes for the output material could effectively control for toxic metals/metalloids. Nonetheless, it is unlikely that pyrolysis & gasification materials derived from sewage sludge can make up an important share of the pyrolysis & gasification materials on the internal market, unless the limit values for non-volatile toxic metals are respected through the mixing with other component materials. The limited market viability of pyrolysis & gasification materials derived from sewage sludge might be further undermined by the fact that the plant bio-availability of phosphorus in such materials remains largely unknown under European agricultural settings (see Section 6.2.4). The plant nutrient availability in pyrolysis & gasification materials is controlled by the coordinated cations present in the feedstock applied (Al, Fe, Ca, Mg) (Ippolito et al., 2015). As some sewage sludges are enriched in Al and Fe, relative to other nutrient-rich input materials such as manure, a reduction in the plant nutrient availability can be expected for sewage-sludge-derived pyrolysis & gasification materials relative to their manure-derived counterparts. In view of consumers' confidence in pyrolysis & gasification materials, the uncertainty associated with the plant availability of the nutrients present in sewage-sludge-derived pyrolysis & gasification materials is a concern, especially as the STRUBIAS subgroup indicated a lack of satisfactory chemical testing methods to evaluate plant nutrient and P availability in STRUBIAS materials.

In conclusion, there are two fundamental problems that have led the JRC to take its present position of not proposing sewage sludge on the positive input material list for pyrolysis & gasification materials in this second draft report. First, **the necessary science of the impacts on human health and the environment is not in place for organic contaminants, nor is the presumption of non-adverse impacts confirmed by techno-scientific evidence collected by the STRUBIAS subgroup for sewage-sludge-derived pyrolysis &**

gasification materials. Second, in view of the limited market potential for sewage-sludge-derived pyrolysis & gasification materials, **the risk of undermining consumer confidence in pyrolysis & gasification materials in general and of increasing the complexity of the compliance scheme for the CMC group is so large that it presently distorts the evaluation of any other factors involved in the assessment.** At present, the possible benefit of adding sewage sludge on the input material list is simply too low to counterbalance any eventual loss in consumer confidence for pyrolysis & gasification materials, and, by extension, fertilising materials derived from waste. This proposal is in line with the non-acceptance of contaminated input materials, including sewage sludge, for pyrolysis & gasification materials according to voluntary standardisation schemes (EBC, 2012) and national legal frameworks (Meyer et al., 2017). Moreover, it should be noted that, in view of the very local nature of certain product markets, EU Member States can still rely on the principle of optional harmonisation to make available non-harmonised fertilisers on the market in accordance with national law. Finally, the proposals in this document provide two other avenues for the safe recovery of valuable fertilising elements from sewage sludge, via precipitation of phosphate salts or thermal oxidation.

As outlined in Article 42 of the EU Fertilising Products Regulation ((EU) 2019/1009), the European Commission has proposed to be empowered to adopt delegated acts to amend Annexes I to IV to the Regulation for the purposes of adapting them to technical progress in the light of new scientific evidence. Based on the currently collected information, it is indicated that some pyrolysis & gasification manufacturing may be candidate materials to comply with the conditions outlined in Article 42(1) of the Regulation. In view of the possible development of process and quality criteria for such materials at a later stage, the JRC therefore recommends undertaking more scientific research to build up a more robust techno-scientific database to demonstrate that those materials are effectively compliant with the conditions outlined. Specifically, more techno-scientific data are required to show that EU fertilising products derived from (specific) pyrolysis & gasification materials (i) do not present an unacceptable risk to human, animal or plant health, to safety or to the environment, and (ii) are sufficiently effective to fulfil their function as EU fertilising materials.

Exhibit 2

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Pyrolysis transports, and transforms, PFAS from biosolids to py-liquid†

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Per- and poly-fluoroalkyl substances (PFAS) in wastewater solids have resulted in bans on land application of biosolids, causing utilities to explore thermal treatment options. Pyrolysis is a thermal treatment process that converts wastewater solids to biochar, py-liquid (*i.e.*, aqueous phase liquid and non-aqueous phase liquid), and py-gas. Research on the impact of pyrolysis on PFAS in biosolids has yielded mixed results, and no research has investigated if PFAS are present in the py-liquid. The goals of this research were to determine if pyrolysis releases PFAS with the effluent py-liquid and to distinguish "removal" from "transformation" of PFAS. Triplicate batch pyrolysis experiments were performed at 500 °C, 650 °C, and 800 °C. Targeted PFAS were analyzed in biosolids, biochar, and py-liquid *via* LC-MS/MS, and PFAS precursor compounds were measured in the biosolids and biochar using the total oxidizable precursor assay. Pyrolysis removed all targeted PFAS from resulting biochars, with the one exception of perfluorobutanoic acid (PFBA) being present slightly above detection limit in one of the 800 °C biochar samples. PFAS precursor compounds were not detected in five of the nine biochar samples, and the other four biochar samples had only perfluoropentanoic acid (PFPeA) detected slightly above detection limit. Overall, pyrolysis removed >99% of targeted PFAS and PFAS precursor compounds from the solid phase. Interestingly, the mass of *N*-ethyl perfluorooctane sulfonamidoethanol (NEtFOSE), and *N*-methyl perfluorooctane sulfonamidoethanol (NMeFOSE) increased by over two orders of magnitude in the effluent py-liquid compared to the influent biosolids. This phenomenon occurred at all three temperatures tested. Similarly, the mass of PFBA also substantially increased following pyrolysis due either to the thermal breakdown of higher chain PFAS, the transformation of PFBA precursor compounds, or a combination of both. These key findings illuminate that pyrolysis of biosolids can cause transformation reactions that lead to specific PFAS in the effluent py-liquid found at higher levels than in the influent biosolids. Overall, this research indicates that pyrolysis could be employed to remove PFAS from biosolids to generate a value-added biochar product for soil amendment benefits, but py-liquid that contains PFAS could also be generated.

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Water impact

Concern over PFAS in biosolids has increased interest in pyrolysis as a solids handling process to mitigate this issue. This research revealed that pyrolysis removed PFAS from solids, generating a PFAS-free biochar. The py-liquid contained specific PFAS at higher levels than in the influent solids indicating pyrolysis alone is not a tool to mineralize PFAS.

1. Introduction

Water resource recovery facilities (WRRFs), also referred to as wastewater treatment plants, have historically been operated to meet regulations. However, recent efforts have targeted ways to maximize energy recovery and generate value-added products.[1,2] Biosolids are the stabilized solids stemming from treatment of municipal sludge and have long been used as a value-added product to recycle nutrients and carbon to land

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as a soil conditioner.[3] Concerns regarding per- and polyfluoroalkyl substances (PFAS) in biosolids, however, are threatening the long-term feasibility of biosolids land application. Indeed, Maine has banned land application of biosolids due to PFAS. Other states are evaluating control mechanisms as public and governmental discourse over PFAS increases, and PFAS is a high priority at the USEPA as well.[4–7] Consequently, utilities are reconsidering options around land application of biosolids.

Established solids stabilization processes such as anaerobic digestion, composting, and thermal drying do not remove PFAS from wastewater solids.[8] Pyrolysis has recently garnered interest as a wastewater solids stabilization process that could remove PFAS.[9–11] Pyrolysis is a thermal treatment process that heats wastewater solids or other carbonaceous materials at 400 to 900 °C without the presence of oxygen.[12,13] Pyrolysis converts biosolids to biochar, py-liquid, and py-gas.[14–16] The biochar is generally considered a value-added product, though the biosolids–biochar market is still emerging. It is similar to activated carbon and has value-added potential because it improves moisture holding capacity of soil, grass growth, and carbon sequestration.[17–19] Biochar can also be used as an adsorbent to remove micropollutants from wastewater.[20–22] The py-gas consists of reduced gases including hydrogen and methane and is a valuable product that can be used for energy recovery.[15] The py-liquid consists of a non-aqueous phase liquid (NAPL), *i.e.*, a py-oil phase, and an aqueous phase liquid (APL). While earlier research investigated pyrolysis for generation of py-liquid for its high energy content, more recent research revealed that the py-liquids can be difficult to handle.[15,23] APL is toxic to anaerobic digesters, and co-digestion requires acclimation periods.[24] The NAPL is high in aromatic compounds, and together these py-liquids are corrosive.[15] The value and management of each these effluent products would likely be altered by the presence, or absence, of PFAS.

Pyrolysis has been shown to remove organic compounds from biosolids, including triclosan, triclocarban, estrogenicity (*i.e.*, phenols), and antibiotic resistance genes.[25–27] Some of these compounds volatilized away from the influent solids and condensed with py-liquid, and others underwent chemical transformations. These previous studies shed light on what pyrolysis might do to PFAS. The possible fates of PFAS during pyrolysis include:[28,29]

i) no reaction, in which case the PFAS would remain with the biochar,

ii) volatilization away from solid phase to effluent py-liquid or py-gas, in which case the chemical structure of the influent PFAS remains unchanged,

iii) transformation whereby a chemical moiety changes (addition or loss of a chemical group); the resulting transformation product could still be classified as a PFAS, or

iv) mineralization whereby C–F bonds are broken and inorganic fluoride (F−) remains.

Only a few studies have investigated the impacts of pyrolysis on PFAS in biosolids. The first study by Kim *et al.*, in 2015 found that perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) were still present in biochar following pyrolysis at 700 °C, *i.e.*, they found that no reaction occurred.[30] These results are surprising in light of thermal studies on PFOA and PFOS that revealed 100% of PFOA volatilized by 200 °C and 80% of PFOS volatilized by 500 °C in a nitrogen atmosphere.[29] More recent studies found the biosolids-derived biochar to be void of detectable levels of PFAS.[9,31] Kundu *et al.* found that pyrolysis at 500–600 °C reduced PFAS to below detection limits in biochar.[31] Thoma *et al.* also observed removal of PFAS to below detection limits in a pilot-scale pyrolysis reactor operating at approximately 580 °C to 650 °C. Williams *et al.* found that pyrolysis at 700 °C removed all measured PFAS to below detection limit in the biochar; they found three PFAS in the biochar at 500 °C with an overall PFAS removal 99%.[32] While these studies have demonstrated that pyrolysis removes PFAS from wastewater solids, research has not fully explored the fate of PFAS in liquid and gas products of pyrolysis. This research gap is due in large part to a lack of established methods for quantifying PFAS in py-gas and py-liquid. While development of a validated gas method would require substantial work, a py-liquid method can be readily adapted from existing liquid analysis methods. Analysis of py-liquid for PFAS would shed important light on the impacts of pyrolysis on PFAS fate, including if influent PFAS or PFAS-transformation products exit the pyrolysis system. Additionally, pyrolysis of biosolids-PFAS studies have not employed the total oxidizable precursor (TOP) assay to determine if precursors to PFAS found in biosolids still reside in the biochar. Filling these research gaps will help determine if pyrolysis can be used to generate a biochar product void of PFAS and more broadly determine if PFAS transformation products are generated and associated with effluent products.

The objective of this research was to determine if PFAS reside in py-liquid following pyrolysis of biosolids. Based on temperatures employed during pyrolysis, it was hypothesized that pyrolysis would cause volatilization and transformation, but not complete mineralization of PFAS, and that PFAS would be detected in the py-liquid. To test this hypothesis, bench-scale pyrolysis experiments were conducted at 500–800 °C. Targeted PFAS were analyzed in the biosolids, biochar, and py-liquid samples. Additionally, PFAS precursor compounds were analyzed in the biosolids and biochar *via* the TOP assay to determine if pyrolysis removed these precursors from the solid phase and to help explain the presence of PFAS in py-liquid.

2. Materials and methods

2.1 Pyrolysis experiments

Experiments were conducted in a lab-scale batch pyrolysis system as shown in the ESI,† Fig. S1 and described elsewhere.[15,33,34] The feedstock used was dried biosolids that contained a heat dried blend of waste activated sludge and anaerobically digested primary solids. Approximate and ultimate analyses were detailed elsewhere; briefly, the volatile solids, fixed carbon, and ash content of the dried biosolids were 66.6%, 7.70%, and 25.7%, respectively (wt%, dry basis). The dried biosolids contained 36.5% carbon, 4.62% hydrogen, 7.18% nitrogen, 1.09% sulfur and 50.6% oxygen (by difference).[15]

Dried biosolid particles were pyrolyzed in triplicate at 500 °C, 650 °C, and 800 °C. Argon was purged into the pyrolysis vessel at 10–15 mL min^{-1} to guarantee an oxygen-free pyrolysis environment. The heating rate was controlled at 10 to 15 °C min^{-1} for slow pyrolysis. After the pyrolysis vessel reached the desired pyrolysis temperature, the vessel was maintained at that temperature for a retention time of 20 minutes to completely pyrolyze the feedstock. Pyrolysis vapor which contained py-gas and uncondensed py-liquid passed through the downstream transition tubing (maintained at 500 °C to prevent vapor from condensing during transition) and two condensers in an ice bath in which py-liquid and py-gas were separated. Py-liquid was collected in condensers and py-gas was collected in a Tedlar® bag. While py-liquid is biphasic as noted above in the introduction (APL + NAPL), it was collected as a single effluent liquid product. Biochar remained in the pyrolysis vessel until collection after the experiment. The masses of biochar and py-liquid were measured gravimetrically. The py-gas mass was calculated by difference (*i.e.* initial dried biosolids mass minus the sum of biochar and py-liquid masses). Biochar and py-liquid were transferred to sample containers and stored in a freezer.

In addition, a PFAS negative control pyrolysis test at 500 °C was performed using standard spectrum Ottawa sand that was purchased from Fisher Scientific to ensure no PFAS leached from the pyrolysis system. Sand was pyrolyzed using the same pyrolysis setup except that 10 mL of methanol (>99.8% HPLC grade purchased from Fisher Scientific) were loaded in two condensers (5 mL in each condenser, respectively) to capture possible condensate. The effluent gas from the control test was collected in a Tedlar® bag. For the control pyrolysis test, Ottawa sand and methanol were weighed before and after the test. Sand and methanol were transferred to sample containers and stored in a freezer. All the frozen samples were finally shipped to PACE® for PFAS analysis along with influent wastewater biosolids and Ottawa sand. No PFAS were detected in the negative control samples.

Table 1 Methods employed for PFAS analysis

Lab method[a]	Method reference
PFAS by isotope dilution (ID)	537 M/DoD QSM B-15
TOP assay	Lab-developed SOP[35]

[a] In some instances, Pace® modified its existing protocol for some of these novel matrices.

2.2 PFAS analysis

2.2.1 Analysis overview. A NELAC-accredited testing laboratory experienced with PFAS testing performed the analysis. Pace® utilized two of its PFAS centers of excellence to utilize the methods listed in Table 1. Throughout the entire study, samples were maintained in a laboratory-controlled, secure environment using the sample control and documentation procedures codified in the Pace® Laboratory Quality Systems Manual. The quality management system is intended to establish conformance and compliance with standards such as ISO 17025 and the NELAC/TNI standard.

2.2.2 Sample extraction. For targeted PFAS analysis of solid matrices (*e.g.*, biosolids, biochar), approximately 1 g of solid sample was spiked with isotopically-labeled extracted internal standards (EIS) and mixed with 4 mL of methanol and 4 mL of ammonia–methanol (0.6%). The spiked sample with extraction solvent was then shaken on an orbital shaker, followed by sonication and centrifugation. The extract was filtered by SPE followed by a cartridge rinse of 2 mL of clean methanol. The final extract volume following the filtration step was approximately 10 mL. 10 μL of the fortified aliquot was injected on an LC with a C18 column that is linked to an MS/MS detector. Additional details on EIS recovery is provided in the electronic supplemental information. While labelled internal standards were added as a QA/QC step, it is possible that they were more readily recovered than PFAS bound to biochar. Using an organic phase such as methanol should extract more PFAS from the biochar than would be expected to leach into an aqueous phase, but what percent of PFAS were successfully extracted is unknown. Therefore, PFAS concentrations in the biosolids and biochar are referred to as "extractable solid-phase concentrations".

For targeted PFAS analysis in the py-liquid, which was biphasic, Pace® thoroughly mixed the py-liquid and performed a 1 : 1 dilution of a 1 mL aliquot and methanol and added the appropriate EIS. This approach provides concentration data of PFAS across the well-mixed py-liquid sample and makes it possible to determine if PFAS are present in the py-liquid. The biphasic py-liquid sample consisting of APL and NAPL was mixed to have enough sample volume for PFAS analysis of py-liquid. The py-liquid (by volume) was approximately 35% APL and 65% NAPL. Future research can investigate the fate of PFAS between the two phases.

2.2.3 Quantification of target compounds. Pace® methods all employ isotope dilution quantification, whereby a group of isotopically-labeled pure chemicals referred to as EIS that chemically resemble target method analytes is added to a sample aliquot in known amount(s) before the extraction and analysis processes. The purpose of the EIS is to monitor method performance from extraction to final chromatographic measurement. For the ID methods, the EIS is also used as an isotope dilution standard to quantify the target analytes using relative chromatographic responses *via* LC-MS/MS.

Instrumentation used were either SCIEX 4500/5500 or Agilent 6495C LC-MS/MS systems. An injection volume of 10 μL was introduced into the HPLC system, where the target compounds and EIS are separated by a C18 column (3 μm, 50 mm × 3 mm). An Agilent 1260 HPLC was used for analyte separation and was coupled to one of the three triple quadrupole mass spectrometers for analyte detection and quantification. A combination of 20 mM aqueous ammonium acetate and methanol mobile phases were used for a gradient elution program with a flow rate of 1.2 mL min^{-1}.

The analytes are separated and identified by comparing the acquired mass spectra and retention times to the reference spectra and retention times for calibration standards acquired under identical LC-MS/MS conditions. The concentration of each analyte is determined by using the internal standard isotope dilution technique.

2.2.4 TOP assay for precursor compounds. The targeted methods described above were able to identify and individually quantitate 36 PFAS. However, it is widely known that there are thousands of PFAS, somewhere between 4730 (OECD, 2018) to over 12 000 (EPA CompTox database).[36,37] It is also widely known that the majority, estimated at greater than 80%, of all identified PFAS are precursors.[36] These precursors are known to transform, or under natural environmental conditions degrade, to "terminal" carboxylic acids (PFCA) or sulphonic acids (PFSA).[38] Many of these "terminal" PFCA/PFSA compounds are the most studied and regulated targeted compounds (*e.g.*, PFOA, PFHxA, PFBA). Therefore, it is important to (a) understand if biosolids contain precursors, which has in fact been documented,[39] (b) to quantify the total mass of precursors, and (c) to determine what happens to these precursors during the pyrolysis process.

The TOP assay is a powerful tool to measure the mass of precursors present. This method is designed to chemically convert all precursors in a sample into perfluoroalkyl acids (PFAAs), which can be readily measured. The premise of the TOP Assay method employed by Pace® is that an unknown sample, in this case the biosolids and biochar, were analyzed twice using a conventional LC-MS/MS targeted method: first the sample was analyzed as-is to understand the baseline concentration of targeted PFAS, then the sample was strongly oxidized, followed by a second conventional LC-MS/MS targeted assay. The strong oxidation process converts all precursor compounds that may be present to terminal PFAAs (primarily PFCAs) through an oxidative digestion. Specifically, the oxidative process involves introducing the sample to a highly basic persulfate solution that was then placed in a sealed container at an elevated temperature (85 °C) to thermolyze persulfate into sulfate radical. At elevated pH, the sulfate radical is scavenged by hydroxide and forms hydroxyl radical, which then converts any free PFAA precursor compounds to PFCAs. The predominant products of the precursors are the PFCAs, regardless of whether the precursors contain sulfonamide or telomer functionalities. The additional concentration of PFCAs generated after the strong oxidation step elucidates a worst-case (*i.e.*, highest) estimate of the concentration of oxidizable PFAA precursors. The increase in PFCAs measured after the TOP assay, relative to before, is an estimate of the total concentration of PFAA precursors present in a sample.

2.2.5 QA/QC. Rigorous quality control on the analysis was performed using the same type and frequency as that used during routine compliance monitoring (*e.g.*, drinking water methods); QC tools used include (1) monitoring EIS recoveries ensuring they recover within acceptance limits, (2) performing method blanks to monitor system and consumable cleanliness, (3) utilizing laboratory control samples (LCS), where known concentrations of all target compounds are spiked in reagent water, again ensuring the spiked recoveries are within recovery limits, and (4) utilizing matrix spike (MS) and matrix spike duplicates (MSD) using spiked replicates of actual study samples to monitor precision and accuracy of the extraction and analytical method. Detection limits for specific compounds are shown in the ESI.†

3. Results & discussion

3.1 Pyrolysis product yields

Biochar was the dominant product similar to previously published studies (Fig. 1).[15,40,41] The average biochar yield at 500 °C was nearly 50%, and biochar yield dropped as temperature increased with the average biochar yield at 800 °C being just under 43%. These biochar yields highlight a benefit of pyrolysis, *i.e.*, solids reduction. With over 50% solids reduction, associated solids hauling costs would be

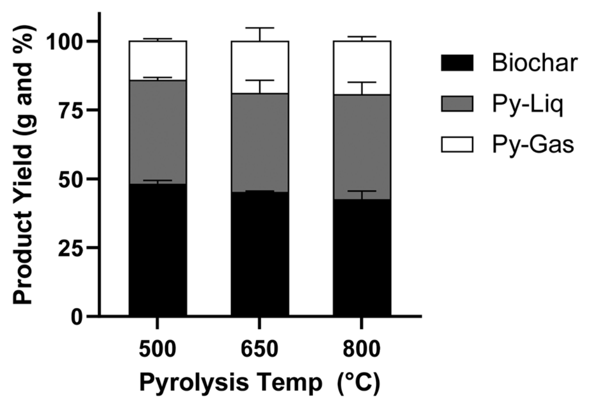

Fig. 1 Effect of pyrolysis temperature on product yield. These batch experiments were fed 100 g of dried biosolids as influent to the pyrolysis reactor; the sum of all three products was 100 g for each test. Triplicate tests were performed at each temperature. Bars represent average values and error bars are standard deviation.

reduced. The py-gas yield increased as temperature increased going from an average of 14% yield to 19% yield. The py-liquid average yield was between 35 and 40%. These yields are in line with previously published lab-scale and pilot-scale studies.[15,40,42] Biochar is a potential value-added product, and pyrolysis could be employed as a means to generate biochar; however, the value of biochar may vary depending on the presence of PFAS.

3.2 Pyrolysis removes PFAS from biosolids

At all three temperatures tested, pyrolysis removed PFAS from the influent biosolids (Fig. 2). PFAS detected prior to the TOP assay, *i.e.*, non-precursor PFAS, are shown in the figure as "Pre"; there were no PFAS above detection limit in the 500 °C or 650 °C biochar samples. Two of the three 800 °C biochar samples also did not have PFAS above detection limit, and one 800 °C biochar sample had PFBA just above detection limit at 0.047 μg kg^{-1}. Any PFAS present in biosolids–biochar would be much more likely to remain fixed in the solid material and be less likely to leach into environmental media relative to PFAS in biosolids. The lack of PFAS in biochar samples is important because several PFAS were found above detection limit in the influent biosolids (concentrations are also listed in Table S1 of the ESI†). For example, PFOS was above detection limits in the influent biosolids and is one of the most studied PFAS, in part because of health advisories released on PFOS for drinking water. 6:2 fluorotelomer sulfonate (6:2FTS), which is considered a PFAS precursor, and perfluorohexanoic acid (PFHxA), which is used in manufacturing products, were also detected in influent biosolids.[43–47] The removal of PFAS from biosolids during pyrolysis observed here is corroborated by other recent studies that found biochar to be void of PFAS.[9,31]

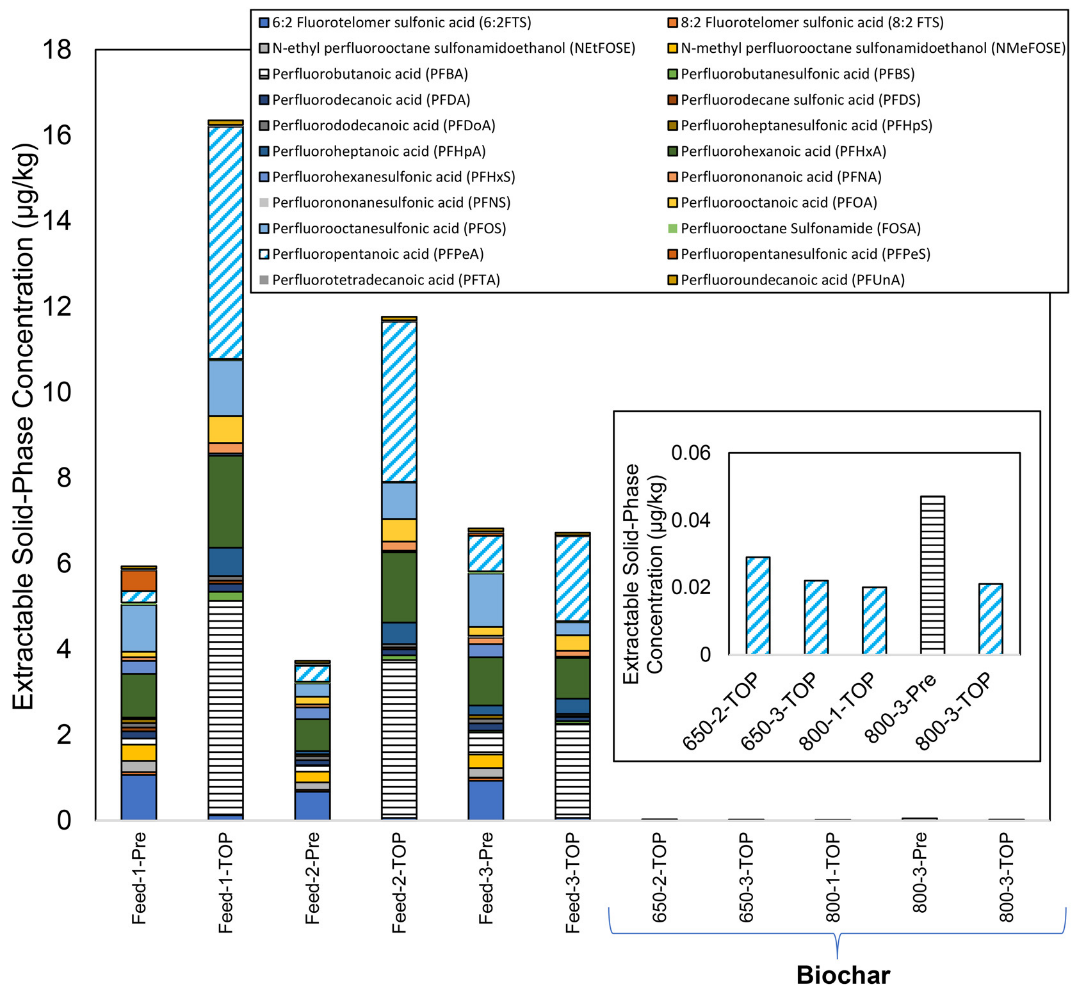

Fig. 2 Pyrolysis removes targeted PFAS and precursor compounds from solids. Samples labeled "Pre" were analyzed with targeted PFAS analysis prior to the TOP assay. Samples labelled "TOP" were analyzed after the TOP assay. All three feed biosolids samples had PFAS detected. For effluent biochar samples, only samples with PFAS detected above detection limits are shown. PFAS were not detected in any 500 °C biochar samples which is why there are no 500 °C biochar samples shown. The biochar samples with detections are shown in the inset with a lower scaled axis because concentrations were substantially lower than the feed concentrations.

The TOP assay results also corroborated that pyrolysis substantially removes PFAS, including precursor compounds, from biosolids (Fig. 2). The TOP assay drives precursor compounds to their terminal compound that can be measured, so in theory the TOP assay results should be equal to or greater than the targeted results for specific compounds (assuming each biosolid sample was homogenous when splitting between TOP analysis and targeted analysis). Thus, the sum of PFAS concentrations post TOP assay ranged from approximately 7 μg kg^{-1} to 16 μg kg^{-1}, higher than the 3–7 μg kg^{-1} range in targeted analysis (Fig. 2). It is noted though that the pre and post-TOP assay samples for influent biosolids sample 3 were similar. While the explanation for this is unknown and plausibly due to the heterogeneity of biosolids, the important overall observation is that pyrolysis removed PFAS and precursor compounds from biochar. All three 500 °C biochar samples were void of PFAS post the TOP assay. The 650 °C and 800 °C were mostly void of PFAS post TOP assay, except for two of the three biochar replicates at both temperatures having perfluoropentanoic acid (PFPeA) above detection limits.

The TOP assay provides a larger picture for PFAS and precursor compounds in biosolids and biochar. Removal of precursor compounds from biochar is important because it means biochar would not be a source of PFAS if land applied. While PFPeA was detected in some biochar samples, the solid-phase extractable concentration was very low and overall removal was greater than 99% (see ESI† Table S2 for masses of compounds). These TOP assay results, combined with targeted PFAS analysis results, indicate that pyrolysis can be used to remove PFAS from biochar.

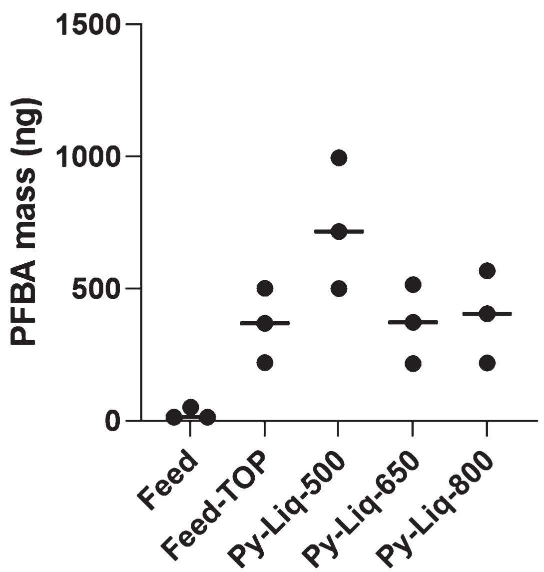

Fig. 3 Pyrolysis generates py-liquid with PFBA. "Feed" represents PFBA found in influent biosolids from targeted analysis. "Feed-TOP" represents PFBA found in influent biosolids post TOP assay. Py-liquid samples are separated by temperature. Each circle represents the result from an individual experiment. Horizontal bars for each data set represent mean of the three replicates.

3.3 Pyrolysis transforms PFAS, and the products are found in the py-liquid

3.3.1 More mass of perfluorobutanoic acid (PFBA) detected in effluent py-liquid than influent biosolids. PFBA is a four-carbon fluorinated compound that was detected in the py-liquid (Fig. 3). Pyrolysis may have converted PFBA-precursor compounds from the biosolids into PFBA that condensed into the py-liquid. PFBA was only detected at an average concentration of 0.27 μg kg^{-1} in the influent biosolids with the average total mass being 27 ng. Following the TOP assay, PFBA was found at an average concentration of 3.6 μg kg^{-1} with the average mass being 364 ng. The average mass of PFBA in the effluent py-liquid for 650 °C and 800 °C was similar to the mass of PFBA in the feed biosolids-TOP assay (Fig. 3). These data indicate that, while PFBA was present in low amounts in the biosolids, PFBA precursor compounds present in the influent biosolids may have been converted to PFBA during pyrolysis. These data highlight that employing the TOP assay on influent biosolids can shed light on PFAS that could be present in the effluent py-liquid. The average mass of PFBA in the py-liquid at 500 °C was higher (>700 ng) than the mass of PFBA in the py-liquid at the other two temperatures, indicating that either i) PFBA formed from an additional pathway besides precursor conversion, or ii) the influent biosolids to the 500 °C had more initial PFBA than the influent biosolids tested for analysis.

PFBA might also have formed from the breakdown of higher chain PFAS. Previous research on thermal stability of PFOS revealed that it thermally degraded to smaller products at 500 °C, and the degradation pathway included loss of CF_2 moieties.[29] A proposed degradation pathway of PFOS during pyrolysis is shown in Fig. S2.† This reaction presumes that, during pyrolysis, the PFOS molecule loses 4 fluoride moieties at the 1 and 2 carbon position and undergoes the addition of a hydroxyl group, resulting in the formation of intermediate $C_8H_4F_{13}O_5S$. Further reaction with pyrolysis caused desulfonation, cleaving the bond between the end group of the sulfonate ($-SO_3^-$) and the polyfluorinated tail. In this process, the polyfluorinated tail could be carboxylized at the end to form PFHpA. The PFHpA could be further degraded to PFHxA by losing $-CF_2$. Thus, the produced PFHxA undergoes further degradation of C6–C2 perfluoroalkyl groups gradually. PFOS, along with other PFAS that were detected in the influent biosolids, including, PFHpA, PFHxA, and PFPeA, are found in this pathway that leads to PFBA. A proposed degradation pathway of 6:2 FTS that leads to PFBA during pyrolysis is shown in Fig. S3.†[48] The average sum of these five compounds (PFOS, PFHpA, PFHxA, PFPeA, and 6:2 FTS) in the influent biosolids was 335 ng (see Table S2 in ESI†). This mass is similar to the PFBA mass in the py-liquid from the 650 °C and 800 °C tests. The breakdown of PFAS to PFBA and

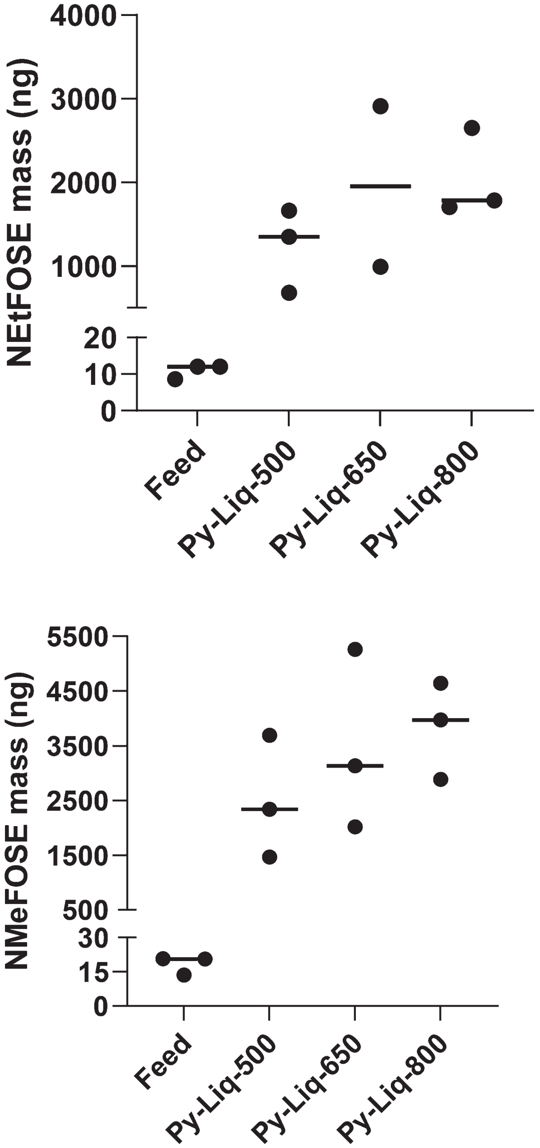

Fig. 4 Mass of NEtFOSE (top) and NMeFOSE (bottom) in influent and effluent products. These compounds were not detected in the biochar. Py-liquid samples are separated by temperature. Horizontal bars for each data set represent mean of the three replicates with the exception of 650 °C for EtFOSE which was detected in 2 of 3 py-liquid samples.

the conversion of precursors to PFBA could have explained the higher masses at 500 °C, but it is important to note that the actual pathway for PFBA being found in the py-liquid cannot be elucidated from these data alone. Future research is needed to investigate the specific pathways of formation. Nevertheless, these data indicate that pyrolysis of biosolids generates py-liquid that contains PFBA.

3.3.2 FOSE compounds increased by two-orders of magnitude in py-liquid. Pyrolysis substantially increased the mass of *N*-ethyl perfluorooctane sulfonamidoethanol (NEtFOSE) and *N*-methyl perfluorooctane sulfonamidoethanol (NMeFOSE) (Fig. 4). NEtFOSE was detected in eight of the nine py-liquid samples. The average concentration of NEtFOSE in the influent biosolids fed to the pyrolysis reactor was 0.1 μg kg^{-1} with the total mass being approximately 10 ng. The average concentration of NEtFOSE in the py-liquid was 32 μg L^{-1} with the average total mass being well over 1000 ng associated with the py-liquid at each temperature (Fig. 4). There was a 100×-fold increase in the mass of NEtFOSE after pyrolysis. Similarly, pyrolysis also substantially increased the mass of NMeFOSE which appeared in all nine py-liquid samples. NMeFOSE was detected at an average concentration of 0.18 μg kg^{-1} in the influent biosolids fed to the pyrolysis reactor with the total mass being approximately 18 ng. The average concentration of NMeFOSE in the py-liquid was 90 μg L^{-1} with the average total mass being well over 2000 ng associated with the py-liquid at each temperature (Fig. 4). Pyrolysis increased the mass of NMeFOSE 100×-fold.

NMeFOSE and NEtFOSE both have eight fluorinated carbons in a chain connected to an oxygenated sulfur head (Fig. S4†). PFOS also has eight fluorinated carbons in a chain connected to an oxygenated sulfur group. One main difference is that NEtFOSE and NMeFOSE have a nitrogen-based amide group connected to sulfur in lieu of the alcohol group that PFOS contains. Py-liquid contains high amounts of ammonia that stems from the high N levels found in biosolids.[24] Moreover, biosolids contain high levels of amines (approximately 20% by weight of total N).[49–51] The mass of PFOS alone in the influent biosolids is not enough to explain the formation of NEtFOSE and NMeFOSE, but the loss of PFOS from the solid phase and the formation of NEtFOSE and NMeFOSE in the py-liquid implies that PFOS could have reacted to form these two compounds. The high temperatures employed during pyrolysis combined with the initial PFAS present in biosolids and the high N levels in the influent biosolids likely resulted in the formation of FOSE compounds that resided with the py-liquid. It is possible these amines are reacting with PFAS to form NMeFOSE and NEtFOSE (Fig. S4†) with the formation of the sulfonamide group found on the FOSE compounds stemming from activation of sulfonic acid and amines.[52] Additional mechanism studies would be required to confirm this pathway. Collectively, these data indicate that pyrolysis can remove PFAS from the solid phase *via* volatilization and transformation reactions, but pyrolysis does not mineralize all PFAS as evidenced by PFAS detected in the py-liquid.

3.4 Environmental implications

These findings indicate that py-liquid contains PFAS at the μg L^{-1} level which is higher than drinking water health advisory levels. A fortunate aspect of this finding is that the py-liquid is not a primary beneficial end-product of pyrolysis. Py-gas is valuable for renewable energy, and biochar is valuable as a soil amendment, but the py-liquid is difficult to handle due to being corrosive and containing other undesirable toxic chemicals.[15,24] Thus, research has successfully investigated ways to increase py-gas while reducing py-liquid yields,[15] and one full-scale facility has developed a process to not produce py-liquid.[9] For instances where py-liquid is produced, it will be important to determine how PFAS partition between the two py-liquid phases (APL and NAPL) so that they can be properly handled. Now that this research has revealed that pyrolysis can release PFAS with effluent py-liquid, an important next step is to determine the fate of PFAS in the effluent py-gas which could also have PFAS and PFAS-transformation products. A wholistic understanding for the benefits on avoiding py-liquid will depend in part on the compounds detected in the py-gas phase.

This research was an important step in understanding the mass balance in PFAS during pyrolysis of biosolids, but critical research gaps remain. Specifically, to determine the extent of mineralization, a fluoride mass balance across all phases is required. The research presented here focused on the solid and liquid effluent phases, but PFAS in the py-gas phase were not quantified. Thermal degradation research on non-biosolids samples such as aqueous film-forming foams found several fluorinated volatile compounds such as perfluoroalkenes.[53] Additionally, total organic fluorine analysis would reveal how much of the PFAS removal from biosolids is due to transformation to other PFAS and will also reveal which phase the transformation products reside. Although difficult, it is imperative to develop and employ these methods on the gas phase to determine the impact of pyrolysis on PFAS in the environment, including in the air. A mass balance on fluoride will shed light on the relative fractions that reside with the solid, liquid, and gas phases. If the primary concern around PFAS and biosolids has only to do with the presence of PFAS in biosolids then pyrolysis is a technology that can reduce the PFAS load associated with wastewater solids. If the primary concern, however, is a global concern over the existence of PFAS then it remains unclear the extent to which pyrolysis of biosolids can be used to mineralize PFAS.

Conflicts of interest

The authors declare no conflict of interest.

Acknowledgements

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Exhibit 3

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Review

Potential hazards of biochar: The negative environmental impacts of biochar applications

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ABSTRACT

Biochar has been widely used as an environmentally friendly material for soil improvement and remediation, water pollution control, greenhouse gas emission reduction, and other purposes because of its characteristics such as a large surface area, porous structure, and abundant surface O-containing functional groups. However, some surface properties (i.e., (i) some surface properties (i.e., organic functional groups and inorganic components), (ii) changes in pH), and (iii) chemical reactions (e.g., aromatic C ring oxidation) that occur between biochar and the application environment may result in the release of harmful components. In this study, biochars with a potential risk to the environment were classified according to their harmful components, surface properties, structure, and particle size, and the potential negative environmental effects of these biochars and the mechanisms inducing these negative effects were reviewed. This article presents a comprehensive overview of the negative environmental impacts of biochar on soil, water, and atmospheric environments. It also summarizes various technical methods of environment-related risk detection and evaluation of biochar application, thereby providing a baseline reference and guiding significance for future biochar selection and toxicity detection, evaluation, and avoidance.

1. Introduction

With the increasing global population, it is necessary to seek efficient, environmentally friendly, sustainable, and economically feasible solutions to solve the pressing global problems of environmental pollution, food security, and resource and energy shortages (Chen et al., 2020; Wang et al., 2020b; Zhang et al., 2019a). In recent years, biochar has been widely applied for soil improvement (Teixidó et al., 2013; Ye et al., 2019), agricultural production (Oladele and Adetunji, 2020; Xia et al., 2020), greenhouse gas (GHG) emission reduction (Paustian et al., 2016; Roberts et al., 2010), water pollution treatment (Qin et al., 2020; Xing et al., 2020), waste management (Sparrevik et al., 2014; Yang et al., 2020), and other purposes (Fig. 1) because of its large surface area, rich porous structure, and high structural stability. Although biochar has been widely regarded as an environmentally friendly soil amendment, harmful components [heavy metals, polycyclic aromatic hydrocarbons (PAHs), environmentally persistent free radicals (EPFRs), dioxins, and perfluorochemicals (PFCs)] may be produced because of the improper selection of biomass feedstocks, preparation conditions, and preparation methods (Table 1). Recent studies have turned their attention to the negative environmental effects of biochar owing to its potentially harmful components and various interactions with the environment (El-Naggar et al., 2020; Cui et al., 2021).

Meanwhile, the evolution (aging) of biochar upon being subjected to environmental processes may produce negative effects in the environment (media) owing to changes in its properties, which not only affect the medium itself but also the interface of the medium (Rombola et al., 2019; Joseph et al., 2010). A soil–water–gas cycle is possibly induced during biochar transportation (Chen et al., 2018b). Biochar may be transported from soil to water due to migration and leaching, from water to soil due to runoff, from soil to the atmosphere due to wind erosion and weathering, and finally from the atmosphere to soil or water due to free settlement and precipitation (Wang et al., 2013a, 2013b; Novak et al., 2009). Therefore, it is imperative to systematically discuss the negative

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environmental effects of biochar from the perspective of various media to avoid possible risks.

Previous reviews and studies on biochar have mainly focused on the modification of biochar (Ye et al., 2020), reaction mechanisms (Yang et al., 2020), and the active role of biochar in environmental remediation (Deng et al., 2021). However, the negative effects and potential risks of biochar have only recently been highlighted. For example, Zhang et al. (2019a) and Lian and Xing (2017) briefly mentioned the environmental risks of biochar in their commentaries; however, the comprehensive phenomena and mechanisms involved require elucidation. Similarly, Godlewska et al. (2021) reviewed the potential environmental risks of biochar in a single environmental medium (soil); however, the potential hazards of biochar to water and the atmosphere, as well as the comprehensive effects on different media, must be investigated. The utilization of life cycle assessment (LCA) to assess the negative impacts of biochar has recently been focused on (Owsianiak et al., 2018; Wowra et al., 2021), which should be summarized and reviewed for research guidance. Therefore, the overall potential risks of biochar application in soil, water, and the atmosphere must be comprehensively studied to determine the corresponding occurrence, detection, assessment, and avoidance measures of these risks.

2. Negative impact potential of biochar

Considering the harmful components, structure, and particle size of biochar, the negative effects of biochar application on the environment should not be ignored. In this section, the mechanisms that induce these negative effects are discussed.

2.1. *Harmful components of biochar*

2.1.1. *Internal harmful components of biochar*

Based on the information in previous studies (Visioli et al., 2016; Hale et al., 2012; Lyu et al., 2016; Zhang et al., 2019c), this section describes the primary environmentally harmful substances in biochar [heavy metals, PAHs, dioxins, EPFRs, PFCs, and volatile organic compounds (VOCs)]. Most of the cited articles are laboratory-scale studies; however, the amount of biochar typically used in such experiments is close to the actual amount that would be used in environmental remediation. Moreover, actual water or soil was used in the laboratory experiments or formulated by chemical reagents. Because of the experimental conditions, the application time in most studies was usually shorter than that in field experiments. Under laboratory conditions, although the actual amount of biochar may have negative environmental impacts over a short period and can be reduced or degraded in the long term (Quilliam et al., 2013b), these phenomena are correlated with actual field remediation conditions. Therefore, these laboratory-scale studies have high relevance in the field.

2.1.1.1. Heavy metals. The content and bioavailability of heavy metals in biochar varies with biomass type. When biomass with a high heavy metal content is used, the resulting biochar may increase the environmental heavy metal content because of processes such as leaching. *Miscanthus*, an energy crop, often grows in soils fertilized with sewage sludge or wastewater and shows high accumulation of trace metals (Galbally et al., 2014). Oleszczuk et al. (2013) also reported that *Miscanthus*-derived biochar showed a higher hazardous metal content than other biochars and might leach heavy metals to the environment. von Gunten et al. (2017) found that in wood biochar (derived from pin wood chips, bamboo, or oak), heavy metals such as Zn and Mn (present in large amounts) may mainly exist in the form of monovalent and divalent cations. Therefore, these heavy metals are weakly adsorbed onto the biochar matrix and are easily released, even under mild conditions (such as irrigation) (Forghani et al., 2012). Wood-derived biochar has a large surface area (180–270 m^2/g), and thus a higher heavy metal concentration in the exchangeable/acid-soluble fraction (sometimes greater than 50% of the total) may lead to higher heavy metal bioavailability (von Gunten et al., 2017). Controlling the pyrolysis temperature is also important for controlling the heavy metal content in biochar. For example, Devi and Saroha (2014) found that the Cu, Pb, and Zn contents in biochar increased significantly as the temperature increased, and when the pyrolysis temperature increased from 200 °C to 700 °C, the contents of the three metals increased by 61%, 73%, and 65%, respectively. This occurred mainly because as the temperature increased, the organic matter (OM) present in the biomass decomposed, which in turn led to the release of heavy metals bound to the OM. It has been found that the heavy metal bioavailability in biochar may decrease as the pyrolysis temperature increases (Devi and Saroha, 2014). The

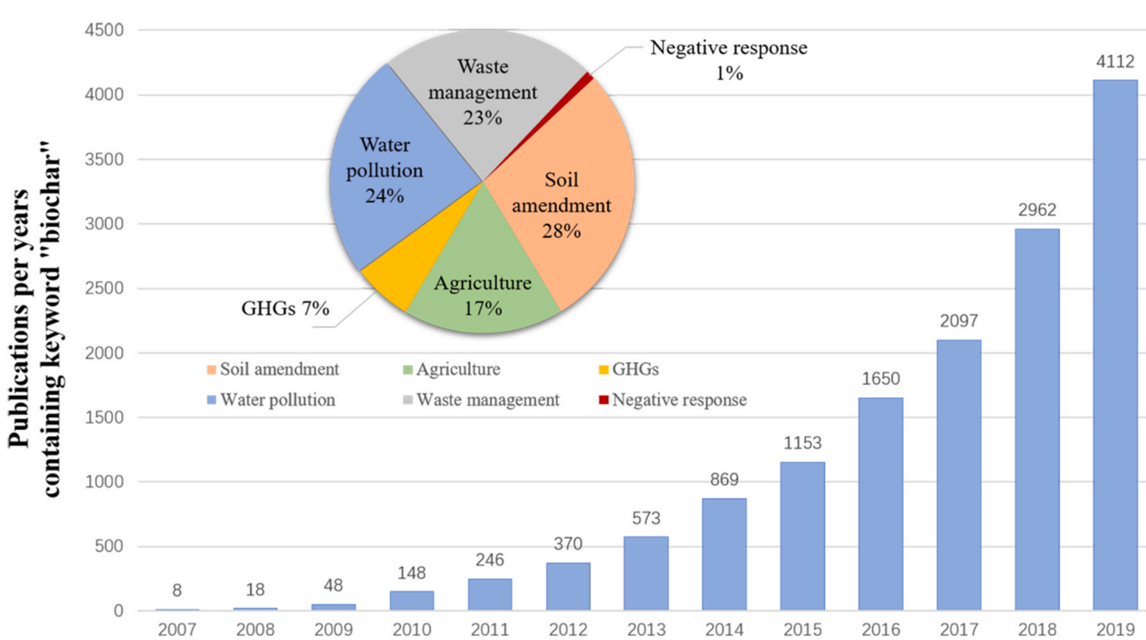

Fig. 1. Publications per year containing the keyword "biochar" on indexed journals between 2007 and 2019. The percentage of motivation in biochar application. The data is based on the search results from Web of Science (Nov. 2020).

environmental risk of heavy metals in biochar not only depends on the heavy metal content and pyrolysis temperature, but also on the pH, existing forms of heavy metals, mineral structures, and application environment. Devi and Saroha (2014) reported a contrasting effect of pH on the leaching capacity of heavy metals in sludge biochar. The heavy metals in the biochar showed the maximum leaching ability at a pH of 3 because low pH conditions generally enhance metal dissolution. As the pH of the solution increased from 3 to 7, the leaching amount decreased. A further increase in the solution pH from 7 to 13 led to an increase in the leaching of heavy metals, especially Cr. This might have occurred because the leached Cr reacted with CaO to form $CaCrO_4$ after carbonate decomposition (Zheng et al., 2010). Meanwhile, the environmental medium may change the forms of heavy metals in biochar, which may change the potential risk degree of the latter. Studies have shown that the environmental risks in different forms of heavy metals are in the order (from high to low) of carbonate-bound state, Fe-Mn oxide-bound state, OM, sulfide-bound state, and residual state. When alkaline biochar with a high heavy metal content (higher content of acid-soluble or exchangeable fractions) is used in acidic soil media, Cd, Zn, Pb, and Cu in the biochar may be activated and converted from a low-risk state (e.g., residual state) to a high-risk state (e.g., carbonate-bound state) (Bandara et al., 2017). This is mainly because with the decrease in soil pH, the free metal components of heavy metals in the soil, the reciprocal action, and the heavy metal contact and absorption of the plant may increase (Wu et al., 2021b). Therefore, the type of biomass feedstock and pyrolysis temperature should be correctly selected when producing biochar to reduce its heavy metal content as much as possible (Table 1). If the application of biochar with a high heavy metal content cannot be avoided (Table 2), then it is necessary to systematically consider the relationship between the biochar and the environmental medium, such as the soil pH, to minimize the environmental risks of biochar due to the presence of heavy metals. The literature provides contradictory results. Chagas et al. (2021) reported that when using sludge biochar with a high heavy metal content, heavy metal leaching in the environmental medium was measured using diethylenetriamine pentaacetate, and it was found that the amount of heavy metal leaching was lower than the highest limit of the international standard. This might have occurred because the biomass component bonded with the high-concentration metal component during the char formation process, thereby resulting in the formation of a metal–C/metal–O–C bond structure (Alipour et al., 2021), which stabilized the heavy metal morphology and made leaching more difficult. However, to review the potential risks of biochar as thoroughly as possible, this relatively stable combination should also be treated as a potentially risky environmental pollutant (Odinga et al., 2020).

2.1.1.2. PAHs. PAHs, which have high biotoxicity, can influence the survival of plants and microorganisms in different environmental media. In the literature, the PAH content in biochar prepared from biomass was different under different production conditions (such as temperature) (Hale et al., 2012) (Table 3). The PAH content in biochar from different feedstocks is naturally different; biochar obtained from hemp has a higher mutagen content than that obtained from wood (Anjum et al., 2014). Because there are few PAH precursors in plant biomass, the main PAH in biochar produced from plant biomass-dominated feedstocks is light naphthalene. Hale et al. (2012) conducted a quantitative analysis of PAHs in more than 50 biochars by slow pyrolysis (characterized by slow heating of organic material to approximately 400 °C in the absence of O with long solid and gas residence times, typically for several minutes to hours) between 250 °C and 900 °C. It was found that the total concentration of PAHs in the slow pyrolysis biochar was lower than that in the fast pyrolysis and gasification biochar. Flash evaporation also increased the PAH content of biochar. The PAH content in biochar generally decreases as the pyrolysis time and temperature increase. Hale et al. (2012) reported that the PAH concentration of pine wood at 900 °C was significantly lower than that at all other production temperatures (except for at 600 °C) because the π–π interactions between PAHs and biochar would be disrupted by an increase in pyrolysis time and temperature. Additionally, as the pyrolysis temperature increased, the release of Ca, Al, and Ba in the biochar also increased, which was conducive to the leaching of PAHs. The leaching of PAHs occurs because of the destruction of hydrophobic organic compounds (HOCs)–metal ion–mineral bonds, thereby improving the release of HOCs and HOC-bound PAHs. Moreover, the extent of metal cross-linking in

Table 1
Main pollutants and avoidance measures of biochar obtained under different biomass and preparation conditions.

Biomass/Conditions		Dominant pollutants	Total concentrations	Bioavailability	Risk avoidance measures	Reference
Wood biochar	Pin wood Chips Bamboo Oak	Heavy metals (Zn, Mn)	–	Sometimes more than 50% of the total	Biomass with low heavy metal content is recommend	(von Gunten et al., 2017)
Sewage sludge		Heavy metals (Zn, Cu, Pb,)	41.4-54.6, 2.7-11.6, 6.6-7.6 mg/kg	7-10%, 12-32%, 14-18%	–	(Chen et al., 2018a)
		PFCs (PFOA, PFOS)	10.6-11.5 ng/g, 4.8-6.3 ng/g	–		(Sun et al., 2011)
		PAHs	13.88-15.49 mg/kg	11.75 μg/L		(Chen et al., 2019b)
Food waste (with high content of salt)		Dioxins	–	1.2 pg/g TEQ	Choose biomass with low chlorine content	(Hale et al., 2012; Sørmo et al., 2020)
Softwood (Douglas firs)		EPFR	–	–	Hardwood is recommended	(Lei et al., 2019)
Plant (herbaceous plant)		MB/NB	–	The toxicity increased with the decrease of particle size	Woody plant biochar is less prone to physical aging	(Luo et al., 2017; Jia et al., 2021)
Ball milling technology						
High temperature		Heavy metals	Increases with increasing temperature (200-700 °C)	–	Reasonable selection of pyrolysis temperature	(Devi and Saroha, 2014)
		EPFR	Increases with increasing temperature	Increases with increasing temperature		(Zhang et al., 2019c)
Low temperature		PAHs	–	–	Reasonable selection of pyrolysis temperature	(Devi and Saroha, 2014)
		MB/NB				(Yang et al., 2019)
pH		Heavy metals	–	pH 3-7: decline pH 7-13: rise	Consider the pH of biochar and medium	(Devi and Saroha, 2014)
Pyrolysis rate		PAHs (fast, flash evaporation)	–	–	Slow pyrolysis is recommended	(Hale et al., 2012)

Table 2
The types and concentrations of heavy metals in some of biomass and corresponding biochar.

Biomass category	Biomass	Types of main heavy metals	Concentrations of heavy metals (mg/kg)	Leachability of heavy metals (mg/kg)	Bioavailability of heavy metals (mg/kg)	Reference
Animal excrements	Pig manure	Zn, Cu	129.24, 122.89	1.21, 2.38	31.05, 129.24	(Meng et al., 2017)
Sewage sludge	Municipal sewage sludge	Zn, Cu, Pb, Fe	2103.6 ± 61.1, 690.8 ± 4.3, 438.3 ± 6.3, 192.8 ± 407.6	–	47.50, 11.30, 10.38, 196.60	(Lu et al., 2013)
Sewage sludge	paper mill sludge	Zn, Cu, Pb, Ni	332.79, 146.97, 52.99, 20.81	7.98, 3.72, 0.72, 1.81	1.12 , 4.03 , 0.83 , 0.49	(Devi and Saroha, 2014)
Plant	Miscanthus	Zn, Cu, Pb, Ni, Cr	102.00, 2.22, 22.30, 9.95, 18.00	–	–	(Oleszczuk et al., 2013)
Plant	Wicker	Zn, Pb	21.60, 32.90	–	–	(Oleszczuk et al., 2013)
Plant	Pennisetum sinese	Cu, Cd	MB: 21.40, 6.31	2.31, 1.64	3.93 ± 0.20a, 1.47 ± 0.12a	(Cui et al., 2021)
			HB: 40.20, 5.29	1.22, 0.80	3.26 ± 0.15bc, 0.53 ± 0.05cd	
Food waste	Restaurant food waste	Zn, Pb, Fe, Mn	0.03, 0.03, 4.21, 0.03	–	–	(Oleszczuk et al., 2013)
Food waste	Coconut shell	Zn, Cu, Mn	41.46, 33.84, 41.47	–	–	(Castilla-Caballero et al., 2020)

HB, MB: biochars with different concentrations of Cu and Cd were produced from the straws of *Pennisetum sinese* grown in moderately-polluted (MB) and highly-polluted (HB) soils.

Table 3
Total and bioavailable PAHs content in biochar derived from different biomass and operating conditions.

Biomass	Temperature (°C)	Production conditions	PAHs	Total PAHs concentration (μg/kg)	Dominant PAHs	Bioavailable PAHs	Reference
Hemp	500	Atmosphere: N2 Residence time: 30min	16 US EPA	34900 (dry mass)	2- ring (NAP), 3- ring (PHE)	N/D	(Anjum et al., 2014)
Wood pellets	500	Atmosphere: N2 Residence time: 30min	16 US EPA	33700 (dry mass)	3- ring (PHE)	N/D	(Anjum et al., 2014)
Corn stover	350 450 550	–	16 US EPA	1609 1959 1770	3- ring (PHE) 2- ring (NAP) 2- ring (NAP)	1.62 ng/L 1.41 ng/L 1.303 ng/L	(Hale et al., 2012)
Pine wood (PW Pinus ponderosa)	500 700 900	–	16 US EPA	106 111 73	3- ring (PHE) 2- ring (NAP) 2- ring (NAP)	1.297 ng/L 1.103 ng/L 1.304 ng/L	(Hale et al., 2012)
Hardwood	–	–	16 US EPA	338	2- ring (NAP)	1.904 ng/L	(Hale et al., 2012)
Sewage sludge	500 600 700	Atmosphere: N2 Residence time: 3h	16 US EPA	2263 1730 1449	3- ring (PHE)	44 ng/L 51 ng/L 46 ng/L	(Kończak et al., 2019)
Wood Rice husk Softwood Rice	450 500	Residence time: 48h	16 US EPA	9556 64650 8701 2267	2- ring 2- ring 2- ring 4- ring (PYR)	N/D	(Quilliam et al., 2013b)
Poplar wood Grape marc Wheat straw	1200	gasification	16 US EPA	15660 3810 15840	4- ring (PYR) 3- ring (ACY) 4- ring (PYR, FLT)	N/D	(Visioli et al., 2016)
Softwood pellets	550	Residence time: 20min Some biochars went through re-condensation	16 US EPA	6090-53420	2- ring, 3- ring (PHE)	<0.001-2.040 μg/g	(Buss et al., 2015)

biochar is reduced during the leaching process, resulting in the diffusion of PAHs through the internal matrix and accelerating the desorption of PAHs (Chen et al., 2019b; Van de Wiele et al., 2004). Chen et al. (2019b) evaluated the leaching behavior of PAHs in biochar derived from sewage sludge pyrolyzed at different temperatures (300–700 °C). The total PAH concentration in the leachate reached its peak of 11.75 μg/L at 700 °C, which was equivalent to 15.9% of the total PAHs in the biochar. Rombolà et al., (2015) proposed that almost 1 year after the last biochar application, the total PAH concentration in the amended soils (153 ± 38 ng/g) was significantly higher than that in the control soil (24 ± 3 ng/g). Similarly, Quilliam et al. (2013a, 2013b) found that the concentration of 16 United States Environmental Protection Agency priority PAHs in a soil amended with wood-based biochar (50 t/ha) for 3 years was 1953 μg/kg, which was observably higher than that of the control soil (1131 μg/kg). This phenomenon occurred because plants actively or passively release root secretions, which enhance the release of PAHs in biochar by changing the surface structure of biochar or dissolving solid OM combined with PAHs (Wang et al., 2018). Regarding the environmental risk of PAHs, their bioavailability is more important and is mainly affected by the pyrolysis temperature and biomass of the raw materials. Some studies reported that biochar produced at low pyrolysis temperatures may contain a high content and bioavailability of PAHs (Hale et al., 2012) (Table 3). Other studies found that among various biomasses, the PAHs (mainly 3-ring PAHs) produced from sludge have the highest bioavailability (37–126 ng/L) and generally appear at 500–600 °C (Hale et al., 2012).

2.1.1.3. Dioxins. Harmful components, such as dioxins, may also be produced during biochar preparation (Tsouloufa et al., 2020). The preparation conditions are the key factors affecting the amount of dioxins in biochar. Hale et al. (2012) quantitatively studied the dioxins (130 toxic and non-toxic dioxins) in more than 50 types of biochars (derived from food waste, digested milk fertilizer, pine wood, and pine) produced by slow pyrolysis between 250 °C and 900 °C with concentrations ranging from 84 ng/kg to 92 ng/kg. Food waste, which often has a high salt content, has been shown to contain a significant amount of dioxins (Sørmo et al., 2020). The selection of the biochar pyrolysis temperature also has an effect on the formation of dioxins. Although dioxins are destroyed at production temperatures of > 1000 °C, the energy consumption increases significantly. Therefore, the initial biomass feedstocks should have sufficiently low Cl contents to prevent the formation of detectable levels of dioxins (Wiedner et al., 2013). However, the dioxin concentration alone is not a direct indication of the environmental risk of dioxins because such risk is usually expressed by the toxicity equivalency quotient (TEQ). The limits established by the International Biochar Initiative and European Biochar Certificate for dioxins in biochar are 17 ng/kg and 20 ng/kg TEQ, respectively. Lyu et al. (2016) discovered that the dioxin concentration was 50–610 pg/g in wood chip-derived biochar produced at 250–700 °C, and the TEQ was significantly lower (1.7-9.6 pg/g). Hale et al. also observed the highest TEQ concentration (1.2 pg/g TEQ) in biochar derived from food residues at 300 °C (Hale et al., 2012). The bioavailable dioxin content was below the detection limit. Therefore, the dioxin content in biochar is generally low. However, environmental contamination can still occur under circumstances with repeated application of biochar containing these compounds.

2.1.1.4. EPFRs. A very strong EPFR signal can be detected in biochar, which is generally 10^{18} unpaired spins per gram (Fang et al., 2014). These EPFRs are widely involved in environmental processes during the production and large-scale application of biochar (Pan et al., 2019). During pyrolysis, the organic components of biomass are thermally decomposed, and both the type of raw materials and carbonization conditions contribute to the formation of EPFRs in the process. Lignin, cellulose, and hemicellulose are the main precursors of EPFR formation in biochar (Fig. 2a) (Odinga et al., 2020). Because there are two possible cleavage positions in the cellulose chain, free radicals may be formed via the uniform cleavage reaction of the chain (Zhang et al., 2013). Compared with cellulose and hemicellulose, lignin has a tighter structure. Thus, cellulose undergoes a strong decomposition reaction, which includes the gradual reaction of EPFRs (Kibet et al., 2012). Compared with non-wood and hardwood lignin, softwood lignin contains more G-type subunits and a phenylcoumaran structure, which contains a weak α-aryl ether bond, thereby leading to the production of more free radicals under the same conditions (Lei et al., 2019). Therefore, more attention should be paid to the potential environmental risks of EPFRs in the application of biochar, especially softwood-derived (e.g., Douglas fir) biochar. In addition, EPFRs can be produced from biochar residues in the environment. This process occurs mainly because of the presence of transition metals, such as Fe^{2+} (Assaf et al., 2016). Transition metals are usually transferred onto biomass via chemical adsorption during pyrolysis and then continue to transfer electrons from the polymer to the metal center, thereby leading to the formation of EPFRs (Ruan et al., 2019). Lignin and cellulose in biomass may be decomposed to form aromatic molecular precursors during pyrolysis and converted into EPFRs after exposure to air. In addition, a stable EPFR can be generated directly without precursors at high pyrolysis temperatures (Fig. 2a) (Maskos et al., 2005). In addition to the influence of the type of biomass

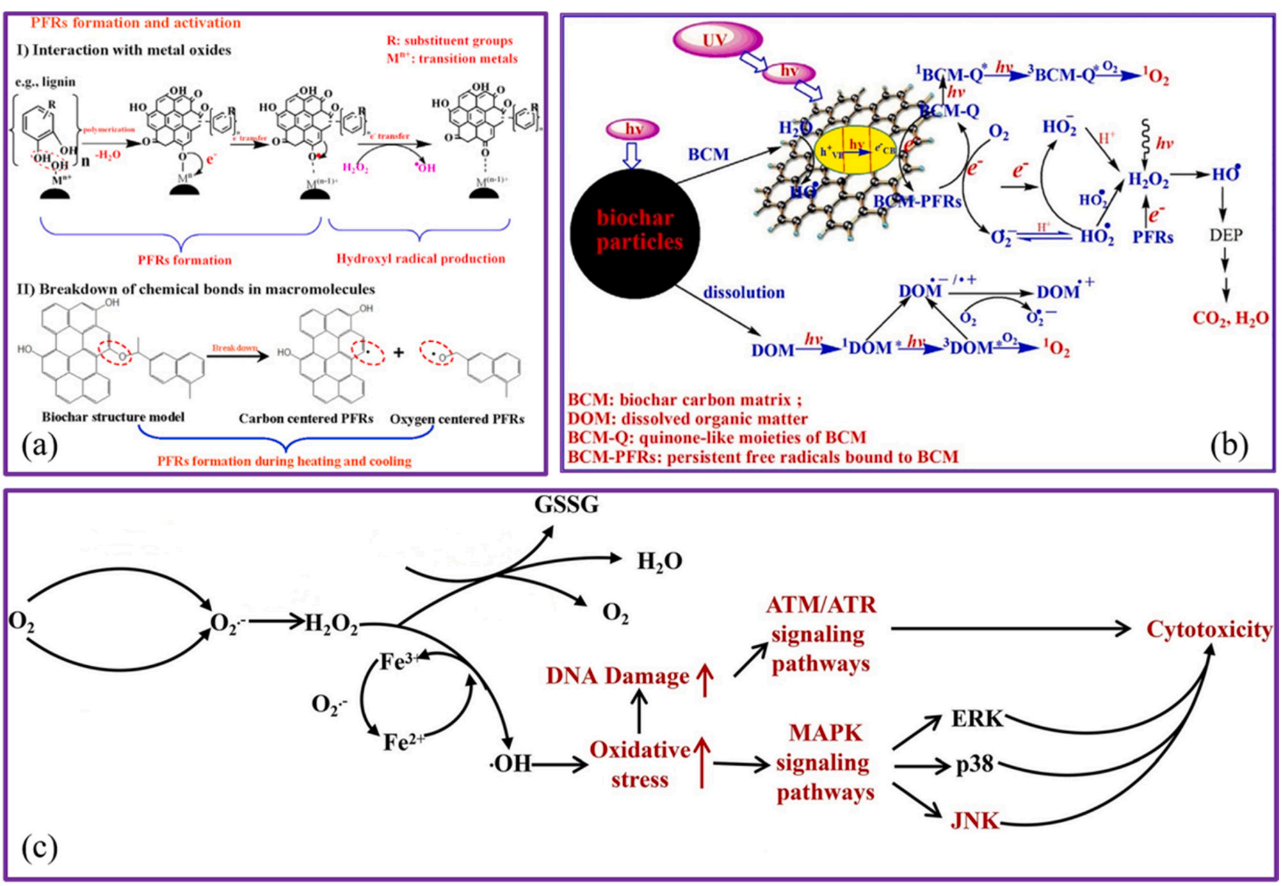

Fig. 2. EPFR induces the formation of ROS and the biological toxicity mechanism of ROS production (a) Schematic of the mechanisms of PFR formation and free radical generation on biochar, including: I) the interaction between organic compounds containing oxygenous functional groups and metal oxidation, and II) the breaking of chemical bonds in macromolecules during heating and cooling. (b) Proposed framework for ROS formation from biochar suspension under light. (c) The mechanism of ROS biological toxicity, the figure is modified from reference materials.
(a) Reproduced with permission from ref (Zhu et al., 2017). Copyright 2017 Elsevier. (b) Reproduced with permission from ref (Ruan et al., 2019). Copyright 2019 Elsevier. (c) Reproduced with permission from ref (Liang et al., 2019). Copyright 2019 Elsevier.

on the EPFR content in biochar, in one study, the EPFR signal intensities increased as the pyrolysis temperature increased (Liao et al., 2014). This indicated that the increase in pyrolysis temperature (200–500 °C) caused the formation of EPFRs in the biochar. When the pyrolysis temperature was further increased to 600 °C, the organic compounds in the biomass, which are the main components required for EPFR formation, decomposed (Zhang et al., 2019c; Fang et al., 2015). Moreover, the concentration of EPFRs in the biochar increased at higher temperatures. Considering the binding ability of environmental media (especially soils with a high complexing/binding capacity), the total EPFR concentration cannot directly represent the toxicity index; however, the bioavailability of EPFRs should be used as an index for toxicity assessment. Maskos et al. (2005) found that the free radicals produced by biochar obtained at a high temperature of 450 °C had greater environmental sustainability than those produced by biochar obtained at 320 °C. This suggests that the pyrolysis temperature affects not only the free radical content in biochar, but also the environmental sustainability of free radicals. Accordingly, the importance of the pyrolysis temperature in biochar production should be determined.

A study of persistent free radicals similar to EPFRs found that the stability of the properties of biologically active free radicals is due to their long-term presence on the surface of particulate matter (PM) in the atmosphere (Stephenson et al., 2016), which is the result of redox reactions under atmospheric conditions (Nwosu et al., 2016). Thus, EPFRs in biochar are stable on the surface of transition metals and can persist in the atmosphere (Odinga et al., 2020). EPFRs in biochar may pose a potential environmental risk because they can induce the formation of reactive oxygen species (ROS) with high phytotoxicity and cytotoxicity within environmental media (Fig. 2c) (Dellinger et al., 2000). The internal mechanism of ROS production induced by EPFRs can be explained by the semiquinone-phenoxyl hypothesis, which states that semiquinone radical anions react with molecular O to form superoxide, which then reacts with biological reduction equivalents (such as nicotinamide adenine dinucleotide phosphate and ascorbate) to disproportionate to hydroxyl peroxide (Lomnicki et al., 2008). Moreover, the biotoxicity and cytotoxicity of EPFRs may be related to induced oxidative stress, which can lead to cell cancer and death (Liao et al., 2014; Xue et al., 2020). Balakrishna et al. (2009) found that EPFRs significantly increased ROS production in BEAS-2B cells and reduced cellular antioxidants, which ultimately led to cell death. Therefore, the ratio of oxidants and antioxidants may become imbalanced owing to the ROS induced by EPFRs, thereby leading to cell death (Xue et al., 2020; Kisin et al., 2011). Meanwhile, the ROS induced by EPFRs may also react with macromolecules (e.g., glycoproteins), thereby leading to membrane instability, which further results in cell apoptosis (Odinga et al., 2020). Zhang et al. (2019c) used pine needle-derived biochar to explore its biotoxicity to aquatic algae. The results showed that EPFRs in the biochar induced the production of not only acellular ROS (e.g., ·OH) in water (Fig. 2b), but also intracellular ROS in aquatic organisms. Therefore, the ROS and superoxide dismutase (SOD) activities in algae cells were both upregulated, thereby leading to oxidative damage.

2.1.1.5. Other contaminants. In addition to the typical pollutants mentioned above, which are often discussed, there may be other environmentally harmful substances in biochar owing to the different types of raw materials used for biochar production. For example, PFCs are persistent pollutants with high resistance to both chemical and thermal degradation (Yu et al., 2009). Kim et al. (2015b) studied the pollution caused by perfluorooctane sulfonic acid (PFOS) and perfluorooctane acid (PFOA) present in plant residues and sewage sludge after biochar formation. It was found that the total residual concentration of PFOA and PFOS in the sludge biochar was 15.8–16.9 ng/g, which did not decrease significantly after pyrolysis. However, these perfluorocarbons were not found in plant-derived biochar. Additionally, biotoxic VOCs are potential environmental pollutants in biochar. For instance, Spokas et al. (2011) tested the VOC content in biochar produced from more than 30 material types under different conditions and found that acetone, benzene, methyl ethyl ketone, toluene, and methyl acetate were identified in more than half of the biochars. Buss et al. (2015) also observed that the re-condensation of VOCs occurred during the preparation of biochar from pyrolyzed cork, which in turn resulted in a higher VOC content.

2.1.2. External pollutants adsorbed onto biochar

After biochar is applied to an environmental medium, it undergoes physical, chemical, and biological actions during its contact with various parts of the medium, which promotes its aging and significantly changes its characteristics (Lehmann et al., 2011) (Fig. 3). Physical aging mainly refers to the effect of various physical factors on biochar after entering the environment. For example, owing to wear, impact, or wind effects, biochar may shrink in size after entering the environment. Compared to woody plant biochar, herbaceous plant biochar is more susceptible to such physical forces (Skjemstad and Graetz, 2003). Under the action of these physical conditions, large pieces of biochar may be broken up, thereby exposing more surface area, which is beneficial to chemical and biological aging processes (Prendergast-Miller et al., 2014). Chemical aging mainly refers to changes in the chemical structure (property) of biochar due to chemical oxidation after application in the environment (Luo et al., 2017). Through the analysis and summary of the literature, it was found that oxidants can violently oxidize biochar, altering its surface structure and resulting in the generation of oxygen-containing functional groups (hydroxyl, nitro, and carboxyl groups) (Wang et al., 2017). Biological aging mainly refers to the process by which microorganisms use biochar as a substrate for oxidative respiration and other life activities (Zimmerman, 2010). During this process, extracellular enzymes are secreted from microorganisms, which leads to the breakage of the C-C bonds of the aromatic structure of biochar, thereby resulting in biochar degradation (Czimczik and Masiello, 2007).

The biochar aging process is extremely complex. In the natural environment, owing to the synergistic effects of physical, chemical, and biological aging, the physical and chemical properties of biochar and its influence on environmental media change dynamically. The three main points of this process are described as follows:

(1) Theoretically, the increase in O-containing functional groups on the surface of the aged biochar strengthens the ion exchange with heavy metals (Luo et al., 2017; Wu et al., 2021a). However, Guo et al. (2014) proposed that over a range of pH (5.0-6.8), the cation exchange capacity and adsorption capacity of Cu(II) on the aged biochar were smaller than those of new biochar. The dissociation properties of oxygen-containing functional groups change during aging, which may be the mechanism of inhibiting Cu(II) adsorption during aging of biochar. Compared to low pH range (3.3–5.0), within a relatively high pH range (5.0–6.8), functional groups (phenolic hydroxyl) that are more difficult to dissociate played a major role. Furthermore, the aging process could make it more difficult for functional groups on the biochar surface to dissociate, thus inhibiting the adsorption of Cu(II). Therefore, it is necessary to comprehensively consider the pH of the medium and the internal mechanism of the heavy metal adsorption by biochar when determining the changes in the heavy metal adsorption capacity of the aged biochar. In addition, under the acidic conditions formed by aging, some heavy metal ions (such as Cr) undergo a reduction reaction and exist in the form of precipitates (Choppala et al., 2016), thereby reducing the amount of heavy metals adsorbed by biochar.

(2) PAHs are adsorbed onto biochar via the π–π interaction between the benzene ring of PAHs and the aromatic C structure of biochar. However, during the biochar aging process, aromatic C rings rich in π–π electrons become oxidized (Joseph et al., 2010). Therefore, aged biochar may also cause the release of organic pollutants

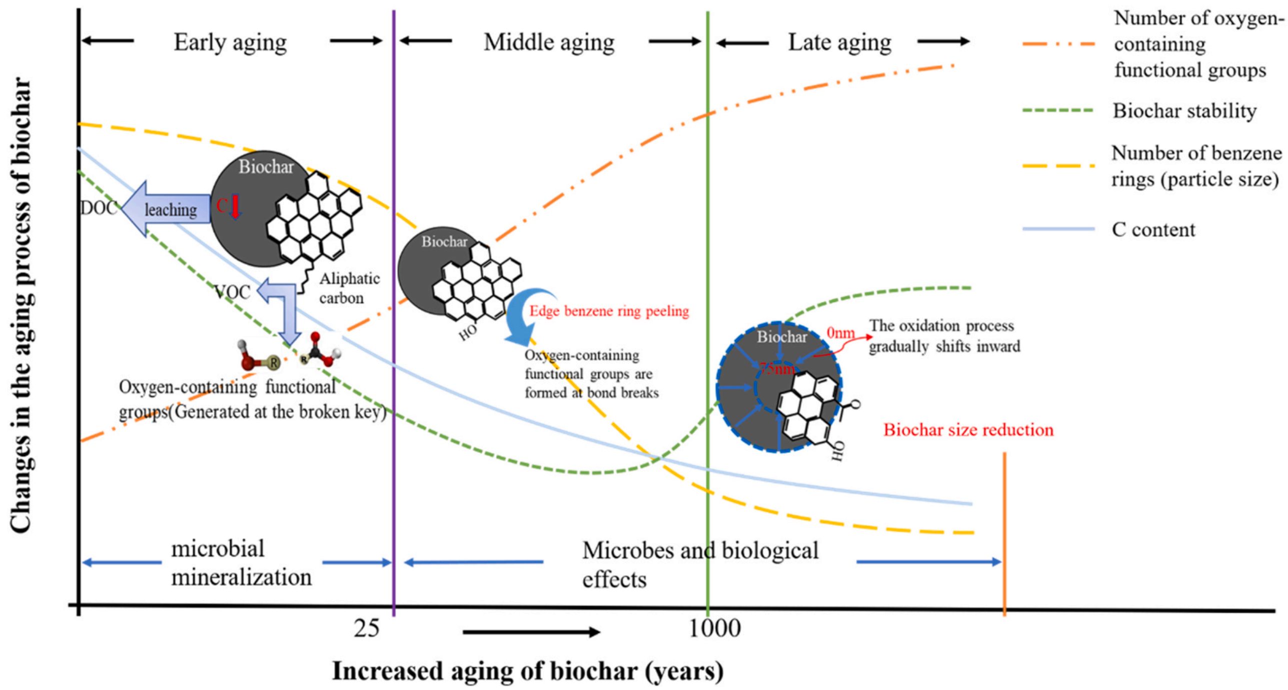

Fig. 3. Schematic diagram of structural changes during oxidation and aging of biochar.

originally adsorbed onto the biochar, thereby causing secondary environmental pollution.

(3) Aged biochar is more prone to biodegradation or physical decomposition, thereby resulting in the release of a series of biochar components (e.g., dissolved OM and soluble black C) and endogenous pollutants (e.g., heavy metals) (Mia et al., 2017; Liu et al., 2017; Khan et al., 2013; Li et al., 2019a). For example, Cui et al. (2021) found that aging can activate heavy metals in biochar, which can improve the leaching rate and bioavailability of heavy metals, thereby posing potential environmental risks. In their study, biochars with high, medium, and low heavy metal contents were aged using dry–wet and freeze–thaw aging methods. After dry–wet and freeze–thaw aging, the concentrations of bioavailable (acid-soluble) Cu and Cd increased, especially in the biochar with a high intrinsic metal concentration and high heavy metal content. This phenomenon can be explained by several factors. Initially, aging increases the specific surface area and pore volume of the biochar, which in turn increases the exposure of endogenous heavy metals to the environment, thereby resulting in the release of endogenous metals from the biochar. In addition, owing to the increase in CO_2 adsorption and acidic functional groups during the aging process, the pH of the biochar decreases (Xu et al., 2018). Endogenous heavy metals combined with organic C (OC) may then be released owing to the decomposition and mineralization of unstable OC (dissolved OC) (Huang et al., 2019). In addition, different types of metals are activated in different ways. The activation of endogenous Cu is mainly related to the composition of organic functional groups in the biochar, whereas the activation of Cd is mainly influenced by the changes in the inorganic components and pH of the biochar. Meanwhile, the increase in the leaching and bioavailability rates of endogenous heavy metals in biochar with different aging methods also differ. For example, freeze–thaw-aged biochar has higher Cu and Cd leaching rates than dry–wet-aged biochar. Both wet–dry and freeze–thaw aging increase the available Cu content, while only increasing the available Cd in biochar with a medium heavy metal content (Cui et al., 2021). Therefore, the fate and potential pollution risks of biochar must be considered prior to biochar-based environmental remediation.

2.2. Micro-/nano-dimensions of biochar

Micro-biochar (MB) and nano-biochar (NB) particles are mainly smaller than 1 μm and 100 nm, respectively. Based on the source of MB/NB in the environment, MB/NB existing in environmental media can be divided into two categories, namely (1) primary MB/NB, which is produced non-deliberately during the preparation process or specially prepared in the laboratory via grinding, ultrasound, and other treatments; and (2) secondary MB/NB, which is produced by the interaction of bulk biochar with the environment after application (Zhang et al., 2020a). In terms of structural characteristics, the O content of MB/NB formed by ultrasonic treatment was 19.2–31.8% higher than that of the original structure. Although MB/NB shows better dispersion in water, MB/NB with a less aromatic structure exhibits decreased C stability (Liu et al., 2018b).

The presence of MB/NB can promote the release of heavy metal ions into the medium when applied to soil. Kim et al. (2018) observed that biochar particles with a particle size of less than 0.45 μm could increase the release and mobility of As in soil. Moreover, the co-migration ability of biochar with heavy metals is affected by the feedstock. Song et al. (2019) reported the pollutant co-migration abilities of biochar produced by nine types of biomass, and found that compared with urban-derived MB/NB, plant-derived MB/NB contained more fused aromatic rings and functional groups. Plant-derived MB/NB also showed high potential for the co-transportation of pollutants (such as Cd^{2+}). Contrary to the positive effect of biochar in maintaining soil fertility, MB/NB promotes the loss of P in alkaline soil by mediating the retention and migration of P (Fig. 4b), which leads to a decline in soil fertility. This could be explained by the fact that P can form P-Fe/Al soil colloids via electrostatic attraction and ligand adsorption in the soil (Arai and Livi, 2013), which promotes the release of P-Fe/Al soil colloids and their migration to the groundwater system. More importantly, MB/NB can act as a carrier for P migration in acidic or alkaline soils, and MB/NB with bound P has great potential for co-transportation to groundwater (Liu et al.,

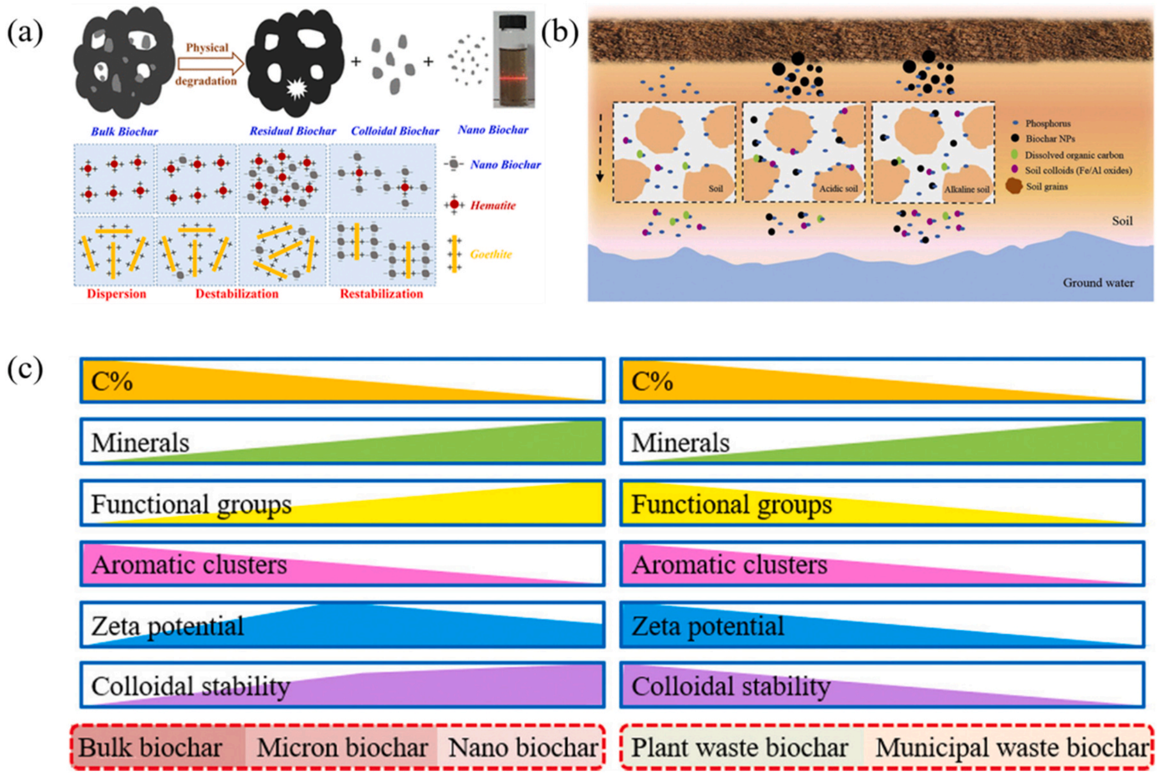

Fig. 4. MB/NB's main negative environmental impact and internal mechanism; (a) Biochar could be weathered in the environment to form MB/NB with high activity. (b) MB/NB promoted the loss of P in alkaline soil by increasing the release of Fe / Al soil colloids, and soil fertility decreased. (c) Schematic diagram of the composition and structure changes of urban-origin biochar and plant-origin biochar from bulk to micron- and nano-level particles.
(a) Reproduced with permission from ref (Liu et al., 2018b). Copyright 2018 ACS publications. (b) Reproduced with permission from ref (Jiang et al., 2015). Copyright 2019 Elsevier. (c) Reproduced with permission from ref (Song et al., 2019). Copyright 2019 Elsevier.

2018b; Chen et al., 2018c). Therefore, adding biochar to soils might result in nutrient leaching and pollution of the environment.

In contrast, once applied to the soil, biochar can migrate laterally via surface runoff or vertically to groundwater systems, ultimately reaching the ocean via environmental media, such as rivers or the atmosphere (Novak et al., 2009). For example, during biochar application, MB/NB easily separates from the biochar matrix and migrates with the soil solution (Wang et al., 2013a; Wang et al., 2013b), which is caused by physical (e.g., water erosion and abrasion) or biological processes (e.g., biodegradation). Furthermore, MB/NB has significant mobility in the process of upward and downward migration in soil and aquifers (Qu et al., 2016). Compared with bulk biochar, MB/NB has a richer mineral and O content, higher alkalinity, and higher dynamic stability (Fig. 4a) (Xu et al., 2017). Therefore, MB/NB has a high reactivity in soil and aquatic environments (Song et al., 2019). When MB/NB is present in water, it has higher dispersibility because of the polar groups, along with a stronger co-migration effect on pollutants in aquatic environments, thereby leading to increased water pollution and biotoxicity in aquatic organisms (Wang et al., 2013b; Liu et al., 2018b). Moreover, under the action of wind, MB/NB may enter the atmospheric environment and cause ecological toxicity in organisms via respiration owing to the presence of semiquinone and phenoxyl radicals (Odinga et al., 2020).

Regarding the biotoxicity of MB/NB, it has been previously reported that particle-induced oxidative stress is a key mechanism of MB/NB cytotoxicity, which increases as the particle size decreases. The EPFR concentration of particles with an aerodynamic diameter of less than 1 μm is the highest (Pan et al., 2019; Jia et al., 2021). The toxicity of biochar is affected by its preparation method. In particular, ball-milled NB has higher biotoxicity than NB formed by other preparation methods (Lyu et al., 2018a). Because the spherical structure of ball-milled NB makes it easier to contact and collide with cells than the original biochar or other nanomaterials such as sheets and tubes (Liu et al., 2019b). For instance, ball-milled biochar can permeate cells and induce the production of cytotoxic ROS. The produced ROS can further damage the inner structure of the cell and reduce the amount of starch granules that maintain the osmotic pressure of the cell. This ultimately leads to an increase in cell mortality (Lin et al., 2012). Therefore, the potential risks of MB/NB in the environment are worthy of attention.

Recent studies have shown that the internal physical and chemical properties and the interaction with natural soil colloids may influence the aggregation and stability of MB/NB (Wang et al., 2013a; Chen et al., 2017b; Saleh et al., 2008). For example, Yang et al. (2019) pointed out that the presence of more surface O-containing functional groups (e.g., hydroxyl and carboxyl groups) leads to more negative surface charges of MB/NB, which in turn increases the electrostatic repulsion between colloidal particles and makes them more stable in aqueous solutions. Some minerals in biochar can be dissolved and release cations into aqueous solutions, in which the repulsive energy barrier between colloidal particles is screened via cationic bridging action, thereby progressing the aggregation of MB/NB (Liu et al., 2018a). In contrast, in the binary system of MB/NB-soil colloids, for negatively charged soil inorganic colloids, such as kaolin, the stability of MB/NB can be increased to enhance their migration ability in the natural environment. In contrast, positively charged soil inorganic colloids can limit the migration of MB/NB via charge neutralization. The behavior of MB/NB aggregation is also affected by natural OM, such as humic acid (HA). For example, HA can be adsorbed onto the surface of MB/NB via van der Waals and hydrophobic forces, ligand exchange, and energy, which can then change the zeta potential and increase the electrostatic repulsion between MB/NB particles (Gui et al., 2021). Such an increase in electrostatic repulsion increases the potential risk of MB/NB and further affects the adsorption performance, environmental toxicity, and migration of MB/NB and contaminants. However, one study showed that when the HA concentration was high (approximately 5 mg/L) and divalent cations were present at high concentrations to induce cation bridging, the aggregation of biochar colloids in soil was enhanced (Yang et al., 2019). In addition, for pyrolysis temperature, MB/NB rich in functional surface groups (i.e., low-temperature pyrolyzed MB/NB) is generally less likely to accumulate in the soil solution, thereby having high fluidity in the soil (Yang et al., 2019; Cely et al., 2015). In summary, biochar particles can form a stable suspension in soil solutions, especially in acidic soils with low alkali saturation. Dissolved OM can further enhance the stability of MB/NB, thereby enhancing the potential transport of MB/NB by soil water. Therefore, considering the transportation and fate of MB/NB, when biochar is applied to agriculture or environmental remediation, the biochar raw material, preparation temperature, and composition of soil colloids should be considered simultaneously.

3. Negative impacts of biochar on the soil environment

Biochar is widely used in soil amendment applications (Fig. 5), but its presence may inevitably change the physical and chemical properties of the soil, thereby negatively affecting the growth conditions of microorganisms in the soil and crops (Xia et al., 2020; Liu et al., 2019a).

3.1. Soil physical and chemical properties

The pH, structure, porosity, mobility, bioavailability of toxic elements, and other properties of the soil can be changed by biochar (Lee et al., 2010; Wang et al., 2019c). Because as the pyrolysis temperature increases, the amount of acidic functional groups on the surface of the biochar decreases with the loss of O, thereby causing the pH of the biochar to gradually increase from neutral or acidic to alkaline (Wang et al., 2019c). The increase in soil pH due to biochar may limit the supply of certain nutrients (such as NH_4^+) to the original soil (Zhang et al., 2019a). El-Naggar et al., (2019b) reported the failure of woody plants to establish and survive owing to the high accumulation of charcoal and micronutrient deficiency caused by increased soil pH from soil biochar application. The biochar-induced increase in soil pH may also promote the hydrolysis of N-acyl-homoserine lactone (AHL), a signaling molecule used by gram-negative bacteria for cell–cell communication, thereby resulting in a decrease in the bioavailability of AHL (Gao et al., 2016). Eventually, communication between the bacterial cells is inactivated. Yang and Lu (Yang and Lu, 2021) evaluated the effects of five different types of biochar on the physical properties of paddy soil using field experiments and found that the addition of biochar to the soil significantly reduced the tensile strength. As the amount of biochar increased, the degree of soil tensile strength decreased. The soil tensile strength under five biochar (rice straw, maize straw, wheat straw, rice husk, and bamboo) treatments decreased by 63.6%, 63.3%, 50.3%, 41.7%, and 55.0%, respectively, compared with that of the control group. The decrease in soil tensile strength and cohesion indicates that the ability of the soil to resist external forces is reduced, which causes the soil to rupture and move under the action of external forces (Li et al., 2019b). Biochar application to soil may have a negative impact not only on the soil but on other related environmental aspects as well. For example, biochar may inhibit the soil nutrient supply and crop productivity by reducing plant nutrient absorption (El-Naggar et al., 2019c). Biochar can also increase the bioavailability of toxic elements in the soil, which poses potential environmental risks to soil contaminated with toxic elements (e.g., As and Pb). For instance, El-Naggar et al. (2020) found that the application of straw biochar significantly increased the bioavailability of As in soil by 101.6%.

3.2. Crops

The positive effects of biochar on crop growth are well known; however, we found that biochar still poses potential risks under specific situations; this section summarizes and analyzes those situations. Biochar may have a direct toxic effect on plants because of the presence of hazardous organic or inorganic compounds (e.g., PAHs and heavy metals) (Lehmann et al., 2011). During biochar preparation, cellulose or hemicellulose in raw materials is cracked to produce gaseous hydrocarbon groups, which are then subjected to a series of reactions to form aromatic rings (Gelardi et al., 2019). The PAH content in the soil with biochar amendment is higher (Fig. 6a) than that of soil without biochar (Rombola et al., 2019). For instance, Wang et al. Wang et al. (2018) found that 75.0% of Chinese cabbage (*Brassica chinensis*) and 87.5% of pak choi (*Brassica campestris*) samples had benzo[a]pyrene TEQ values

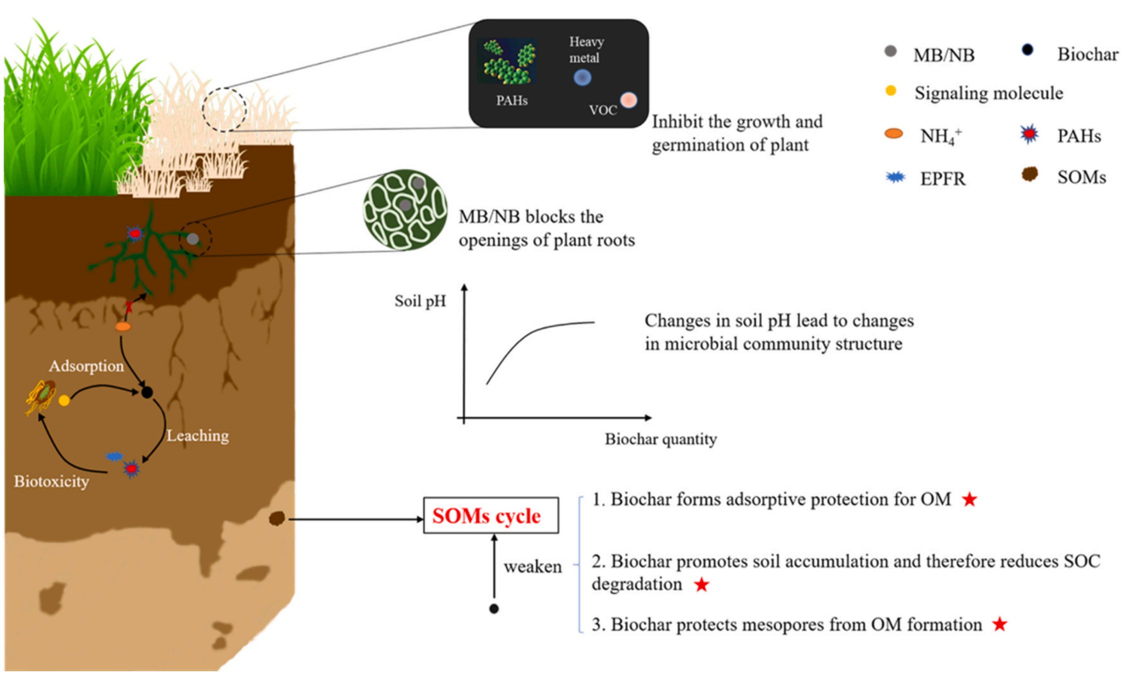

Fig. 5. Schematic diagram of the potential negative environmental impact of biochar in the soil environment.

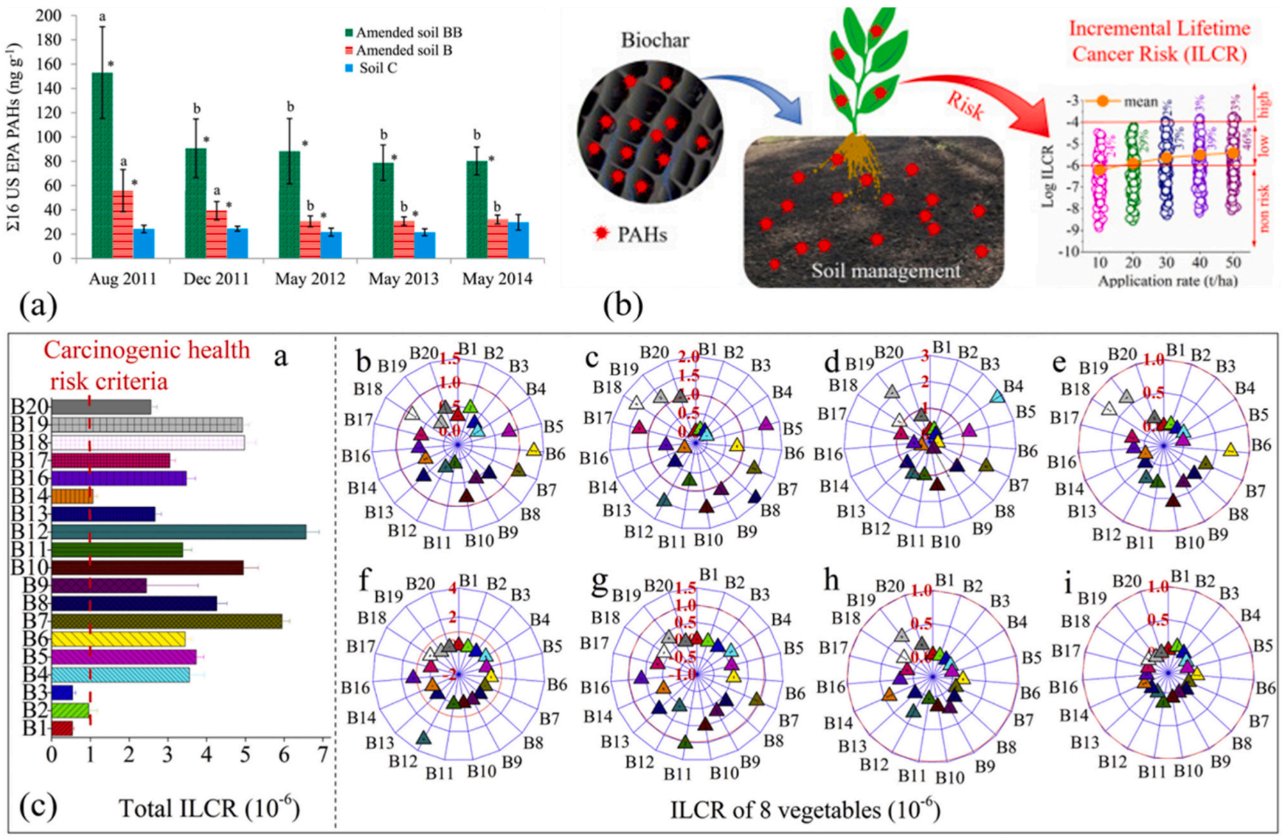

Fig. 6. Biotoxicity of PAHs in biochar. (a) The application of biochar results in an increase in the content of PAHs in the soil. (b) PAHs in biochar are enriched by plants and enter the food chain. (c) The human body may ingest PAHs due to the intake of vegetables grown in the soil after biochar modification, which may cause a (ILCR).

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higher than the maximum contaminant level. This indicates that the crops concentrate the PAHs leached from biochar, which negatively affects their growth, and in turn, threatens human and animal health (Fig. 6b and c). To verify this, Wang et al. (2018) conducted a follow-up experiment on the consumption of PAHs in vegetables by animals to assess their health risks. The total increase in lifetime cancer risk (ILCR) of adults was higher than 10^{-6}, which indicated that direct contact with PAHs in vegetables grown in biochar-modified soil can harm human health. The negative environmental impact of metals contained in biochar on plants in the soil has also received close attention. Visioli et al. (2016) demonstrated that electrical conductivity and Cu negatively affected both germination and root elongation at a biochar application rate of $\geq$ 5% (w/w), Zn affected both at a biochar application rate of $\geq$ 10%, and elevated pH affected both at a biochar application rate of $\geq$ 20%. Moreover, in all species, root elongation was more sensitive than germination, and strongly decreased at high rates of grape marc biochar application (> 10%) and wheat straw biochar application (> 50%), whereas root length in cucumber and sorghum was affected at a low conifer and poplar biochar application rate of 0.5%, with marked impairment at application rates of > 5.0% of all biochars. This could be explained by the fact that cell division/elongation at the root tip is sensitive to metal pollutants. In the growth and development of plants, the presence of EPFRs in biochar is related to the inhibition of plant germination and survival (Lian and Xing, 2017). Liao et al. (2014) prepared biochar from wheat, corn, and straw at 200, 300, 400, and 500 °C in a germination test and found that rice straw-derived biochar prepared at 500 °C inhibited the growth of roots and stems of wheat, rice, and corn seedlings. Moreover, EPFR-induced ROS can react with macromolecules (such as glycoproteins), thereby destabilizing the cell membrane and further leading to apoptosis, which explains the inhibitory effect of free radicals on seedlings (Odinga et al., 2020). In addition, low molecular weight organic molecules (LOM) accumulate on the surface of biochar and condense in the pores during biochar production. The growth of animals and plants can be repressed by high concentrations of LOM compounds (Joseph et al., 2014). A germination test showed that VOCs in biochar had an inhibitory effect on the germination and growth of cress (Buss and Mašek, 2014), possibly because the re-condensation of VOCs during biochar pyrolysis resulted in a high content of mobile phytotoxic compounds.

In addition to the PAHs, heavy metals, and EPFRs contained in biochar, NB has been widely used in agriculture and poses potential risks to agricultural production (Ramadan et al., 2020). Zhang et al. (2020a) prepared six types of biochar via pyrolysis of straw and wood chips at 300, 500, and 700 °C, followed by ultrasonic treatment (i.e., the simulation of the physical and chemical decomposition of biochar) and centrifugal separation. Furthermore, the effects of the six types of NB on the seed germination and growth of rice, tomato, and reed seedlings were studied. The results showed that NB derived from lignin-rich raw biomass had an inhibitory effect on reeds, and significantly reduced the bud length and biomass. This phenomenon occurred because phenolic compounds were deposited on the NB during biochar pyrolysis, which have a cytotoxic effect on fibroblasts and thus a negative impact on the plants (Oliveira et al., 2019; Sigmund et al., 2017). The pyrolysis temperature also affects the toxicity of MB/NB; the MB/NB obtained from low-temperature biochar contains higher concentrations of highly unsaturated phenolic compounds and polyphenols than the MB/NB obtained from high-temperature biochar (Fig. 7) (Wang et al., 2018). In addition, the ability of low-temperature MB/NB to release PAHs is

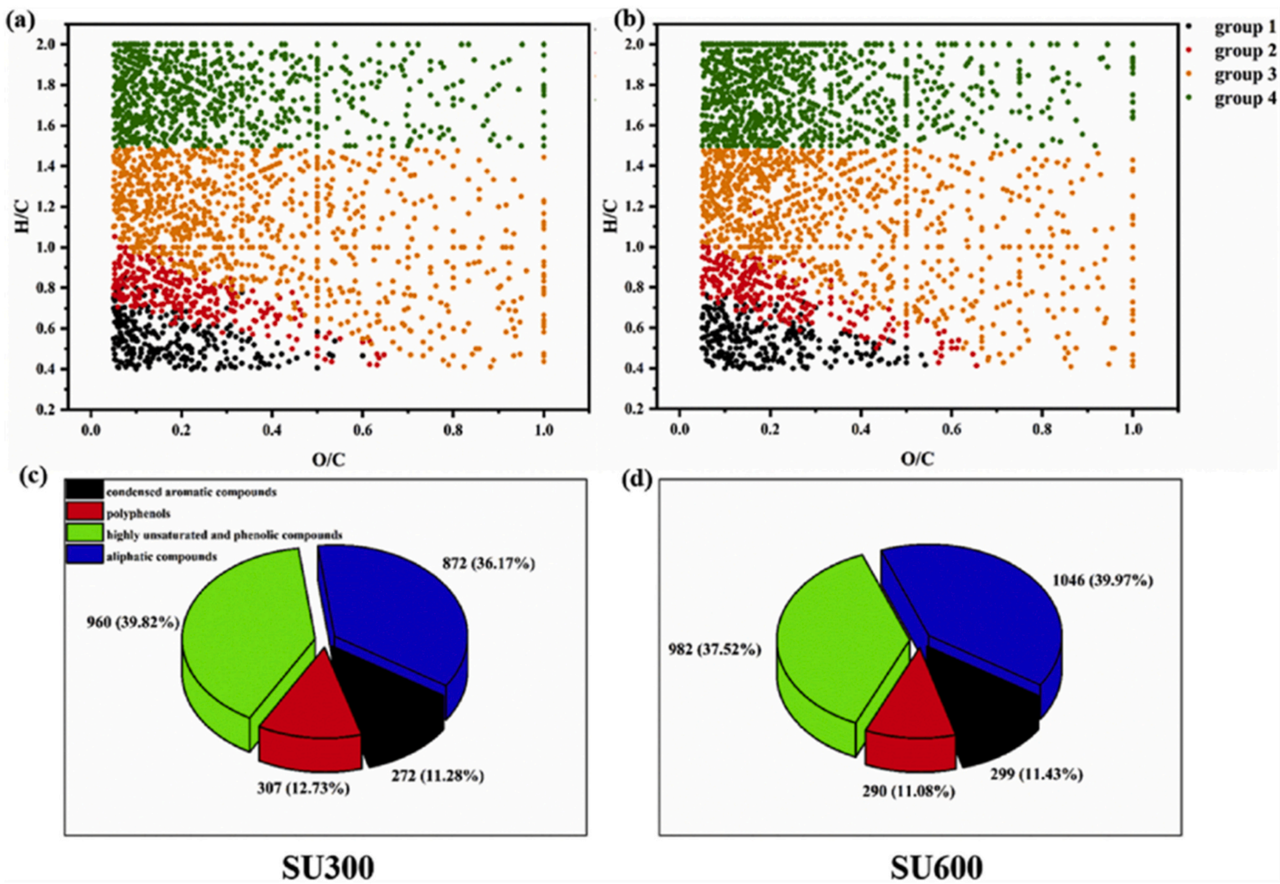

Fig. 7. Van Krevelen diagrams of low-temperature MB/NB(a) and high-temperature MB/NB; (b) and relative percentage of four groups in low-temperature MB/NB; (c) and high-temperature biochar(d).
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higher than that of high-temperature MB/NB, thereby making low-temperature MB/NB more biotoxic (Zhang et al., 2019b). Moreover, the toxicity of biochar depends on its raw biomass. Because the pyrolysis of lignin can produce a large quantity of phenolic compounds (Jung et al., 2016), NB obtained from biomass with a high lignin content poses higher potential environmental risks. However, whether the main source of toxicity of MB/NB is the adsorbed harmful substances or the biochar itself, the effect of size must be further explored.

Kim et al. (2015a) reported that it was difficult to obtain N from the soil because of its increased distribution on the biochar surface, and showed that as biochar application increased, lettuce growth was further delayed. Rajkovich et al. (2012) also found no growth-promoting effect of corn with more than 2% biochar addition, regardless of the biochar type. The reason for the lack of beneficial effects at higher application rates was that the available nutrients were reduced. The reduction of plant nutrient elements in the soil by biochar due to adsorption has been verified in previous studies. Novak et al. (2010) found that the concentration of nitrate in the soil leachate decreased after applying biochar for 25 days, and was proportional to the amount of biochar applied. This indicated that N could be adsorbed onto the surface of the biochar, thereby resulting in the inhibition of plant growth by reducing the available inorganic N. Similar conclusions have been reported in other studies (El-Naggar et al., 2019c; Bruun et al., 2012; Hussain et al., 2017). The biochar composition also affects its N fixation ability. As the content of mineralizable components (volatile substances) in biochar increases, the N content fixed by biochar from the environment also increases, thereby suggesting a lower available N content for plant growth (Deenik et al., 2010). In conclusion, the negative impact of biochars competing for nutrient elements required by plants in soil environments is possibly due to an improper amount of biochar application, as well as the use of biochar with high contents of mineralizable components. The adsorption of nutrients and the adsorption of plant hormones cannot be ignored. Phytohormones, which are signal molecules, have a regulatory effect on plant growth and development. However, it has been found that biochar has an immobilizing effect on plant hormones, thereby inhibiting plant growth (Lehmann et al., 2011; Akiyama et al., 2005; Jain and Nainawatee, 2002; Zhu et al., 2017). Moreover, recent studies have reported that rice husk biochar could increase the solubility, mobility, and phytoavailability of toxic elements (such as Sb, As, Cd, Zn, and Ni). This might be due to the wider range of the redox potential (E_H) (−12 mV to +333 mV) and pH (4.9-8.1) in the biochar treated soil than the un-treated soil ($E_H = -30$ mV to $+218$ mV; pH = 5.9-8.6) (i.e., biochar could increase the potential mobility of the toxic elements under oxic acidic conditions). Therefore, application of such rice husk biochar to soil might stimulate the release of the toxic elements (such as As, Co, and Mo) under flooding conditions, which might increase the environmental and health risks in such wetland ecosystems (Rinklebe et al., 2020; El-Naggar et al., 2019a, 2018b).

Based on the above discussion, it can be concluded that the three main reasons for the potential risks of biochar to crops are as follows: (1) the various environmental pollutants (e.g., PAHs, heavy metals, EPFR, and VOCs) contained in biochar have an inhibitory effect on the germination and rooting of crops. According to research on the causes of various pollutants in biochars presented in Section 2.1.1, the selection and consideration of biomass, pyrolysis temperature, and physicochemical properties of the environmental media are the key factors affecting the negative effects of biochar in agricultural fields; (2) MB/NB, especially from biomass with a high lignin content or produced at low temperatures, may have toxic effects on crops owing to the presence of phenolic compounds on its surface; and (3) biochar with high contents of mineralizable components may absorb nutrients (such as N, P, and inorganic salts) and plant hormones from the soil, thereby leading to reduced plant access to important nutrients.

3.3. Soil organisms

Biochar addition to soil can have a direct or indirect negative impact on soil microorganisms. Indirect effects are mediated by changes in the environment (Marks et al., 2014), such as pH, or other factors related to the ecological tolerance range of the exposed species. For instance, biochar application changes the pH of the soil, and because some signaling compounds in fungi (such as farnesol) are not sensitive to pH, the ratio between fungi and bacteria becomes imbalanced (Gao et al., 2016; Khodadad et al., 2011). This indicates that the influence of biochar on the structure of the microbial community depends on the type of biochar as well as complex and changeable mechanisms.

In contrast, direct effects of biochar affect microbial activity by releasing heavy metals or organic chemicals, and can be mediated by multiple exposure pathways (ingestion or touch) (Liu et al., 2019a). For instance, PAHs unintentionally generated during biochar pyrolysis have mutagenic effects on salmonella/microsomes (Anjum et al., 2014), and EPFRs can reduce the contents of some cellular enzymes (Balakrishna et al., 2009). The negative impact of PAHs is caused by chemical stress on the microbial community at a higher soil nutrient level (Wang et al., 2020a). For EPFRs, the negative impact originates from the EPFRs themselves that cause the transfer of electrons between the biochar surface and specific cells during the remediation process, thereby changing the microbial community structure. Additionally, EPFRs may have potential toxicity to specific soil microorganisms (Odinga et al., 2020; Balakrishna et al., 2009).

The inhibitory effect of biochar on microbial activity increases as the pyrolysis temperature increases owing to the changes in the structure and chemical composition of biochar, especially the C content. The reduction in C content weakens the interaction between the soil matrix and pollutants (e.g., PAHs and heavy metals), thereby increasing the bioavailability and toxicity of the latter (Gondek et al., 2016). The biotoxic compounds adsorbed onto biochar inhibit the growth of microorganisms (Lehmann et al., 2011). Studies have found that biotoxic compounds (e.g., catechol) are strongly adsorbed by high-temperature biochar derived from ash-rich corn stover (Borraccino et al., 2001; Kasozi et al., 2010). Biotoxic compounds have been found to desorb from biochar material used to prepare the agar growth medium toxic to

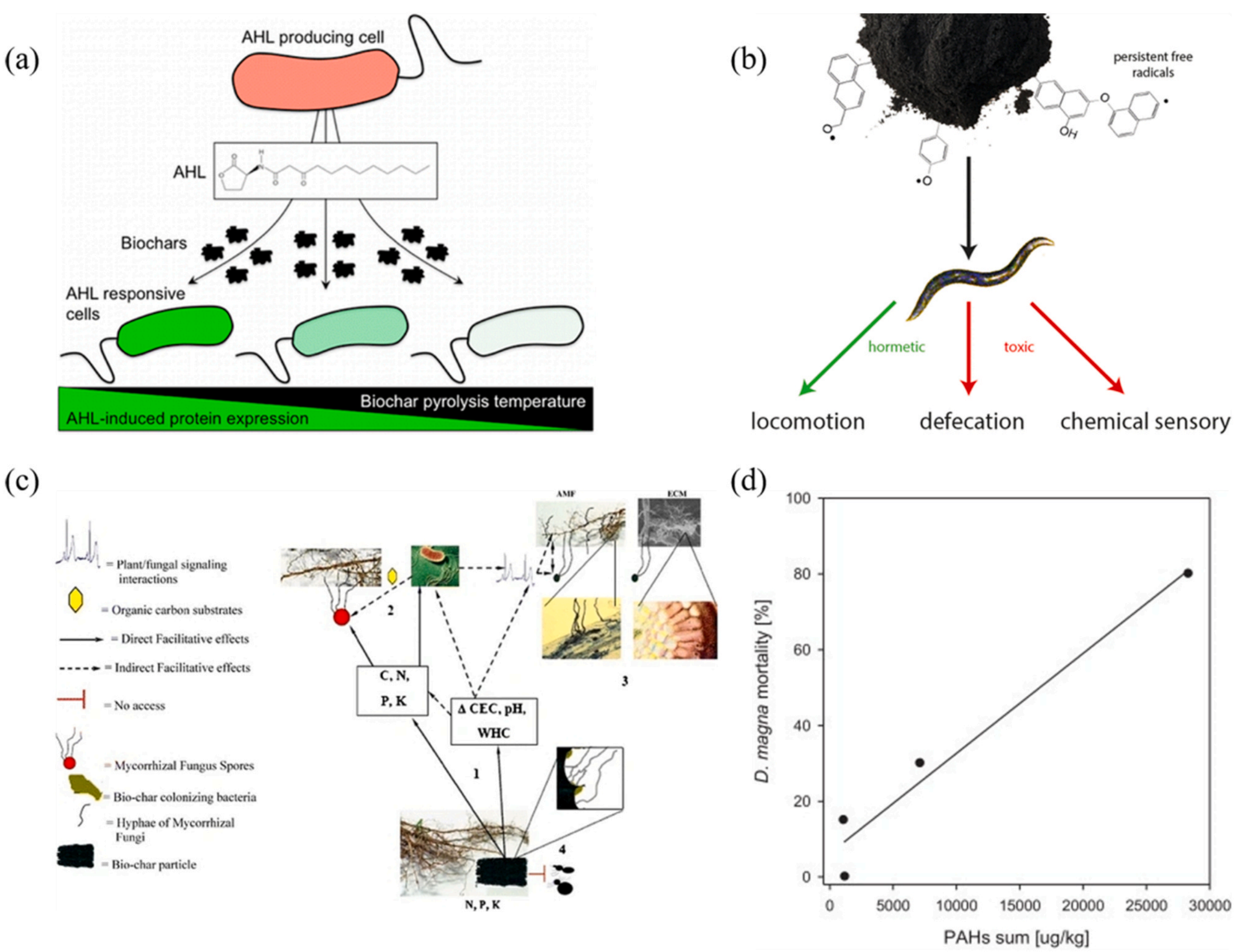

Fig. 8. The negative impact of biochar on microorganisms. (a) Biochar adsorbs signal molecules (such as AHL) and promotes its hydrolysis to change the microbial community structure. (b) Microbial decay resulting from EPFR in biochar. (c) Biochar changes the physical and chemical properties of the soil and then changes the microbial community structure in the soil (Warnock et al., 2007). (d) PAHs content is in direct proportion to the mortality rate of biological D. Magna. Therefore, PAHs contained in biochar have chemical stress effect on microorganisms in soil.
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Bordetella pertussis, indicating that the growth-inhibiting substance was retained by the biochar (Lehmann et al., 2011).

Biochar has both positive and negative effects on arbuscular mycorrhizal (AM) fungi and exogenous mycorrhizal fungi, the most common types of mycorrhizal fungi in soil; the negative effects are mainly due to alternations in nutrients (Rousk et al., 2010; Wallstedt et al., 2002). Warnock et al. (2010) found that the relative abundance of AM decreased after biochar application. AM fungi are known to have an intergrowth relationship with more than 80% of plants on land (Jain and Nainawatee, 2002). Studies have shown that the signal transduction process of flavonoids is disturbed by the adsorption of flavonoids on biochar (Akiyama et al., 2005), which poses a threat to the growth and survival of soybean plants, AM fungi plants, and AM fungi (Jain and Nainawatee, 2002). Biochar not only affects the transmission of signaling molecules between microorganisms and plants, but also affects the exchange of information between microorganisms. Biochar can change the cell–cell communication of microorganisms by adsorbing signaling molecules and promoting their hydrolysis, thereby changing the microbial community structure (Fig. 8a) (Masiello et al., 2013).

In conclusion, the mechanisms involved in the influence of biochar on microorganisms include, but may not be limited to, (1) detaining the available nutrients for microbial growth (Lehmann et al., 2011), (2) promoting the adsorption and hydrolysis of signaling molecules to interrupt the interspecies communication of microorganisms (Fig. 8a) (Zhu et al., 2017), (3) releasing harmful components (e.g., PAHs, heavy metals, and organic pollutants) that are biologically toxic to microorganisms (Gondek et al., 2016), (4) decreasing the ability of mycorrhizal fungi to colonize plant roots via the persistent adsorption of signaling compounds, (Warnock et al., 2007) (5) changing the physical and chemical properties of the soil (Fig. 8c) (Rousk et al., 2010), and (6) increasing the amount of pollutants adsorbed by microorganisms.

Biochar also poses a potential threat to soil organisms. For instance, high concentrations of biochar negatively affect the survival of invertebrates in the soil (Fig. 8b). Furthermore, the presence of EPFRs in biochar may be neurotoxic to soil organisms (Pan et al., 2019). For instance, EPFRs in biochar can trigger neurotoxic effects in *Caenorhabditis elegans*, thereby inhibiting its life characteristics (movement and defecation) in the soil (Lieke et al., 2018). *Caenorhabditis elegans* also serves as food for *Bacteroides nematodes* and plays an important role in soil productivity and nutrient cycling; a decrease in the population of *C. elegans* would inevitably affect the hunting and growth of *B. nematodes* (Jean et al., 2016). In addition, because biochar adsorbs pesticides applied for agricultural production, organisms such as earthworms and mites can indirectly ingest pesticides by the casual predation of biochar particles (Jones et al., 2011). In the worst-case scenario, pesticides may be released inside the insect gut, exposing insects to toxic pesticide concentrations. However, there is no direct evidence to prove that biochar increases the exposure of soil organisms to pesticides. This effect should be explored in future studies. Moreover, small-size biochar not only increases the adsorption of contaminants, but also is more easily ingested by organisms, thereby indicating that MB/NB has a stronger negative impact on organisms. The activity of applied pesticides, such as herbicides, is reduced by biochar (Jones et al., 2011; Hussain et al., 2017), which could lead to the excessive use of pesticides in agricultural production and cause pesticide accumulation, thereby leading to more serious negative environmental impacts (Khalid et al., 2020). Therefore, in view of the toxic effects of biochar on soil microorganisms and organisms, caution should be exercised when using biochar as a soil amendment.

3.4. *Soil organic carbon cycle*

The mineralization of soil is vital to the biological cycle of N, C, P, S, and other elements in nature. There are three main reasons for the influence of biochar on mineralization, namely (1) the original unstable OM in soil is adsorbed onto the surface of biochar to form adsorbent protection (Cheng and Reinhard, 2008). (2) Biochar can prevent OM adsorbed in the mesopores from mineralization by isolating microorganisms and enzymes outside the mesopores. It can also greatly reduce the activity of laccase (a type of phenol oxidase that can use molecular O to catalyze the oxidation of aromatic compounds) and inactivate laccase via adsorption in its mesopores, thereby preventing OM mineralization (Zimmerman et al., 2004). (3) Biochar also promotes the formation of soil mineral aggregates, which reduces its degradation as well as that of soil organic carbon (SOC) to a certain extent (Jastrow et al., 2007). Therefore, when biochar is applied to soil, it may have an inhibitory effect on the SOC cycle.

4. Negative impacts of biochar on aquatic environments

Some studies have shown that biochar also poses potential risks to aquatic environments, including the enhancement of eutrophication, acceleration of pollutant migration, and inhibition of aquatic organism growth (Fig. 9).

4.1. *Eutrophication*

Biochar may contain endogenous N and P because of the composition of their biomass feedstocks (such as cow dung) (Xu et al., 2013). As such, inorganic N and P can be released from biochar and become a source of nutrients. Chen et al., (2017a) reported that the leaching of NH_4^+ from biochar into an aquatic environment accounted for 0.30–4.92% of the total NH_4^+ concentration. Similarly, Park et al. (2015) observed that the amount of phosphate released by sesame straw-derived biochar was high. The content of released phosphate changed from 62.6 mg/g to 168.2 mg/g with an increase in pyrolysis temperature. The low binding affinity of phosphate to biochar with a low Ca and/or Mg content may be responsible for the high levels of PO_4^{3-} released in water (Zhang et al., 2020b). Additionally, the abundant ions in water not only weaken the pollutant adsorption ability of biochar, but also promote the release of inorganic N/P adsorbed onto the biochar. For instance, Novais et al. Novais et al. (2018) reported that a pure water solution extracted more than 20% of P from used poultry manure and sugarcane straw biochar after four extraction rounds, whereas HCO_3^- solution could extract more than 90% of P. Therefore, when biochar is used on a large scale, its existence and accumulation in aquatic environments may accelerate the eutrophication of water. In conclusion, when applying biochar in aquatic environments rich in ions, the use of a biochar with a lower content of endogenous N/P is recommended (i.e., attention should be paid to the choice of biomass). In addition, the application of modified biochar materials requires special attention. Studies have shown that the use of chloro-phosphate-impregnated biochar (CPBC) can remove Pb^{2+} and Cd^{2+} from sewage. However, in the first 20 min after the addition of CPBC, the content of available P in the solution increased because of the dissolution of $Ca_5(PO_4)_3Cl$ (Deng et al., 2019b).

4.2. *Pollutant migration*

There are also potential environmental risks of co-transportation in the use of carbonaceous nanocomposites because the biochar nanocomposite can act as an active carrier (Song et al., 2019). Biochar and its adsorbed pollutants can infiltrate the surface and groundwater via surface runoff, ditches, or irrigation (Chen et al., 2019a), thereby posing potential environmental risks to aquatic environments such as groundwater and rivers (Wang et al., 2013b). The co-migration ability of the nanocomposites is also affected by the biochar source. Under the same experimental conditions, the enhancement of the Cd^{2+} migration ability by biochar–Fe_3O_4 nanocomposites derived from wheat straw was significantly higher than that derived from sawdust (Chen et al., 2019a). This could be explained by the fact that biochar with a high content of mineral components (such as calcium carbonate) is beneficial for Cd^{2+} adsorption (Wu et al., 2018), thereby increasing the diffusion and

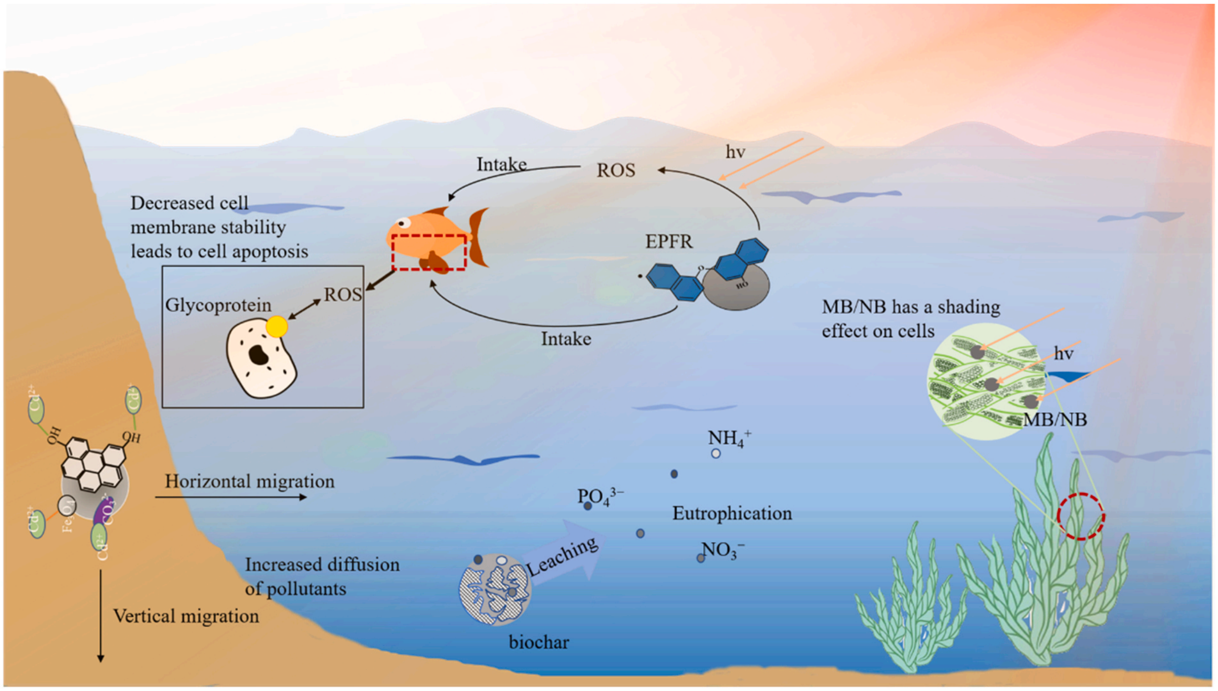

Fig. 9. Schematic diagram of potential negative environmental impact of biochar in aquatic environment.

transfer of Cd^{2+} in the environmental media.

MB/NB is known to exhibit higher mobility and accessibility owing to surface reactivity and polarity, thereby accelerating the transfer and diffusion of environmental pollutants (Wang et al., 2013b). Because more polar groups are present in MB/NB, they have higher dispersibility in natural water (Liu et al., 2018b) and a stronger co-migration effect on pollutants in the aquatic environment. Biochar-based metal oxide/-hydroxide composite materials are mainly used in aquatic environments to remove heavy metals and organic and inorganic pollutants. Therefore, when applying biochar materials, such as MB/NB or biochar nanocomposites, to environmental media, especially aquatic environments, special attention should be paid to the potential risk of promoting the transfer and diffusion of pollutants. Moreover, the selection of appropriate biomass types, preparation methods for amendment materials, and methods for controlling the potential co-migration of pollutants and carbonaceous nanocomposites in the underground environment should be the focus of future research.

4.3. Aquatic organisms

By exploring the degree of toxicity of biochar on a series of organisms, Oleszczuk et al. (2013) found that biochar had the greatest impact on crustaceans, and the PAH content in biochar was directly proportional to the mortality of crustaceans (Fig. 8d). Because biochar absorbs the substances necessary for chemical communication in symbiotic organisms, nutrient bioavailability is reduced and the symbiosis of microorganisms and plants is disturbed. For instance, Chi and Liu (2016) added biochar produced from wheat straw at 400 °C or 700 °C to bed sediments at a rate of 3% (w/w), and its effects on the growth and root and stem biomass of *Vallisneria spiralis* were studied. After 54 days, the presence of 700 °C biochar not only resulted in a lower *V. spiralis* biomass but also reduced root length compared with the plants in the control experiment. Additionally, EPFRs in biochar were found to generate hydroxyl free radicals in aquatic environmental media, which could also induce the generation of ROS (i.e., hydroxyl free radicals) in aquatic plant cells and cause damage to cells and organs (Odinga et al., 2020). For instance, Zhang et al. (2019c) found that three prepared biochars significantly promoted the generation of cellular ROS in *Streptococcus obliquus*. The ROS levels induced by 800 mg/L of biochar obtained at 300, 400, 500, and 600 °C were 120%, 134%, 125%, and 113% higher than the control, respectively. Except for ROS, when the concentration of biochar was greater than 200 mg/L, the SOD activity of all exposed groups was also significantly higher than that of the control group. This indicates that the redox balance of *S. obliquus* is disrupted by biochar. Meanwhile, it was found that the chlorophyll-*a* (Chl-*a*) concentration in *S. obliquus* was decreased by biochar. Biochar prepared at 500 °C had a high inhibition rate (89%) for Chl-*a* at a concentration of 500 mg/L. Steinberg et al. (2003) reported that the photosynthetic O content of *Ceratophyllum demersum* was reduced by EPFRs. This could be explained by the fact that the semiquinone free radicals formed in biochar influence the electron transfer chain by acting as electron scavengers in the humus and the plants growing in the media, hindering O production from plant photosynthesis (Odinga et al., 2020). Liu et al. (2018b) produced NB via the collapse of pores and fracture of the biochar skeleton, and found that MB/NB and its associated pollutants may pose an exposure risk to aquatic organisms owing to the high dispersion of MB/NB in natural waters. Among the negatively affected aquatic organisms, algae are one of the most sensitive to MB/NB. The toxicity of MB/NB to algal cells can be directly related to their exposure and to indirect effects, such as shading effects of MB/NB on the cells (negatively influencing light absorption and photosynthesis) and the adsorption of nutrients on MB/NB (Freixa et al., 2018). Different species of algae have different toxic sensitivities to MB/NB exposure. For instance, MB/NB can be directly ingested and accumulated in aquatic organisms, thereby posing a potential environmental risk (Rhema et al., 2017). MB/NB is widely present in aquatic media because it flows into surface water or groundwater systems owing to its high migration capacity. Moreover, the various pollutants carried by MB/NB continue to accumulate after entering the aquatic environment. Because of the various interactions between MB/NB and environmental media, the adsorbed pollutants may be released, posing serious environmental risks. The interaction between MB/NB and many pollutants, such as pesticides, metals, drugs, and surfactants, can result in increased toxicity to aquatic organisms (Freixa et al., 2018).

5. Negative impacts of biochar on the atmospheric environment

The potential negative impacts of biochar application on the atmospheric environment are mainly reflected in the change in the atmospheric greenhouse effect and the increase in air particulate concentrations (Fig. 10).

5.1. *Atmospheric greenhouse effect*

Biochar plays an important role in the atmosphere by affecting CH_4, N_2O, and other GHG emissions (Cayuela et al., 2014). However, some studies have shown that the application of biochar also has a negative impact on GHG emissions, which in turn poses potential environmental risks (Lehmann et al., 2011; Ribas et al., 2019; Xu et al., 2020). The N dynamics are affected by the soil pH, aeration, and biochar type (Lin et al., 2017; Yanai et al., 2007). When biochar is applied to the soil, it may affect soil N_2O emissions by influencing the activity of microorganisms (Deng et al., 2019a). For example, the addition of straw-derived biochar to soil regulates the surrounding pH, which can enhance the growth of ammonia-oxidizing bacteria and thus increase the nitrification rate, thereby causing an increase in soil N_2O emissions (Lin et al., 2017). This phenomenon is mainly due to the porous structure of biochar, which leads to the adjustment of diverse microbial habitats. At higher temperatures in summer, biologically induced anoxic conditions in biochar pores (acting as microsites) may be promoted, under which complete denitrification to N_2 occurs, leading to N_2O uptake and promoting CH_4 production (Ribas et al., 2019). The ash concentration of biochar also affects N_2O emissions because high-salt biochar will cause a "salting-out effect," leading to high N_2O emissions (Heincke and Kaupenjohann, 1999). Luz et al. (2013) found a positive correlation between N_2O emissions and ash concentrations in a study on nine biochars under denitrification conditions. Therefore, the importance of the concentration of mineral components in biochar in relation to GHGs requires further research. Biochar derived from different raw materials may have different effects on the N_2O concentration in the atmosphere owing to the different interactions between microbes and biochar with various properties (Niu et al., 2018). For instance, Xu et al. (2020) found that straw-derived biochar significantly reduced soil N_2O emissions by 51.4–93.5%, whereas the use of biochar derived from camellia husk increased soil N_2O emissions. Meanwhile, different contents of NH_4^+-N and NO_3^--N in biochar led to different levels of N_2O emissions in the soil (Zwieten et al., 2010). Regarding the impact of soil texture on N_2O emissions, biochar can significantly reduce N_2O emissions in finer soils, whereas the average use of biochar in coarse soils can increase N_2O emissions by 53% (under high moisture conditions) (Cayuela et al., 2014). The impact of soil pH has a significant impact on the N_2O/N_2 emission ratio; N_2O/N_2 increases with the decreasing soil pH in the saturated soil (Clough et al., 2004). Therefore, it is not possible to accurately determine the N_2O concentration in the atmosphere around biochar-modified soils. More research on the effects of biochar in different types of agricultural systems with various climatic conditions on N_2O emissions is necessary.

Biochar mainly affects the decomposition ability of microbial communities in the soil by influencing their species and activity. Therefore, terrestrial OC emitted to the atmosphere in the form of CO_2 is reduced, thereby reducing the greenhouse effect (Rousk et al., 2010). However, Zimmerman et al. (2011) found in a 1 year field experiment that all other types of biochar-soil mixtures released more CO_2 than related soils without biochar and had higher initial CO_2 release rates. This was probably because biochar, especially freshly prepared biochar produced at low temperatures, is inherently unstable, thereby contributing to the loss of degradable C in the mixture. The mechanism most often proposed involves the growth of r-strategist microbes that are adapted to respond quickly to newly available C sources, re-mineralize soil nutrients, and co-metabolize more refractory OM, such as soil humic materials, in the process (Kuzyakov, 2010). Regarding the effect of soil texture and biomass sources on soil CO_2 emissions, three types of biochar (straw, umbrella wood, and grass) were applied to sandy loam and sandy soil in a short-term incubation experiment conducted by El-Naggar et al. (2018a). The results showed that the sandy loam soil had 2–3 times higher CO_2 emissions than those of the sandy soil due to the higher microbial community abundance in the sandy loam soil. Rice straw biochar treatment induced the highest CO_2 emission rate in sandy soil, which was attributed to the high content dissolved aliphatic OC of rice straw biochar. Wang et al. (2016) conducted a meta-analysis based on 116 observations, and the results showed that after the addition of

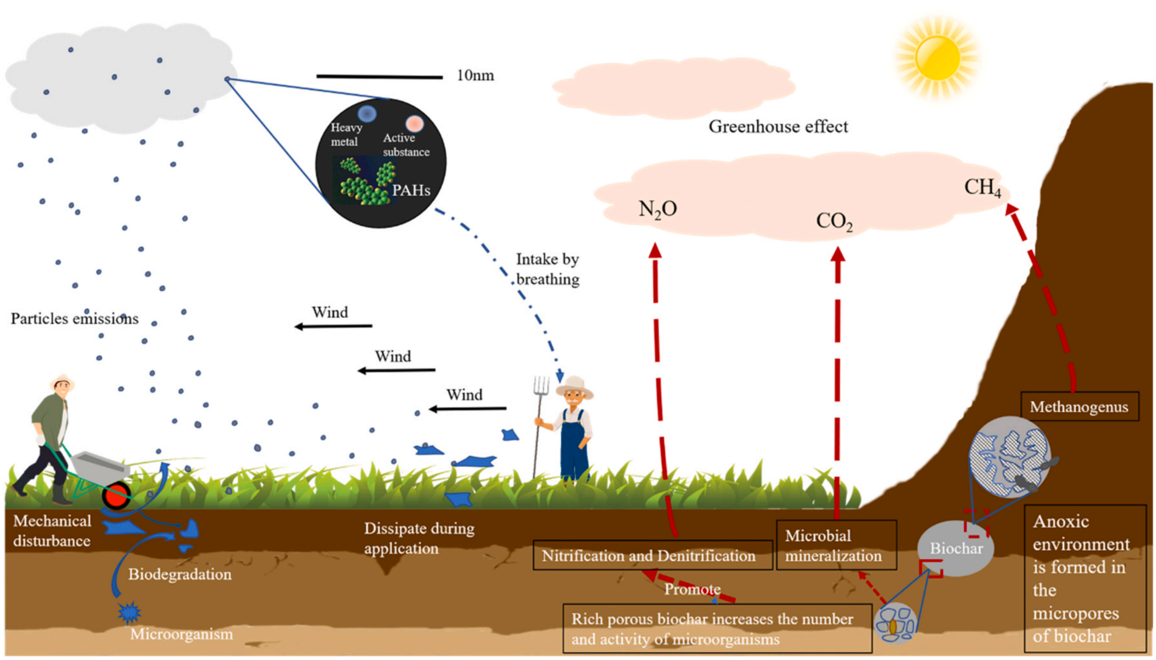

Fig. 10. Schematic diagram of the potential negative environmental impact of biochar in the atmospheric environment.

biochar, sandy soils with poor soil fertility usually showed increased CO_2 emissions owing to the stimulation of microbial activity in soils. Furthermore, one study reported that biochar could change the utilization of C by microorganisms in the soil. Coupled with the catalytic reduction of minerals or free radicals and the adsorption of NH_3, the main role of fungi or bacteria in the soil GHG emission process may change (Zimmerman et al., 2011). Considering the contribution rate of CH_4 and N_2O to the greenhouse effect, the impact of biochar requires more comprehensive analysis methods, such as LCA.

5.2. Particulate concentrations in the atmospheric environment

Biochar application may increase PM_{10} emissions (Li et al., 2018; Ravi et al., 2016). The typical characteristics of biochar are: low bulk density, large surface area, and variable particle size distribution; these facilitate biochar release into the atmosphere by natural or mechanical interference and contribute to the measured PM_{10} (El-Naggar et al., 2019b; Gelardi et al., 2019). Aged biochar is more likely to be broken into small particles because of its reduced mechanical strength (Spokas et al., 2014). Compared with bulk biochar, small and light particles of biochar can easily enter the atmosphere under natural wind conditions, thereby resulting in an increased PM_{10} concentration (Gelardi et al., 2019). Ravi et al. (2016) reported that PM_{10} emissions were generally higher from all soils studied at all biochar application rates and wind velocities. Meanwhile, monovalent cations have a dispersive effect on soil particles, which leads to aggregate instability and colloid mobilization, thereby resulting in the amended soil being more susceptible to dust emission (Gelardi et al., 2019; Li et al., 2018). PM_{10} is hazardous to human health because it can be deposited in the lungs and can enter the alveoli and blood. The particulates deposited on the alveoli damage them as well as the mucous membranes, thereby causing a series of pathologies such as chronic rhinitis and bronchitis (Yang et al., 2017). Because of adsorption of pollutants onto biochar in large quantities, the adsorbed pollutants may be discharged into the air along with the biochar and may be released from the biochar into the atmosphere. From the perspective of dust emissions, biochar-bound pollutants (such as neurotoxins, carcinogens, mutagens, and reproductive toxins) pose a threat to human health when the biochar dust is inhaled (Gelardi et al., 2019). Using the LCA method for evaluation, the results of some studies have shown that biochar-related air pollution may contribute to a larger negative effect over its life cycle owing to potential adverse human health impacts (Ibarrola et al., 2012; Sparrevik et al., 2013). However, there is a lack of relevant research on several associated topics, namely the possibility of biochar emission in the form of dust, the possibility of the intake of the pollutants in biochar after its release, and the bioavailability of biochar after adsorption. In agricultural settings, this airborne release may occur during the application of biochar to the soil or via natural wind-driven erosion or mechanical farming events after it has been incorporated into the soil (Gelardi et al., 2019). Therefore, particular attention must be paid to the problems caused by dust emissions when applying biochar to actual agricultural production.

MB/NB formed from larger biochar particles or originally existing in biochar is usually dispersed in the atmosphere in the form of dust during the production and use of biochar, thereby posing potential risks to human health owing to its nature and characteristics (Sigmund et al., 2017). Sgro et al. (2009) observed the cytotoxic cell internalization of fine biochar particles. However, Sigmund et al. (2017) did not observe the internalization of biochar in NIH 3T3 mouse fibroblast cells. This indicated that the dust formed by the biochar particles had a cytotoxic effect on the fibroblast cells. This cytotoxic effect was related to the size distribution of the biochar, and increased as the particle size decreased (Kong et al., 2013). Therefore, compared with bulk biochar, MB/NB poses a higher biological risk via biological inhalation. The presence of semiquinone and phenoxyl radicals may lead to activated species in combustion-generated particles and ambient fine PM (Odinga et al., 2020; Lyu et al., 2018b). The generated active substances accumulate in the human respiratory tract and induce the production of ROS, thereby causing oxidative stress and threatening human health (Lyu et al., 2018b).

6. Detection, assessment, and avoidance of environmental risks posed by biochar

6.1. Risk detection and assessment in the soil environment

6.1.1. Phytotoxicity

Biochar in soil has toxic effects on plants. When biochar is applied to soil, it is necessary to evaluate its phytotoxicity. Biochar phytotoxicity research is mainly based on germination experiments, which have several shortcomings, such as long experiment times, unclear internal mechanism, and other uncontrollable factors (Luo et al., 2018; Malfatti et al., 2021; Onofri et al., 2018). It is difficult to compare and summarize different studies because the results of such studies vary depending on the species (Luo et al., 2018). Therefore, phytotoxicity analysis based on a quantitative index is of practical significance with regard to the application of biochar. Ruzickova et al. (2021) proposed that in the presence of organic compounds in biochar, the ratio of OC to elemental carbon can be evaluated to determine whether biochar is phytotoxic (based on the recognition that biochar is phytotoxic because of the presence of organic compounds (Bargmann et al., 2014)). The phytotoxicity of biochar in soil can also be predicted by the ratio of aliphatic organic compounds to aromatic organic compounds (AL/AR) (e.g., an AL/AR value of < 0.5 indicates the domination of aliphatic compounds, which are involved in biochar toxicity). Kong et al. (2019) proposed the detection and evaluation of the phytotoxicity of biochar from the perspective of metabolism. In their experiment, the toxicology of sewage sludge-derived biochar to wheat was investigated by integrating metabolomics and physiological analysis. A total of 514 peaks were detected in the wheat root extract, of which 211 were identified. The analyzed metabolites were classified into amino acids, organic acids, and sugars. It was found that the sewage sludge-derived biochar obtained at different pyrolysis temperatures led to significantly different wheat metabolism profiles, particularly amino acid metabolites (e.g., proline). The significant reduction in wheat amino acid metabolism indicated that the biochar was phytotoxic, and that many amino acids, including valine, alanine, isoleucine, proline, oxyproline, orthovaline, ornithine, puthumine, and aminomalonic acid, were downregulated by more than four times under biochar exposure compared with the control group. This mainly occurred because the enhancement of oxidative stress caused by biochar in the organism was manifested in the downregulation of amino acid metabolism (Xiangang et al., 2015). The toxicity detection and evaluation of biochar is not only lacking in depth, but also requires a certain degree of universality. Therefore, the establishment of standardized and universal evaluative mechanisms or indicators should be the focus of future biochar toxicity research.

6.1.2. Microbial community

Section 3.3 explains the negative effects of biochar on soil microbial communities. The phosphorus lipid fatty acid (PLFA) method is mainly used to detect the impact of biochar on microorganisms (Wang et al., 2020a; Wei et al., 2020). The PLFA method is based on modern biochemical theory, and is an effective method for analyzing soil microbial communities without the need for separation or culturing (Zhang et al., 2021). Owing to the mutagenic substances (e.g., PAHs and dissolved OC) present in biochar, it is necessary to conduct in-depth research on the genetic changes in microorganisms. Qiu et al. (2019) used 16S ribosomal ribonucleic acid sequencing to analyze the dynamic changes in bacterial community composition in compost with the addition of biochar, and found that the relative abundance of actinomycetes increased in the late composting period, whereas the relative abundance of red caterpillars decreased sharply. A differential operational taxonomic unit abundance analysis was conducted to determine the effect of biochar addition on microbial community separation. It was found that the addition of biochar increased the abundance of specific microbial populations in the compost. Moreover, to gain a more comprehensive understanding of microbial community changes, high-throughput sequencing, network technology, denaturing gradient gel electrophoresis, and other methods can be combined and applied to investigate the impacts of biochar. For example, Qiu et al. (2019) found that biochar has a negative impact on the number and activity of Microbacteriaceae and *Aeromicrobium* via high-throughput sequencing and network technology. However, most quantitative analysis methods have deviations when analyzing the influence of biochar on microbial community structure. Therefore, a reasonable combination of two or more methods should enable a more comprehensive understanding of the effects of biochar on microbial communities. Future research should focus on the use of standard and universal microbial community measurements and analysis methods for long-term experiments and field research on different soil types.

6.2. Risk detection and assessment of aquatic environments

Toxicity tests of biochar on aquatic organisms are mostly conducted via laboratory-level toxicity simulation experiments. Toxicity detection and evaluation of fish are particularly important in aquatic environments of economic significance. Abakari et al. (2020) reared tilapia (*Oreochromis niloticus*) in the presence of biochar and evaluated the toxicity of biochar to tilapia via its performance parameters (e.g., fish growth parameters, fish welfare indicators, proximal analysis of fish back muscle, and determination of antioxidant and immune enzyme activities). The risk substances (i.e., biochars) that enter the aquatic environment via various channels may also act on and damage algae (Lu et al., 2021). Therefore, algae are also one of the main organisms for evaluating the toxicity of biochar to aquatic organisms. Zhang et al. (2019c) proposed four quantitative indicators via the acute toxicity test of *S. obliquus* (model aquatic algae), namely cell growth (inhibition), Chl-*a* (decrease in concentration), ROS content (upregulation), and SOD content (upregulation). Finally, the biotoxicity of biochar to aquatic algae was determined via a comprehensive evaluation of these indicators. Mondal et al. (2016) measured the cell density of the microalgae *Scenedesmus* sp. (a model organism representing phytoplankton and eukaryotes) via a growth inhibition toxicity test to evaluate the aquatic toxicity of biochar. The microbial toxicity test has been shown to be an important method for detecting the toxicity of biochar to aquatic organisms. For example, the luminescence intensity of luminescent bacteria (*Photobacterium phosphoreum* T3 spp.) after treatment with biochar was detected by Zhang et al. (2019c), and it was found that the luminescence inhibition rate increased as the biochar concentration increased. Polymerase chain reaction (PCR) involves in vitro amplification of specific deoxyribonucleic acid fragments (Barkallah et al., 2020). In toxicology studies of protozoa, phytoplankton, zooplankton, and fish, the results obtained using PCR have provided a scientific basis for the ecological risk assessment of pollutants (Qian et al., 2009; Soetaert et al., 2007). However, there are few studies on the application of PCR in the field of biochar aquatic toxicity detection. Therefore, more attention should be given to this subject in future research.

6.3. Risk detection and assessment in the atmospheric environment

The PM produced during the pyrolysis of biochar not only increases the concentration of atmospheric PM, but may also have a toxic effect on organisms (Gelardi et al., 2019). Therefore, the capture and toxicity determination of PM emitted from the pyrolysis of biochar is essential (Wang et al. 2019b). Dunnigan et al. (2017) used a cascade impactor made of stainless steel with a size range of 0.1–10.0 μm to collect PM produced by the combustion of raw pyrolysis volatiles. A gas chromatograph-mass spectrometer was then used to analyze the PAHs in the PM samples. The results showed that as the pyrolysis temperature increased, the PAH concentration of PM increased by 119% between 400 °C (403 μg PAH/g PM) and 800 °C (882 μg PAH/g PM). In addition, between raw pyrolysis volatile production temperatures of 400 °C and 800 °C, the benzo(a)pyrene TEQ of the PM increased from 19.1 μg PAH/g PM to 149.1 μg PAH/g PM. Therefore, running the pyrolysis–combustion process at a lower pyrolysis temperature has the potential for low PM toxicity. In intensive agricultural areas, agricultural dust is the largest contributor to PM in the air (Gelardi et al., 2019). Therefore, a separate study on the contribution of biochar to agricultural dust emissions is of great significance for its application as a soil amendment. Li et al. (2018) used dust generators to simulate possible dust conditions under farming conditions (a large dust cloud formed in a continuous plume) and collected dust samples. The relative biochar content in dust was determined by a special molecular labeling method, which involved the measurement of the benzene polycarboxylic acid (BPCA) produced by the digestion of HNO_3 samples. The separation, analysis, and capture of biochar in mixed cases are difficult because biochar does not have its own separation, characterization, or quantitative techniques. Anton et al. (2009) indicated that biochar can be used to quantify pyrolyzed carbonaceous substances on different substrates. Therefore, the separation technology of various carbonaceous substances, such as CTO-375 (a technique for determining black C with chemothermal oxidation at 375 °C in active air flow) (Zencak et al., 2007), BPCA (Li et al., 2018), Cr_2O_7 (Hammes et al., 2007), and thermal–optical transmittance/reflectance (Park et al., 2015), can be selectively applied to the separation of biochar, which will help to promote the development of an atmospheric environmental risk assessment involving biochar.

6.4. Life cycle assessment

As discussed in this review, although biochar has benefits, its potential risks cannot be ignored. Therefore, in practical applications, it is necessary to systematically evaluate the risks and benefits of biochar in complex ecosystems. LCA is a widely recognized standardized method that has been extensively used to evaluate the efficiency of biochar systems (Owsianiak et al., 2018; Huang et al., 2020). LCA consists of four parts: target definition and scope, life cycle inventory analysis, life cycle impact assessment, and interpretation (Azzi et al., 2019). Using LCA, the environmental effects of biochar have been determined by calculating various indicators, such as net GHG emissions (i.e., GHG emission reduction due to biochar use minus the GHG emissions of biochar preparation, transportation, and other processes) (Dutta and Raghavan, 2014) and the global warming potential, which is used to measure the impact of GHG emissions from biochar systems on global warming (Struhs et al., 2020). The sensitivity index (i.e., sensitivity coefficient and critical point) is another indicator that can be used to draw a sensitivity analysis chart to understand the degree of influence of each factor in the biochar system on the overall environmental effect (Roberts et al., 2010). The N and P efficiency coefficients of the main fertilizers required for crop growth (biochar feedstock) have also been used to evaluate the eutrophication impact of biochar systems (Whitman et al., 2011). For instance, the net negative impact of biochar systems on acidification and eutrophication was assessed by Peters et al. (2015) using LCA. The effects of acidification and eutrophication increased as biochar production increased, which was mainly due to the increase in the amount of biomass that needed to be transported and treated per hectare. Compared with direct biomass combustion, biochar systems achieve GHG reduction at the expense of reduced energy efficiency and increased negative impacts. Esteves et al. (2019) also indicated that the emissions released during upstream operations would have an adverse impact on environmental benefits owing to the use of fossil energy. Moreover, from the overall perspective of bio-LCA (introducing biodiversity in LCA), the best use of biochar is as an alternative for stone coal in power plants under the premise of producing biochar using modern ultra-low-emission pyrolysis equipment (Llorach-Massana et al., 2017). However, in rural areas of Africa or Southeast Asia, it is usually not possible to use more technologically advanced pyrolytic devices owing to economic and social limitations. Without the benefits of energy production offset, the LCA results of the biochar systems will most likely result in negative outputs (Matuštík et al., 2020). Similarly, biochar production systems in tropical rural areas have potentially significant negative impacts on the environment because of the high emissions of gases and aerosols during the production process, which cannot be compensated for by C sequestration (Sparrevik et al., 2013; Smebye et al., 2017). Although many studies have evaluated the benefits of biochar production using LCA, the biochar life cycle results depend on the choice of method and assumptions considered (Muñoz et al., 2017). Therefore, the differences between studies make it difficult to directly compare the corresponding research results or to obtain causality that is applicable to all or even most biochar systems.

6.5. Risk avoidance measures

Based on the above-mentioned detection and tracking technologies, supplemented by modern biochar improvement and optimization technologies, it can be deduced there is an urgent need to reduce or eliminate toxicity risks in the field of biochar research. This would be beneficial not only for expanding the application range, but also for increasing the potential value of biochar. The toxicity of biochar is mainly due to the feedstock and production conditions; therefore, feedstock with low concentrations of harmful substances should be selected. Feedstock containing plant biomass is recommended because it contains fewer PAH precursors (Quilliam et al., 2013b). In terms of the pyrolysis rate, slow pyrolysis is recommended. Biochar produced at a slow rate has lower ecological risks than that produced at fast rates, which is mainly reflected in the lower content of harmful substances in biochar produced at low temperatures and slow rates, as well as the limited soil nutrient immobilization ability and stronger mineralization ability of the biochar (El-Naggar et al., 2019c; Bruun et al., 2012). Biochar prepared at low temperatures has a lower content of harmful substances (e.g., PAHs) and lower ecotoxicity than that prepared at high temperatures. Moreover, the concentration of PAHs usually decreases with increasing pyrolysis time and temperature (Hale et al., 2012).

In the process of biochar application to soil, the physical and chemical properties of the medium (e.g., soil moisture and aeration) should be determined first. For instance, owing to the low soil water content, soil dust emissions have been found to increase after biochar application. Li et al. (2018) suggested that tilling after wetting biochar-amended plots effectively reduced exposure to both soil and biochar particles. However, unlike fine-grained soils, maintaining high water levels near saturation is necessary for coarse-grained soils to achieve maximum dust reduction. We suggest that biochar should be added to soil as large particles, which have lower sorption (due to the reduced surface area-to-volume ratio), thereby reducing the capacity for ingestion or transfer to crops or animals. The amount of biochar has an overall potentially negative impact on the growth of plants. Therefore, it is necessary to determine the appropriate amount of biochar for practical applications. For example, Baronti et al. (2010) found that greater than 1.7% (more than 60 t/ha) biochar application to soil resulted in a decrease in the dry matter yield of perennial ryegrass. Li et al. (2020) found that adding 1% (w/w) or 3% (w/w) biochar can reduce the soil loss rate by simulating rainfall events, whereas adding 7% (w/w) biochar can increase the soil loss rate.

When using biochar in aquatic environments, in addition to the requirements mentioned above for the selection of feedstock, biochar with lower N and P contents and a lower mineral content is more suitable (Xu et al., 2013; Wu et al., 2018). The use of large biochar particles is recommended to prevent smaller biochar particles from increasing both the migration rate of pollutants and the possibility of uptake by aquatic organisms (Liu et al., 2018b). Biochar fixation technology can be used to avoid the environmental risks posed by smaller particles. For example, biochar can be prepared as macroscopic materials such as sheets with large volumes or biochar foam, thereby effectively inhibiting its long-distance migration and achieving effective recovery (Qiangu et al., 2021). In addition, considering that the biotoxicity of EPFRs in aquatic environments is higher than that of EPFRs in soils (i.e., soil exhibits high complexation and EPFRs can induce the generation of hydroxyl free radicals), combined with the reasoning stated in Section 2.1.1, we recommend the use of hardwood lignin, which contains fewer precursor substances than softwood lignin. Regarding modified biochar, studies tend to use magnetic biochar to facilitate recovery from the aquatic environment (Ye et al., 2020).

Although studies have been conducted on the corresponding avoidance measures discussed above, multiple issues have not been resolved. For example, Zhang et al. (2019c) confirmed that biochar has a significant toxic effect on aquatic animals and plants because of the induced production of ROS. Therefore, it is urgent to determine the ability of biochar to induce ROS in aquatic environments. Meanwhile, the modified biochar currently used at large scales has correspondingly larger environmental risks owing to the presence of O-containing functional groups and heavy metals (Kim et al., 2015a; Sun et al., 2018). Therefore, substantial improvements can be made to technologies for biochar risk avoidance measures, which is worthy of further investigative research.

7. Conclusions and outlook

Biochar poses potential environmental risks to soil, water, and atmosphere owing to its harmful components, adverse surface properties or structure, and chemical characteristics at micro-/nano-dimensions. The wider application of biochar has potential environmental uncertainties. Complicated connections between physical properties and unpredictable chemical interactions exist between biochar and various aspects of the environment to which it is applied, thereby resulting in a wide variety of possible negative impacts. Therefore, the following points should be considered in future research:

(1) To achieve an optimal environmental remediation performance of biochar, it is necessary to further investigate the relationships between certain production factors (e.g., biomass sources and preparation conditions) and the environmental risks of biochar in subsequent studies. LCA can be used to assess the potential environmental risks of biochar.
(2) The comprehensive mechanisms of the negative impacts of biochar on the environment at the microcellular and molecular levels should also be further studied. The interaction between biochar and various environmental media in the biosphere (i.e., the atmosphere, water, and soil) and the overall negative environmental impact of biochar on the entire ecosystem (that is, at the macroscopic scale) also require further exploration.
(3) The internal mechanism(s) of the negative impact of MB/NB on the environment must be explained in future studies (e.g., whether the main source of MB/NB toxicity originates from the harmful substances adsorbed onto the biochar or from its size).
(4) In terms of the effects of the discharge of biochar as dust during application, some knowledge gaps exist, including whether the desorption of attached pollutants is possible, whether desorbed contaminants are inhaled by humans after entering the atmosphere, and whether such materials are bioavailable after entering the human body. These issues require more comprehensive and systematic evaluation and research based on quantitative measurement indicators, including LCA, systematic toxicological assessment, and epidemiological investigation. Considering the negative effects of biochar particles, membrane and biochar fixation technology should be further studied to understand their potential ability to change the application form of biochar.
(5) Owing to ecosystem complexity and the changeability of biochar, more research must be conducted to understand the basis of

simple evaluation mechanisms for describing the behavior of biochar in the ecological environment. Considering that certain environmental differences and related systematic errors are difficult to eliminate (such as those related to climate, soil type, raw materials, or pyrolysis devices), various testing and evaluation methods should be unified considering certain aspects to make accurate comparisons. For example, the feedstock and environmental characteristics of biochar in the same region are generally similar. In addition, economic sustainability assessments combined with environmental assessments would be useful for understanding the future priorities of biochar application.

(6) Finally, to achieve the industrial control and formulation of corresponding standards, professional knowledge and capabilities are required for the practical application and management of biochar. The International Biochar Initiative has formulated standards for the safe use of biochar in soil and issued a white paper on the pollutant-biochar-component dioxin (i.e., the production, hazard analysis, and detection report requirements of dioxin). Other environmental media and environmentally harmful substances in biochar require corresponding standards and summaries, which would be of great significance for the sustainable development and safe application of biochar. Existing avoidance measures should also be standardized and unified. In addition, new methods need to be developed for preventing or ameliorating the potential environmental risks of biochar.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Exhibit 4

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Technical Note

Residual perfluorochemicals in the biochar from sewage sludge

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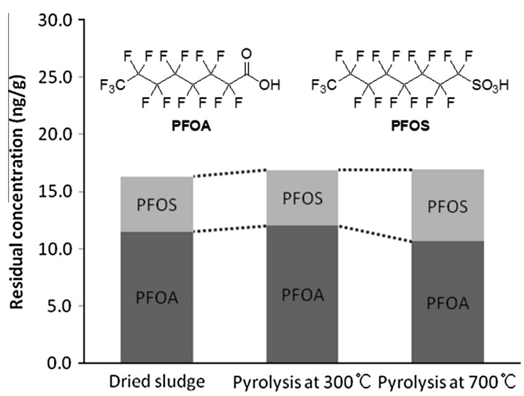
HIGHLIGHTS

- Sewage sludge are found high concentration of perfluorochemicals in environmental mass.
- Thermal process did not decrease the residual PFOA and PFOS concentration in biochar.
- Maximum residual limits for PFCs in biochar are needed for protection of agricultural environment.

GRAPHICAL ABSTRACT

No significant change of residual PFOA and PFOS during pyrolysis of sewage sludge.



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ABSTRACT

Biochar has been recently considered as a candidate for soil amendment and soil remediation. Some pollutants have been screened in the biochar for safety purposes except for perfluorochemicals (PFCs). In this study, the contamination of biochars from plant residues and sewage sludge with perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) was examined. The total residual concentrations of PFOA and PFOS in the sludge biochar were 15.8–16.9 ng/g and these values did not decrease significantly after pyrolysis. On the other hand, these PFCs were not found in the biochar from plant sources. In conclusion, the use of the sludge biochar in the agricultural environment should be re-evaluated, since the concentrations of PFCs in the sewage sludge showed no significant decrease after thermal process.

1. Introduction

Recently, biochar has been featured as a soil conditioner, owing to the various beneficial effects it imparts on the agricultural environment such as carbon sequestration, improvement in soil quality, and immobilization of chemical pollutants (Cabrera et al., 2014; Lehmann et al., 2011; Qian et al., 2015). Many researchers have, therefore, investigated the functions and applications of biochar prepared from various raw materials and by various production processes (Chen et al., 2014; Lee et al., 2013). Biochar produced from the sludge of wastewater treatment plants (WWTPs) and its utilization in agricultural environments for applications such as biotransfer for reducing the effects of organic and inorganic contaminants as well as soil amendment, has been studied (Chen et al., 2014; Khan et al., 2013; Mendez et al., 2013). In addition to the beneficial effects of biochar, preliminary studies

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examining the risks of residual heat-related persistent organic pollutants (POPs) such as dioxins and polycyclic aromatic hydrocarbons (PAHs) have been conducted and the safety guidelines have been established for biochar (Freddo et al., 2012; Hale et al., 2012).

Perfluorooctanesulfonic acid (PFOS) is a newly-registered POPs and perfluorooctanoic acid (PFOA) is an emerging POPs from the Stockholm convention. These POPs show extreme resistance to chemical and thermal degradation (Lehmler, 2005) and are therefore, widely used as flame-retardant materials and in fire-fighting foam. In addition, these materials are also used in various consumer products (Paul et al., 2009). WWTPs are considered to be an important contamination pathway for the perfluorochemicals (PFCs) to enter the environment (Kim and Kannan, 2007; Pistocchi and Loos, 2009). The distribution ratio of the PFCs in the sludge has been estimated to be up to 27.9% of the total influx, with no degradation in the plant (Brooke et al., 2004). Therefore, a recent environmental monitoring study indicated that the sludge from WWTPs had relatively high concentrations of PFOA and PFOS (Sun et al., 2011; Yu et al., 2009). However, the contamination of biochar from sewage sludge with PFOA and PFOS has not been reported so far. Here, a preliminary study was conducted to determine the residual concentrations of PFOA and PFOS in some biochars as well as to examine changes in the residual concentrations of these compounds in sludge biochars after thermal treatment.

2. Materials and methods

2.1. Preparation of chars

Commercial active carbon from palm (Samchullyac Co., Korea), reagent grade granular activated carbon (Sigma-Aldrich Co., Steinheim, German), and Envi-Carb™ (Sigma-Aldrich Co., PA, USA) were purchased. Two types of biochars from oak and from rice husk were purchased from local producers while six biochars from burcucumber and two types of biochars from WWTP sludge were prepared on the programmed temperature (Supporting Material).

2.2. Extraction of PFOA and PFOS

All the chars were analyzed to determine the level of contamination with PFOS as POPs and PFOA as emerging POPs. In a typical procedure, the biochar (0.1 g) was extracted with methanol (MeOH, 5 mL $\times$ 3) and acetonitrile (5 mL $\times$ 3) then centrifuged to separate of the supernatant. The extract was concentrated under nitrogen, and the residue was redissolved in 10% MeOH (10 mL) in distilled water (DW). The sample solution was loaded into a hydrophilic–lipophilic balanced (HLB) cartridge (500 mg, Silicycle Co., Quebec, Canada) and washed with DW (3 mL) followed by 30% MeOH in DW. The washed cartridge was eluted with MeOH (3 mL $\times$ 2). The elute was concentrated under nitrogen and then redissolved in MeOH (1.0 mL).

2.3. Quantitative analysis

The sample solution was analyzed on LC-qTOFMS (Xevo-G2S, Waters Co., MA, USA) with BEH-C_{18} column (1.7 μm, 2.1 $\times$ 100 mm, Waters Co., MA, USA). The mobile phase gradient condition was combined with 5 mM ammonium formate in water and 5 mM ammonium formate in acetonitrile. The quantitation ions were at m/z values of 412.9659 for PFOA and 498.9299 for PFOS in the ESI negative mode and the quantitation was analyzed with UNIFI™ Portal (version 2.0, Waters Co. USA). Detailed instrumental conditions, limit of quantitation (LOQ) and recovery were described in the Supporting Material.

3. Results and discussion

PFOA and PFOS were not found within the LOQs for any of the activated carbons and biochars except the sludge biochar. However, trace amount of perfluorocarboxylic acid (C4–C12) and perfluorosulfonic acid (C4, C6, C7, C8 and C10) were detected in all biochars, regardless of the processing temperature or steam exposure for activation. However, the concentrations of PFOA and PFOS in the biochar from WWTP sludge were found to be within the range of 10.643–11.513 and 4.820–6.275 ng/g, respectively (Table 1). Although the total amounts of PFOA and PFOS in the biochar decreased by up to 50% based on the total weight loss of biochar during pyrolysis, the residual concentrations of the PFCs did not decrease significantly after pyrolysis. The loss of PFOA and PFOS in the biochar may be attributed to their evaporation with the steam generated during pyrolysis because the PFCs are known to be stable up to 900 °C with no decomposition during pyrolysis and are considered to be the final degradation products (Brooke et al., 2004).

To date, the highest recorded concentrations of PFOA and PFOS in sewage sludge are 4780 ng/g and 5383 ng/g, respectively (Sun et al., 2011; Yu et al., 2009). The typical residual concentrations of PFOA and PFOS in sludge biochar could be similar to the result of this study. In addition, recent studies on the applications of biochar in agricultural sector have suggested that up to 2–5% (w/w) of biochar is required for the soil to receive beneficial effects such as soil amendment and/or soil remediation (Ahmad et al., 2014; Rajapaksha et al., 2014). In a previous study, the maximum concentration of PFOS in the biochar-applied agricultural soil was estimated to be 0.269 mg/kg-soil, corresponding to 5% (w/w) of biochar. Furthermore the residual concentrations of PFOS in the crop was also estimated to be 0.002–860 mg/kg, when a biotransfer factor of 0.01–3200 was applied (Lechner and Knapp, 2011; Stahl et al., 2009). Thus, the usage of sludge biochar in agricultural environment should be reconsidered, although it has many beneficial effects on sustainable agriculture.

Table 1
Residual PFCs in sewage sludge and its biochar.

	PFOA (ng/g)	PFOS (ng/g)	References
Sludge from WWTP			
Canada	0.1–5.5	0.1–460	Sun et al. (2011)
China	<LOQ–4780	<LOQ–5383	Sun et al. (2011)
China	23.2–298	27.6–173	Yan et al. (2012)
Nigeria	0.010–0.596	<LOQ–0.540	Sindiku et al. (2013)
Singapore	<5–69.0	13.1–702.2	Yu et al. (2009)
USA	<LOQ–241	<LOQ–993	Sun et al. (2011)
Germany	11–18	14–2615	Sun et al. (2011)
Sweden	<1–4	0.5–35	Sun et al. (2011)
Switzerland	<LOQ–20	20–670	Sun et al. (2011)
Korea (South)	<LOQ–24.7	<LOQ–23.5	Guo et al. (2010)
Char from plant			
Active carbon from Palm	<LOQ	<LOQ	This study
Envicarb™	<LOQ	<LOQ	This study
Oak	<LOQ	<LOQ	This study
Rice husk	<LOQ	<LOQ	This study
Burcucumber	<LOQ	<LOQ	This study
Biochar from sludge			
Non-pyrolyzed sludge	11.51	4.82	This study
Pyrolysis at 300 °C	12.03	4.86	This study
Pyrolysis at 700 °C	10.64	6.28	This study

4. Conclusion

The usage of biochar in agricultural environments has been studied recently, owing to its beneficial effects such as soil amendment and soil remediation. Sewage sludge is a good carbon source for biochar. Most of the biochars considered in this study were found to contain trace amounts of PFCs, except for sewage sludge biochar. However, PFCs were found in sewage sludge as POPs at relatively high concentrations in the environmental mass, on the order of ng/g. Thus, further studies are required to assess the risks posed by residual PFCs in biochar and for formulating guidelines on biochar application in the agricultural sector.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.chemosphere.2015.05.012.

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Exhibit 5

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Environmental Permits, Region 5
1115 State Route 86, PO Box 296, Ray Brook, NY 12977-0296
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July 11, 2023

Saratoga Biochar Solutions LLC
ATTN: Raymond Apy
26 F Congress Street, #346
Saratoga Springs, NY 12866

RE: Request for Additional Information
DEC #5-4144-00187/00001
Facility: Saratoga Biochar Solutions
Moreau (T), Saratoga County

Dear Mr. Apy:

This letter provides follow-up and clarifying information requested in our Notice of Incomplete Application (Notice) dated June 14, 2023; specifically, item #2 "Total PFAS emissions." The technical comments shown below were generated from Air staff's review of your most recent 180-page Air State Facility application submittal and are required for application completeness. Please provide responses to these technical comments in addition to the items contained within the June 14, 2023 Notice:

1. On Page 24, it is stated that "The SBS Facility will thermally oxidize the syngas for heat recovery at a temperature of 1,650°F to 2,300°F (871°C to 982°C), which has an estimated destruction efficiency of 99.99% for PFAS compounds." EPA's research indicates that thermal treatment of PFAS needs to reach greater than 2,500 o F for CF4 destruction to achieve complete mineralization of PFAS compounds down to HF. CF4 and HF are not currently included in the application as the air contaminants being released. Please provide a discussion and supporting documentation regarding the emissions of CF4 that might occur with the partial destruction/breakdown of all the PFAS compounds present. Additionally, a discussion of the HF being formed from the breakdown of the PFAS compounds should also be provided. If the CF4 and HF exiting the Thermal Oxidizer will be captured by the downstream control devices then provide supporting documents/discussion to support the claims. To summarize, in the permit application please discuss, and provide justification for your conclusions, the creation of any CF4 and HF and the ultimate fate of these compounds whether they are captured or emitted from the facility.

2. On Page 7 the air pollution control process after the thermal oxidizer is described with dry cyclones, venturi heads, two packed bed wet scrubbers, and a bio-scrubber. Please provide estimates on the control efficiencies for these devices.

3. On Page 18, the following is stated for the criteria air contaminants NO_x and SO_2: “By achieving the NAAQS, the Facility achieves the necessary Degree of Air Cleaning Required.” However, meeting the required degree of air cleaning specified in Part 212-2.3 (a) Table 3 - degree of air cleaning required for criteria air contaminants is necessary, along with also demonstrating that the residual impacts form the post-control emissions are in compliance with the NAAQS. Please provide a discussion demonstrating compliance with the degree of air cleaning requirements for NO_x and SO_2 emissions.

On Page 19 and 21, the following is stated respectively for the non-criteria air contaminants Naphthalene ($C_{10}H_8$) and Ammonia (NH_3) emissions: “By achieving the Guideline Concentrations, the Facility achieves the necessary Degree of Air Cleaning Required.” Based upon the environmental rating of the air contaminants and its Emission Rate Potential, meeting the required degree of air cleaning specified in Part 212-2.3(b) Table 4 - degree of air cleaning required for non-criteria air contaminants is necessary, along with also demonstrating that the residual impacts from the post-control emissions do not exceed the upper concentration limit of the DEC’s risk management range. Please provide a discussion demonstrating compliance with the degree of air cleaning requirements for Naphthalene and Ammonia emissions.

4. On Page 24 the residence time in the pyrolysis chamber of 20 min with SBS’s small-scale test is stated, but the pyrolysis chamber residence time for the full-scale SBS facility is not specified. Only the pyrolysis chamber operating temperature range of 482°C to 621°C for the full-scale SBS facility is specified, compared to the pyrolysis chamber operating temperature range of 450°C with SBS’s small-scale test. Please provide information on the proposed residence time and more precise operating temperature of the full-scale pyrolysis process.

5. On Air Permit Application form Page 3 the Total HAPs annual PTE is listed as being 9.5 tons/yr but the sum of the individual annual PTEs within the table on Page 66 for all those Air Contaminants which are listed in the current (2021) DAR-1 AGC/SGC Tables as being Federal HAPs is almost 14.5 tons/yr. Naphthalene alone has an annual PTE over 9.5 tons/yr. Please correct the Total HAPs number.

If you have questions regarding the technical items being requested in this letter, please contact Paul Sierzenga, Regional Air Engineer at Paul.Sierzenga@dec.ny.gov or 518-623-1200.

Sincerely,

Erin L. Burns

Erin L. Burns
Regional Permit Administrator

ec: Paul Sierzenga, NYSDEC Air
Julia Stuart, NYSDEC Air
Aaron Love, NYSDEC OGC
Kevin Wood, NYSDEC DMM
Alanah Keddell-Tuckey, NYSDEC OEJ
Andrew Millspaugh, Sterling Environmental

Appendix 2

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

State Pollutant Discharge Elimination System (SPDES) DISCHARGE PERMIT

SIC Code: 4952	NAICS Code: 221320		SPDES Number:	NY0029050
Discharge Class (CL):	05		DEC Number:	5-5205-00015/00002
Toxic Class (TX):	T		Effective Date (EDP):	02/01/2017
Major-Sub Drainage Basin:	11 - 01		Expiration Date (ExDP):	01/31/2022
Water Index Number:	H	Item No.: 941.6 - 6	Modification Dates (EDPM):	01/28/2022
Compact Area:	-			

This SPDES permit is issued in compliance with Title 8 of Article 17 of the Environmental Conservation Law of New York State and in compliance with the Clean Water Act, as amended, (33 U.S.C. '1251 et.seq.)

PERMITTEE NAME AND ADDRESS			
Name:	City of Glens Falls	Attention:	Mayor
Street:	42 Ridge Street		
City:	Glens Falls	State:	NY Zip Code: 12801
Email:	mayor@cityofglensfalls.com	Phone:	518-761-3805

is authorized to discharge from the facility described below:

FACILITY NAME, ADDRESS, AND PRIMARY OUTFALL										
Name:	City of Glens Falls WWTP									
Address / Location:	2 Shermantown Road						County:	Warren		
City:	Glens Falls				State:	NY	Zip Code:	12801		
Facility Location:		Latitude:	43 °	18 '	23.5 " N	& Longitude:	73 °	37 '	26.0 " W	
Primary Outfall No.:	001	Latitude:	43 °	18 '	19 " N	& Longitude:	73 °	37 '	25 " W	
Outfall Description:	Treated Sanitary	Receiving Water:	Hudson River				Class:	C		

and the additional outfalls listed in this permit, in accordance with: effluent limitations; monitoring and reporting requirements; other provisions and conditions set forth in this permit; and 6 NYCRR Part 750-1 and 750-2.

This permit and the authorization to discharge shall expire on midnight of the expiration date shown above and the permittee shall not discharge after the expiration date unless this permit has been renewed or extended pursuant to law. To be authorized to discharge beyond the expiration date, the permittee shall apply for permit renewal not less than 180 days prior to the expiration date shown above.

DISTRIBUTION:
- CO BWP - Permit Coordinator
- CO BWC - SCIS
- RWE
- RPA
- EPA Region II
- NYSEFC

Deputy Permit Administrator:	Beth A. Magee		
Address:	232 Golf Course Road, Warrensburg, NY 12885		
Signature:	Beth A. Magee — Digitally signed by Beth A. Magee Date: 2022.01.31 09:00:28 -05'00'	Date:	1 /28 22

Contents

SUMMARY OF ADDITIONAL OUTFALLS

Outfall	Wastewater Description	Outfall Latitude						Outfall Longitude					
002	Combined Sewer Overflow	**43**	°	**18**	'	**19**	" N	**73**	°	**37**	'	**25**	" W
Receiving Water:	**Hudson River (common outfall pipe with 001)**							Class:	**C**				

DEFINITIONS

TERM	DEFINITION
7-Day Geo Mean	The highest allowable geometric mean of daily discharges over a calendar week.
7-Day Average	The average of all daily discharges for each 7-days in the monitoring period. The sample measurement is the highest of the 7-day averages calculated for the monitoring period.
12-Month Rolling Average (12 MRA)	The current monthly value of a parameter, plus the sum of the monthly values over the previous 11 months for that parameter, divided by the number of months for which samples were collected in the 12-month period.
30-Day Geometric Mean	The highest allowable geometric mean of daily discharges over a calendar month, calculated as the antilog of: the sum of the log of each of the daily discharges measured during a calendar month divided by the number of daily discharges measured during that month.
Action Level	Action level means a monitoring requirement characterized by a numerical value that, when exceeded, triggers additional permittee actions and department review to determine if numerical effluent limitations should be imposed.
Compliance Level / Minimum Level	A compliance level is an effluent limitation. A compliance level is given when the water quality evaluation specifies a Water Quality Based Effluent Limit (WQBEL) below the Minimum Level. The compliance level shall be set at the Minimum Level (ML) for the most sensitive analytical method as given in 40 CFR Part 136, or otherwise accepted by the Department.
Daily Discharge	The discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for the purposes of sampling. For pollutants expressed in units of mass, the 'daily discharge' is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurement, the 'daily discharge' is calculated as the average measurement of the pollutant over the day.
Daily Maximum	The highest allowable Daily Discharge.
Daily Minimum	The lowest allowable Daily Discharge.
Effective Date of Permit (EDP or EDPM)	The date this permit is in effect.
Effluent Limitations	Effluent limitation means any restriction on quantities, quality, rates and concentrations of chemical, physical, biological, and other constituents of effluents that are discharged into waters of the state.
Expiration Date of Permit (ExDP)	The date this permit is no longer in effect.
Instantaneous Maximum	The maximum level that may not be exceeded at any instant in time.
Instantaneous Minimum	The minimum level that must be maintained at all instants in time.
Monthly Average	The highest allowable average of daily discharges over a calendar month, calculated as the sum of each of the daily discharges measured during a calendar month divided by the number of daily discharges measured during that month.
Outfall	The terminus of a sewer system, or the point of emergence of any waterborne sewage, industrial waste or other wastes or the effluent therefrom, into the waters of the State.
Range	The minimum and maximum instantaneous measurements for the reporting period must remain between the two values shown.
Receiving Water	The classified waters of the state to which the listed outfall discharges.
Sample Frequency / Sample Type / Units	See NYSDEC's "DMR Manual for Completing the Discharge Monitoring Report for the SPDES" for information on sample frequency, type and units.

PERMIT LIMITS, LEVELS AND MONITORING - 001

OUTFALL	LIMITATIONS APPLY	RECEIVING WATER	EFFECTIVE	EXPIRING
001	All Year	Hudson River	01/28/2022	01/31/2022

PARAMETER	EFFLUENT LIMITATION					MONITORING REQUIREMENTS				FN
								Location		
	Type	Limit	Units	Limit	Units	Sample Frequency	Sample Type	Inf.	Eff.	
Flow	Monthly Average	9.5	MGD			Continuous	Recorder		X	
Flow	Daily Maximum	Monitor	MGD			Continuous	Recorder		X	
pH	Range	6.0-9.0	SU			3/Day	Grab		X	
Temperature	Daily Maximum	Monitor	°F			3/Day	Grab		X	
$CBOD_5$	Monthly Average	25	mg/L	2000	lbs/d	2/Week	24-hr. Comp.	X	X	1
$CBOD_5$	7-Day Average	40	mg/L	3200	lbs/d	2/Week	24-hr. Comp.		X	
Total Suspended Solids (TSS)	Monthly Average	30	mg/L	2400	lbs/d	2/Week	24-hr. Comp.	X	X	1
Total Suspended Solids (TSS)	7-Day Average	45	mg/L	3600	lbs/d	2/Week	24-hr. Comp.		X	
Settleable Solids	Daily Maximum	0.3	mL/L			3/Day	Grab	X	X	
Total Kjeldahl Nitrogen (TKN) (as N)	Monthly Average	Monitor	mg/L	Monitor	lbs/d	2/Week	24-hr. Comp.		X	
Total Kjeldahl Nitrogen (TKN) (as N)	Daily Maximum	Monitor	mg/L	Monitor	lbs/d	2/Week	24-hr. Comp.		X	
Ammonia (as N)	Daily Maximum	Monitor	mg/L	Monitor	lbs/d	2/Week	24-hr. Comp.		X	
Ammonia (as N) (May 1st to Oct 31st)	Monthly Average	22	mg/L	1700	lbs/d	2/Week	24-hr. Comp.		X	
Ammonia (as N) (Nov 1st to Apr 30th)	Monthly Average	34	mg/L	2700	lbs/d	2/Week	24-hr. Comp.		X	
Mercury, Total	Daily Maximum	50	ng/L			2/Month	Grab			
Mercury, Total	Monthly Average	Monitor	ng/L			2/Month	Grab			
Silver, Total	Daily Maximum	28	ug/L	2.2	lbs/d	2/Month	24-hr. Comp.			
Silver, Total	Monthly Average	Monitor	ug/L	Monitor	lbs/d	2/Month	24-hr. Comp.			
Sulfide, Total	Daily Maximum	220	ug/L	17	lbs/d	2/Month	24-hr. Comp.			
Sulfide, Total	Monthly Average	Monitor	ug/L	Monitor	lbs/d	2/Month	24-hr. Comp.			
Biennial Pollutant Scan						1/Two Years	-		X	2

PERMIT LIMITS, LEVELS AND MONITORING – 001 (continued)

ACTION LEVEL PARAMETERS	Type	Action Level	Units	Action Level	Units	Sample Frequency	Sample Type	Inf.	Eff.	FN
Arsenic, Total	Daily Maximum	Monitor	ug/L	0.35	lbs/d	2/Month	24-hr. Comp.		X	3
Cadmium, Total	Daily Maximum	Monitor	ug/L	2.0	lbs/d	2/Month	24-hr. Comp.		X	3
Chromium, Total	Daily Maximum	Monitor	ug/L	3.1	lbs/d	2/Month	24-hr. Comp.		X	3
Copper, Total	Daily Maximum	Monitor	ug/L	4.6	lbs/d	2/Month	24-hr. Comp.		X	3
Cyanide, Free	Daily Maximum	Monitor	ug/L	3.0	lbs/d	2/Month	Grab		X	3
Lead, Total	Daily Maximum	Monitor	ug/L	7.1	lbs/d	2/Month	24-hr. Comp.		X	3
Zinc, Total	Daily Maximum	Monitor	ug/L	7.7	lbs/d	2/Month	24-hr. Comp.		X	3

EFFLUENT DISINFECTION Required Seasonal from May 1st - October 31st		Limit	Units	Limit	Units	Sample Frequency	Sample Type	Inf.	Eff.	FN
Coliform, Fecal	30-Day Geometric Mean	200	No./ 100 mL			2/Week	Grab		X	
Coliform, Fecal	7-Day Geometric Mean	400	No./ 100 mL			2/Week	Grab		X	

WHOLE EFFLUENT TOXICITY (WET) TESTING		Limit	Units	Action Level	Units	Sample Frequency	Sample Type	Inf.	Eff.	FN
WET - Acute Invertebrate	See footnote			6	TUa	Quarterly	See footnote		X	4
WET - Acute Vertebrate	See footnote			6	TUa	Quarterly	See footnote		X	4
WET - Chronic Invertebrate	See footnote			39	TUc	Quarterly	See footnote		X	4
WET - Chronic Vertebrate	See footnote			39	TUc	Quarterly	See footnote		X	4

Footnotes on next page.

FOOTNOTES – Outfall 001:

1. Effluent shall not exceed 15% and 15% of influent concentration values for $CBOD_5$ & TSS respectively.

2. Biennial Pollutant Scan: The permittee shall perform effluent sampling every two (2) years for all applicable pollutants identified in the NY-2A Application, Tables A - D. Sampling data shall be collected according to the guidance in the NY-2A application and maintained by the permittee. Monitoring results shall not be submitted on the DMR. Data shall be submitted with the next submission of the NY-2A form.

3. Action Levels: If the action level is exceeded, the additional monitoring requirement is triggered, and the permittee shall undertake a short-term, high-intensity, monitoring program. Samples identical to those required for routine monitoring purposes shall be taken on each of at least three consecutive days and analyzed. Results shall be expressed in both mass and concentration. If levels higher than the action levels are confirmed, the permittee shall evaluate the treatment system operation and identify and employ actions to reduce concentrations present in the discharge. The permit may also be reopened by the Department for consideration of revised action levels or effluent limits. Action level monitoring results and the effectiveness of the actions taken shall be summarized and submitted with the DMR data.

4. **Whole Effluent Toxicity (WET) Testing:**
   Testing Requirements – Acute and if directed Chronic WET testing is required. Testing shall be performed in accordance with 40 CFR Part 136 and TOGS 1.3.2 unless prior written approval has been obtained from the Department. The test species shall be Ceriodaphnia dubia (water flea - invertebrate) and Pimephales promelas (fathead minnow - vertebrate). Receiving water collected upstream from the discharge should be used for dilution. All tests conducted should be static-renewal (two 24-hr composite samples with one renewal for Acute tests and three 24-hr composite samples with two renewals for Chronic tests). The appropriate dilution series should be used to generate a definitive test endpoint, otherwise an immediate rerun of the test may be required. WET testing shall be coordinated with the monitoring of chemical and physical parameters limited by this permit so that the resulting analyses are also representative of the sample used for WET testing. The ratio of critical receiving water flow to discharge flow (i.e. dilution ratio) is 20:1 for acute, and 39:1 for chronic. Discharges which are disinfected using chlorine should be dechlorinated prior to WET testing or samples shall be taken immediately prior to the chlorination system.

   Monitoring Period - WET testing shall be performed quarterly (calendar quarters) during calendar years ending in 2 and 7.

   Reporting - Toxicity Units shall be calculated and reported on the DMR as follows: TUa = (100)/(48-hr LC50) [note that Acute data is generated by both Acute and Chronic testing] and TUc = (100)/(7-day NOEC) or (100)/(7-day IC25) when Chronic testing has been performed or TUc = (TUa) x (10) when only Acute testing has been performed and is used to predict Chronic test results, where the 48-hr LC50, 7-day NOEC and/or IC25 are all expressed in % effluent. This must be done, including the Chronic prediction from the Acute data, for both species unless otherwise directed. For Chronic results, report the most sensitive endpoint (i.e. survival, growth and/or reproduction) corresponding to the lowest 7-day NOEC or IC25 and resulting highest TUc. For Acute results, report a TUa of 0.3 if there is no statistically significant mortality in 100% effluent as compared to the control. Report a TUa of 1.0 if there is statistically significant mortality in 100% effluent as compared to the control, but insufficient mortality to generate a 48-hr LC50. Also, in the absence of a 48-hr LC50, use 1.0 TUa for the Chronic prediction from the Acute data, and report a TUc of 10.0.

   The complete test report including all bench sheets, statistical analyses, reference toxicity data, daily average flow at the time of sampling and other appropriate supporting documentation, shall be submitted within 60 days following the end of each test period with your WET DMR and to the WET@dec.ny.gov email address. A summary page of the test results for the invertebrate and vertebrate species indicating TUa, 48-hr LC50 for Acute tests and/or TUc, NOEC, IC25, and most sensitive endpoints for Chronic tests, should also be included at the beginning of the test report.

   WET Testing Action Level Exceedances - If an action level is exceeded then the Department may require the permittee to conduct additional WET testing including Acute and/or Chronic tests. Additionally, the permittee may be required to perform a Toxicity Identification/Reduction Evaluation (TI/RE) in accordance with Department guidance. Enforceable WET limits may also apply. The permittee shall be notified in writing by their Regional DEC office of additional requirements. The written notification shall include the reason(s) why such testing, TI/RE and/or limits are required.

PERMIT LIMITS, LEVELS AND MONITORING - 002

OUTFALL	LIMITATIONS APPLY	RECEIVING WATER	EFFECTIVE	EXPIRING
002	All Year	Hudson River	02/01/2017	01/31/2022

PARAMETER	EFFLUENT LIMITATION					MONITORING REQUIREMENTS				FN
								Location		
	Type	Limit	Units	Limit	Units	Sample Frequency	Sample Type	Inf.	Eff.	
Flow	Monthly Average	Monitor	MGD			Continuous	Recorder		X	1
Flow	Daily Maximum	Monitor	MGD			Continuous	Recorder		X	1
pH	Range	Monitor	SU			1/Day	Grab		X	2
$CBOD_5$	Monthly Average	Monitor	mg/L			1/Day	Grab		X	2
$CBOD_5$	Daily Maximum	Monitor	mg/L			1/Day	Grab		X	2
Total Suspended Solids (TSS)	Monthly Average	Monitor	mg/L			1/Day	Grab		X	2
Total Suspended Solids (TSS)	Daily Maximum	Monitor	mg/L			1/Day	Grab		X	2
Settleable Solids	Daily Maximum	Monitor	mL/L			1/Day	Grab		X	2

FOOTNOTES – Outfall 002:

1. Discharge through Outfall 002 (Combined Sewer Overflow) is prohibited unless influent flows to the WWTP exceed 13.35 MGD.

2. Monitoring is required once per 24-hour period during which discharge through Outfall 002 occurs. Samples shall be collected at the main influent channel.

STORMWATER POLLUTION PREVENTION REQUIREMENTS

NO EXPOSURE CERTIFICATION

The permittee submitted a Conditional Exclusion for No Exposure Form on 1/6/2022, certifying that all industrial activities and materials are completely sheltered from exposure to rain, snow, snowmelt, and/or stormwater runoff. The permittee must maintain a condition of no exposure for the exclusion to remain applicable. If conditions change resulting in the exposure of materials and activities to stormwater, the permittee must notify the Regional Water Engineer. The permittee must recertify a condition of no exposure every five years by completing the "No Exposure Certification Form" found on the NYSDEC website.

BEST MANAGEMENT PRACTICES FOR COMBINED SEWER OVERFLOWS

The permittee shall implement the following Best Management Practices (BMPs). These BMPs are designed to implement operation & maintenance procedures, utilize the existing treatment facility and collection system to the maximum extent practicable, and implement sewer design, replacement and drainage planning, to maximize pollutant capture and minimize water quality impacts from combined sewer overflows. The BMPs are equivalent to the "Nine Minimum Control Measures" required under the USEPA National Combined Sewer Overflow policy. The EPA's policy is available at https://www.epa.gov/npdes/combined-sewer-overflows-csos

1. CSO Maintenance/Inspection - The permittee shall develop a written maintenance and inspection program for all CSOs listed on page(s) 3 of this permit. This program shall include all regulators tributary to these CSOs and shall be conducted during periods of both dry and wet weather. This is to ensure that no discharges occur during dry weather and that the maximum amount of wet weather flow is conveyed to the City of Glens Falls POTW for treatment. This program shall consist of inspections with required repair, cleaning and maintenance done as needed. This program shall consist of monthly inspections.

   Inspection reports shall be completed indicating visual inspection, any observed flow, incidence of rain or snowmelt, condition of equipment and work required. These reports shall be in a format approved by the Region 5 Office and submitted to the Region with the monthly operating report (Form 92-15-7).

2. Maximum Use of Collection System for Storage - The permittee shall optimize the collection system by operating and maintaining it to minimize the discharge of pollutants from CSOs. It is intended that the maximum amount of in-system storage capacity be used (without causing service backups) to minimize CSOs and convey the maximum amount of combined sewage to the treatment plant in accordance with Item 4 below. This shall be accomplished by an evaluation of the hydraulic capacity of the system but should also include a continuous program of flushing or cleaning to prevent deposition of solids and the adjustment of regulators and weirs to maximize storage.

3. Industrial Pretreatment - The approved Industrial Pretreatment Program shall consider CSOs in the calculation of local limits for indirect discharges. Discharge of persistent toxics upstream of CSOs will be in accordance with guidance under **(NYSDEC Division of Water Technical and Operational Guidance Series (TOGS) 1.3.8 New Discharges to POTWs**. (http://www.dec.ny.gov/docs/water_pdf/togs138.pdf). For industrial operations characterized by use of batch discharge, consideration shall be given to the feasibility of a schedule of discharge during conditions of no CSO. For industrial discharges characterized by continuous discharge, consideration must be given to the collection system capacity to maximize delivery of waste to the treatment plant. Non-contact cooling water should be excluded from the combined system to the maximum extent practicable. Direct discharges of cooling water must apply for a SPDES permit.

   To the maximum extent practicable, consideration shall be given to maximize the capture of nondomestic waste containing toxic pollutants and this wastewater should be given priority over residential/commercial service areas for capture and treatment by the POTW.

4. Maximize Flow to POTW - Factors cited in Item 2. above shall also be considered in maximizing flow to the POTW. Maximum delivery to the POTW is particularly critical in treatment of "first-flush" flows. The treatment plant shall be capable of receiving and treating: the peak design hydraulic loading rates of 13.35 for all process units. The collection system and headworks must be capable of delivering these flows during wet weather. If the permittee cannot deliver maximum design flow for treatment, the permittee shall submit a plan and schedule for accomplishing this requirement within 12 months after the effective date of this permit.

5. Prohibition of Dry Weather Overflow - Dry weather overflows from the combined sewer system are prohibited. The occurrence of any dry weather overflow shall be promptly abated and reported to the NYSDEC Region 5 Office in accordance with 6 NYCRR Part 750-2.7.

BEST MANAGEMENT PRACTICES FOR COMBINED SEWER OVERFLOWS (continued)

6. Wet Weather Operating Plan (WWOP) - The permittee shall maximize treatment during wet weather events. This shall be accomplished by having a WWOP containing procedures so as to operate unit processes to treat maximum flows while not appreciably diminishing effluent quality or destabilizing treatment upon return to dry weather operation. The WWOP shall be developed in accordance with the DEC guidance, Wet Weather Operating Practices for POTWs With Combined Sewers, (http://www.dec.ny.gov/docs/water_pdf/wwtechtran.pdf), and submitted to the Regional Water Engineer and the Bureau of Water Permits for review and approval in accordance with the Schedule of Submittals. A revised Wet Weather Operating Plan was submitted on 4/4/2017.

   The submission of a WWOP is a one-time requirement that shall be done to the Department's satisfaction once. However, a revised wet weather operating plan must be submitted whenever the POTW and/or sewer collection system is replaced or modified. When this permit is administratively renewed by NYSDEC letter entitled "SPDES NOTICE/RENEWAL APPLICATION/PERMIT", the permittee is not required to repeat the submission. The above due dates are independent from the effective date of the permit stated in the letter of "SPDES NOTICE/RENEWAL APPLICATION/PERMIT".

7. Control of Floatable and Settleable Solids - The discharge of floating solids, oil and grease, or solids of sewage origin which cause deposition in the receiving waters, is a violation of the NYS Narrative Water Quality Standards contained in Part 703. As such, the permittee shall implement best management practices in order to eliminate or minimize the discharge of these substances. All of the measures cited in Items 1, 2, 4 & 5 above shall constitute approvable "BMPs" for mitigation of this problem. If aesthetic problems persist, the permittee should consider additional BMPs including but not limited to: street sweeping, litter control laws, installation of floatables traps in catch basins (such as hoods), booming and skimming of CSOs, and disposable netting on CSO outfalls. In cases of severe or excessive floatables generation, booming and skimming should be considered an interim measure prior to implementation of final control measures. Public education on harmful disposal practices of personal hygienic devices may also be necessary including but not limited to: public broadcast television, printed information inserts in sewer bills, or public health curricula in local schools.

8. Combined Sewer System Replacement - Replacement of combined sewers shall not be designed or constructed unless approved by NYSDEC. When replacement of a combined sewer is necessary it shall be replaced by separate sanitary and storm sewers to the greatest extent possible. These separate sanitary and storm sewers shall be designed and constructed simultaneously but without interconnections to maximum extent practicable. When combined sewers are replaced, the design should contain cross sections which provide sewage velocities which prevent deposition of organic solids during low flow conditions.

9. Combined Sewer/Extension - Combined sewer/extension, when allowed should be accomplished using separate sewers. These sanitary and storm sewer extensions shall be designed and constructed simultaneously but without interconnections. No new source of stormwater shall be connected to any separate sanitary sewer in the collection system.

   If separate sewers are to be extended from combined sewers, the permittee shall demonstrate the ability of the sewerage system to convey, and the treatment plant to adequately treat, the increased dry-weather flows. Upon a determination by the Regional Water Engineer an assessment shall be made by the permittee of the effects of the increased flow of sanitary sewage or industrial waste on the strength of CSOs and their frequency of occurrence including the impacts upon best usage of the receiving water. This assessment should use techniques such as collection system and water quality modeling contained in the 1999 Water Environment Federation Manual of Practice FD-17 entitled, Prevention and Control of Sewer System Overflows, 2nd edition.

10. Sewage Backups - If, there are documented, recurrent instances of sewage backing up into house(s) or discharges of raw sewage onto the ground surface from surcharging manholes, the permittee shall, upon letter notification from DEC, prohibit further connections that would exacerbate the surcharging/back-up problems.

11. Septage and Hauled Waste - The discharge or release of septage or hauled waste upstream of a CSO is prohibited.

12. Control of Runoff - It is recommended that the impacts of runoff from development and redevelopment in areas served by combined sewers be reduced by requiring compliance with the New York Standards for Erosion and Sediment Control and the quantity control requirements included in the New York State Stormwater Management Design Manual. (http://www.dec.ny.gov/chemical/8694.html).

BEST MANAGEMENT PRACTICES FOR COMBINED SEWER OVERFLOWS (continued)

13. Public Notification – The permittee shall maintain identification signs at all CSO outfalls owned and operated by the permittee. The permittee shall place the signs at or near the CSO outfalls and ensure that the signs are easily readable by the public. The signs shall have **minimum** dimensions of eighteen inches by twenty-four inches (18" x 24") and shall have white letters on a green background and contain the following information:

> **N.Y.S. PERMITTED DISCHARGE POINT**
> **(wet weather discharge)**
> **SPDES PERMIT No.: NY__________**
>
> **OUTFALL No. :____**
>
> For information about this permitted discharge contact:
>
> Permittee Name:
>
> Permittee Contact:
>
> Permittee Phone: ( ) - ### - ####
>
> OR:
>
> NYSDEC Division of Water Regional Office Address:
>
> NYSDEC Division of Water Regional Phone: ( ) - ### -####

14. Characterization and Monitoring - The permittee shall characterize the combined sewer system, determine the frequency of overflows, and identify CSO impacts in accordance with Combined Sewer Overflows, Guidance for Nine Minimum Controls, EPA, 1995, Chapter 10. These are minimum requirements, more extensive characterization and monitoring efforts which may be required as part of the Long-Term Control Plan.

15. Annual Report - The permittee shall submit the Combined Sewer Overflows (CSO) Annual Report Form (https://www.dec.ny.gov/chemical/48985.html), which summarizes the implementation of the above BMPs and the CSO Long-Term Control Plan. The CSO Annual Report shall be submitted by January 31st of each year to the Regional Water Engineer and to the Bureau of Water Permits. The complete documentation shall be stored at a central location and be made available to DEC upon request.

SPECIAL CONDITIONS: CSO CONTROL POLICY

A. Water Quality Requirements for Combined Sewer Overflows

Long-Term Control Plan

The permittee submitted a LTCP in May 2012 in accordance with the Guidance for Long-Term Control Plan, EPA, September 1995. The plan was revised in January 2013 and approved on January 29, 2013. In accordance with the approved LTCP, the permittee was required to:

- Develop an asset management plan for planning and budgeting long term CSS and WWTP operations and maintenance
- Complete GIS mapping of the entire collection
- Clean and rehabilitate the CSS
- Install new regulator at CSO 002 outfall with stormwater screen for floatables control
- Replace mechanical bar screens at preliminary treatment building
- Upgrade the aeration system to reactivate the second aeration tank

Implementation of the LTCP was completed[1] in October 2015. The permittee shall continue to effectively operate and maintain the CSO controls identified in the long-term control plan.

Water Quality Criterion – Presumption Approach

The permittee shall not discharge any pollutant at a level that causes an in-stream excursion of the applicable water quality requirements. The EPA 1994 CSO Control Policy indicates that a CSO control plan that meets the criteria below would provide an adequate level on control to meet the water quality requirements of the CWA. Following implementation of the approved LTCP, the following criteria shall be an enforceable performance metric under this permit:

I. The permittee shall eliminate or capture for treatment, at least 85 percent by volume of the system-wide combined sewage collected in combined sewer system during precipitation events on a system-wide annual average basis.

Any additional discharges of combined sewage flow during wet weather shall receive the minimum treatment specified below:

- Primary clarification or equivalent, and
- Solids and floatables disposal, and
- Disinfection, if required to meet WQS, protect designated uses, and protect human health, including removal of harmful disinfection chemical residuals.

B. Monitoring Requirements – Post Construction Compliance Monitoring Program

1. In accordance with the Schedule of Submittals, the permittee shall submit a revised approvable post-construction monitoring plan (PCCMP) that (a) is adequate to ascertain the effectiveness of the CSO controls and (b) can be used to verify attainment of water quality standards. The PCCMP must include the proposed sampling locations, sampling schedule, details on how effectiveness of the CSO controls will be assessed, and a Quality Assurance Project Plan[2] (QAPP) that details the laboratory that will be performing the analysis[3], monitoring protocols to be followed, where appropriate, including CSO and ambient monitoring. The sampling schedule shall be developed to target the periods for which CSO events are most likely to occur. Ambient sampling must be conducted, at a minimum, for all pollutants listed in Section B.2 below and for all pollutants for which the 303(d) list identifies CSOs as a source of the pollutant to the receiving water(s). Guidance on CSO post construction compliance monitoring and reporting can be found at: https://www.epa.gov/sites/default/files/2015-10/documents/final_cso_pccm_guidance.pdf.

[1] Implementation of the LTCP Recommended Plan was limited to the projects listed under Phase 1 – SPDES Permit and CSO Compliance. The Phase 2 and 3 projects were identified for future planning and the need for their implementation will be dependent upon the improvements in WWTP and collection system performance and their subsequent impact on water quality. The need to implement Phases 2 and 3 will be subject to the results of PCCM and future wastewater capacity needs to support regional economic growth.

[2] The QAPP shall be developed as outlined in the EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations, EPA QA/R-5.

[3] All chemical analyses must be conducted by a laboratory certified by the NYS Health Department under the National Environmental Laboratory Approval Program (NELAP) for test or sample results which require certificates of approval. Tests for pH, temperature, dissolved oxygen and settleable solids do not require certificates of approval but a description of the equipment used, and the calibration schedule of appropriate equipment is required.

SPECIAL CONDITIONS: CSO CONTROL POLICY (continued)

2. The PCCM Program sampling shall be implemented, in accordance with the approved PCCMP required in Section B.1 above, during years ending in **1** and **6**. Ambient sampling must be conducted, at a minimum, for the following parameters:

PARAMETER	Units	Sample Type
BOD_5	mg/L	Grab
Coliform, Fecal	#/100ml	Grab
Dissolved Oxygen	mg/L	Grab
Floatable Material	-	Visual Observation
Ammonia (as NH_3)	mg/L	Grab
Solids, Settleable	mL/L	Grab
Solids, Suspended	mg/L	Grab

3. By March 31st of the year following PCCM sampling, the permittee shall submit an approvable PCCM Program Report. The PCCM Program Report shall include:
   a. Analytical results of the PCCM sampling,
   b. The number of CSO events and volume of CSO discharged during the PCCM period,
   c. An assessment of whether CSO receiving water quality complies with applicable water quality standards,
   d. Recommendations for potential improvements in CSO controls for when water quality standards are not attained, and
   e. A discussion of whether the CSO controls are meeting the frequency goals of the Presumptive Approach, selected by the permittee in the LTCP, to verify the effectiveness of the CSO controls.

C. Special Conditions

1. Sensitive Area[4] Reassessment

The permittee shall reassess overflows to sensitive areas stated in the LTCP, where elimination or relocation of the overflows is not physically possible or economically achievable. The permittee shall also assess whether new or additional sensitive areas may be affected by overflows that were not initially identified in the LTCP. The permittee shall consider new or improved techniques to eliminate or relocate overflows or changed circumstances that influence economic achievability. The permittee shall prepare and submit to the Regional Water Engineer a report, separately from the PCCM Program Report, that presents the results of this reassessment, feasible improvements to eliminate or minimize overflows to sensitive areas, and the permittee's recommendation regarding the elimination or relocation of these outfalls. The permittee shall submit such reports by December 31st in the same year the PCCM Program Report is submitted.

2. Reopener

This permit may be modified or revoked and reissued, as provided pursuant to 6 NYCRR 750-1.18, 6 NYCRR 750-1.20, 40 CFR 122.62 and 124.5, for the following reasons:

I. To include new or revised conditions developed to comply with any state of federal law or regulation that addresses CSOs that are adopted or promulgated subsequent to the effective date of this permit.
II. To include new or revised conditions if new information, not available at the time of permit issuance, indicates that CSO controls imposed under the permit have failed to ensure the attainment of applicable water quality requirements.

[4] Sensitive areas include designated Outstanding National Resource Waters, National Marine Sanctuaries, waters with threated or endangered species and their habitat, waters with primary contact recreation, public drinking water intakes or their designated protection areas, and shellfish beds, waters listed on the NYSDEC 303(d) list, or any other area determined by the Department.

MERCURY MINIMIZATION PROGRAM (MMP) - Type I

1. General - The permittee must develop, implement, and maintain a mercury minimization program (MMP), containing the elements set forth below, to reduce mercury effluent levels with the goal of achieving the WQBEL of 0.7 ng/L.

2. MMP Elements - The MMP must be a written document and must include any necessary drawings or maps of the facility and/or collection system. Other related documents already prepared for the facility may be used as part of the MMP and may be incorporated by reference. At a minimum, the MMP must include the following elements as described in detail below:

   a. Monitoring - Monitoring at Outfall 001, influent and other locations tributary to compliance points may be performed using either USEPA Method 1631 or another sufficiently sensitive method, as approved under 40 CFR Part 136[5]. Monitoring of raw materials, equipment, treatment residuals, and other non-wastewater/non-stormwater substances may be performed using other methods as appropriate. Monitoring must be coordinated so that the results can be effectively compared between locations.

      Minimum required monitoring is as follows:

      i. Sewage Treatment Plant Influent and/or Effluent – The permittee must collect samples at the location(s) and frequency as specified in the SPDES permit limitations table.
      ii. *Key Locations* and *Potential Mercury Sources* – The permittee must sample *key locations*, chosen to identify *potential mercury sources*, at least semi-annually. Sampling of discharges from dental facilities in compliance with 6 NYCRR 374.4 is not required.
      iii. Hauled Wastes – The permittee must establish procedures for the acceptance of hauled waste to ensure the hauled waste is not a potential mercury source. Loads which may exceed 500 ng/L,[6] must receive approval from the Department prior to acceptance.
      iv. Decreased Monitoring Requirements - Facilities with EEQ at or below 12 ng/L are eligible for the following:
         1) Reduced requirements, through a permittee-initiated permit modification
            a) Conduct influent monitoring, sampling quarterly, in lieu of monitoring within the collection system, such as at *key locations*; and
            b) Conduct effluent compliance sampling quarterly.
         2) If a facility with reduced requirements reports discharges above 12 ng/L for two of four consecutive effluent samples, the Department may undertake a Department-initiated modification to remove the allowance of reduced requirements.
         3) Under the decreased permit requirements, the facility must continue to conduct a status report, as applicable in accordance with 2.c of this MMP, to determine if any waste streams have changed.
      v. Additional monitoring must be completed as required elsewhere in this permit (e.g., locations tributary to compliance points).

   b. Control Strategy - The control strategy must contain the following minimum elements:
      i. Pretreatment/Sewer Use Law - The permittee must review pretreatment program requirements and the Sewer Use Law (SUL) to ensure it is up-to-date and enforceable with applicable permit requirements and will support efforts to achieve a dissolved mercury concentration of 0.70 ng/L in the effluent.

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[5] Outfall monitoring must be conducted using the methods specified in Table 8 of *DOW 1.3.10*.

[6] A level of 0.2 mg/L (200,000 ng/L) or more is considered hazardous per 40 CFR Part 261.11. 500 ng/L is used here to alert the permittee that there is an unusual concentration of mercury and that it will need to be managed appropriately.

MERCURY MINIMIZATION PROGRAM (MMP) - Type I (Continued)

ii. Monitoring and Inventory/Inspections for Outfall
   1) Monitoring shall be performed as described in 2.a above. As mercury sources are found, the permittee must enforce its sewer use law to track down and minimize these sources.
   2) The permittee must inventory and/or inspect users of its system as necessary to support the MMP.
      a) Dental Facilities
         1. The permittee must maintain an inventory of each dental facility.
         2. The permittee must inspect each dental facility at least once every five years to verify compliance with the wastewater treatment operation, maintenance, and notification elements of 6 NYCRR 374.4. Alternatively, the permittee may develop and implement an outreach program,[7] which informs users of their responsibilities, and collect the "Amalgam Waste Compliance Report for Dental Dischargers"[8] form, as needed, to satisfy the inspection requirements. The permittee must conduct the outreach program at least once every five years and ensure the "Amalgam Waste Compliance Report for Dental Dischargers" are submitted by new users, as necessary. The outreach program could be supported by a subset of site inspections.
         3. A file shall be maintained containing documentation demonstrating compliance with 2.b.ii.2)a) above. This file shall be available for review by the Department representatives and copies shall be provided upon request.
      b) Other *potential mercury sources*
         1. The permittee must maintain an inventory of other *potential mercury sources.*
         2. The permittee must inspect other *potential mercury sources* once every five years. Alternatively, the permittee may develop and implement an outreach program which informs users of their responsibilities as *potential mercury sources.* The permittee must conduct the outreach program at least once every five years. The outreach program should be supported by a subset of site inspections.
         3. A file shall be maintained containing documentation demonstrating compliance with 2.b.ii.2)b) above. This file shall be available for review by the Department representatives and copies shall be provided upon request.

iii. Systems with CSO & Type II SSO Outfalls – Permittees must prioritize *potential mercury sources* upstream of CSOs and Type II SSOs for mercury reduction activities and/or controlled-release discharge.

iv. Equipment and Materials – Equipment and materials (e.g., thermometers, thermostats) used by the permittee, which may contain mercury, must be evaluated by the permittee. As equipment and materials containing mercury are updated/replaced, the permittee must use mercury-free alternatives, if possible.

v. Bulk Chemical Evaluation – For chemicals, used at a rate which exceeds 1,000 gallons/year or 10,000 pounds/year, the permittee must obtain a manufacturer's certificate of analysis, a chemical analysis performed by a certified laboratory, and/or a notarized affidavit which describes the substances' mercury concentration and the detection limit achieved. If possible, the permittee must only use bulk chemicals utilized in the wastewater treatment process which contain <10 ppb mercury.

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[7] For example, the outreach program could include education about sources of mercury and what to do if a mercury source is found.
[8] The form, "Amalgam Waste Compliance Report for Dental Dischargers," can be found here: https://www.dec.ny.gov/docs/water_pdf/dentalform.pdf

MERCURY MINIMIZATION PROGRAM (MMP) - Type I (Continued)

c. Status Report - An annual status report must be developed and maintained on site, in accordance with the Schedule of Additional Submittals, summarizing:
   i. All MMP monitoring results for the previous reporting period;
   ii. A list of known and *potential mercury sources*
      1) If the permittee meets the criteria for MMP Type IV, the permittee must notify the Department for a permittee-initiated modification;
   iii. All actions undertaken, pursuant to the control strategy, during the previous reporting period;
   iv. Actions planned, pursuant to the control strategy, for the upcoming reporting period; and
   v. Progress towards achieving a dissolved mercury concentration of 0.70 ng/L in the effluent (e.g., summarizing reductions in effluent concentrations as a result of the control strategy implementation and/or installation/modification of a treatment system).

   The permittee must maintain a file with all MMP documentation. The file must be available for review by Department representatives and copies must be provided upon request in accordance with 6 NYCRR 750-2.1(i) and 750-2.5(c)(4).

3. MMP Modification - The MMP must be modified whenever:
   a. Changes at the facility, or within the collection system, increase the potential for mercury discharges;
   b. Effluent discharges exceed the current permit limitation(s); or
   c. A letter from the Department identifies inadequacies in the MMP.

   The Department may use information in the status reports, as applicable in accordance with 2.c of this MMP, to determine if the permit limitations and MMP Type is appropriate for the facility.

DEFINITIONS:

Key location – a location within the collection/wastewater system (e.g. including but not limited to a specific manhole/access point, tributary sewer/wastewater connection, or user discharge point) identified by the permittee as a potential mercury source. The permittee may adjust key locations based upon sampling and/or best professional judgement.

Potential mercury source – a source identified by the permittee that may reasonably be expected to have total mercury contained in the discharge. Some potential mercury sources include switches, fluorescent lightbulbs, cleaners, degreasers, thermometers, batteries, hauled wastes, universities, hospitals, laboratories, landfills, Brownfield sites, or raw material storage.

DISCHARGE NOTIFICATION REQUIREMENTS

(a) The permittee shall install and maintain identification signs at all outfalls to surface waters listed in this permit, unless the Permittee has obtained a waiver in accordance with the Discharge Notification Act (DNA). Such signs shall be installed before initiation of any discharge.

(b) Subsequent modifications to or renewal of this permit does not reset or revise the deadline set forth in (a) above, unless a new deadline is set explicitly by such permit modification or renewal.

(c) The Discharge Notification Requirements described herein do not apply to outfalls from which the discharge is composed exclusively of storm water, or discharges to ground water.

(d) The sign(s) shall be conspicuous, legible and in as close proximity to the point of discharge as is reasonably possible while ensuring the maximum visibility from the surface water and shore. The signs shall be installed in such a manner to pose minimal hazard to navigation, bathing or other water related activities. If the public has access to the water from the land in the vicinity of the outfall, an identical sign shall be posted to be visible from the direction approaching the surface water.

The signs shall have **minimum** dimensions of eighteen inches by twenty-four inches (18" x 24") and shall have white letters on a green background and contain the following information:

N.Y.S. PERMITTED DISCHARGE POINT

SPDES PERMIT No.: NY__________

OUTFALL No. :____

For information about this permitted discharge contact:

Permittee Name: ______________________________

Permittee Contact: ______________________________

Permittee Phone: ( ) - ### - ####

OR:

NYSDEC Division of Water Regional Office Address:

NYSDEC Division of Water Regional Phone: ( ) - ### - ####

(e) Upon request, the permittee shall make available electronic or hard copies of the sampling data to the public. In accordance with the RECORDING, REPORTING AND ADDITIONAL MONITORING REQUIREMENTS page of your permit, each DMR shall be maintained (either electronically or as a hard copy) on record for a period of five years.

(f) The permittee shall periodically inspect the outfall identification sign(s) in order to ensure they are maintained, are still visible, and contain information that is current and factually correct. Signs that are damaged or incorrect shall be replaced within 3 months of inspection.

INDUSTRIAL PRETREATMENT PROGRAM IMPLEMENTATION REQUIREMENTS

A. DEFINITIONS: Generally, terms used in this Section shall be defined as in the General Pretreatment Regulations (40 CFR Part 403). Specifically, the following definitions apply to terms used in this Section:

1. Categorical Industrial User (CIU): an industrial user of the POTW that is subject to Categorical Pretreatment Standards under 40 CFR 403.6 and 40 CFR Chapter I, Subchapter N;

2. Local Limits: General Prohibitions, specific prohibitions and specific limits as set forth in 40 CFR 403.5.

3. The Publicly Owned Treatment Works (POTW): as defined by 40 CFR 403.3(q) and that discharges in accordance with this permit.

4. Program Submission(s): requests for approval or modification of the POTW Pretreatment Program submitted in accordance with 40 CFR 403.11 or 403.18 and approved by USEPA on September 28, 1984.

5. Significant Industrial User (SIU):
   a) CIUs;
   b) Except as provided in 40 CFR 403.3(v)(3), any other industrial user that discharges an average of 25,000 gallons per day or more of process wastewater (excluding sanitary, non-contact cooling and boiler blowdown wastewater) to the POTW;
   c) Except as provided in 40 CFR 403.3(v)(3), any other industrial user that contributes a process waste stream which makes up 5 percent or more of the average dry weather hydraulic or organic capacity of the POTW treatment plant;
   d) Any other industrial user that the permittee designates as having a reasonable potential for adversely affecting the POTW's operation or for violating a pretreatment standard or requirement.

6. Substances of Concern: Substances identified by the New York State Department of Environmental Conservation Industrial Chemical Survey as substances of concern.

B. IMPLEMENTATION: The permittee shall implement a POTW Pretreatment Program in accordance 40 CFR Part 403 and as set forth in the permittee's approved Program Submission(s). Modifications to this program shall be made in accordance with 40 CFR 403.18. Specific program requirements are as follows:

1. Industrial Survey: To maintain an updated inventory of industrial dischargers to the POTW the permittee shall:
   a) Identify, locate and list all industrial users who might be subject to the industrial pretreatment program from the pretreatment program submission and any other necessary, appropriate and available sources. This identification and location list will be updated, at a minimum, every five years. As part of this update the permittee shall collect a current and complete New York State Industrial Chemical Survey form (or equivalent) from each SIU.
   b) Identify the character and volume of pollutants contributed to the POTW by each industrial user identified in B.1.a above that is classified as a SIU.
   c) Identify, locate and list, from the pretreatment program submission and any other necessary, appropriate and available sources, all SIUs of the POTW.

2. Control Mechanisms: To provide adequate notice to and control of industrial users of the POTW the permittee shall:
   a) Inform by certified letter, hand delivery courier, overnight mail, or other means which will provide written acknowledgment of delivery, all industrial users identified in B.1.a. above of applicable pretreatment standards and requirements including the requirement to comply with the local sewer use law, regulation or ordinance and any applicable requirements under section 204(b) and 405 of the Federal Clean Water Act and Subtitles C and D of the Resource Conservation and Recovery Act.

INDUSTRIAL PRETREATMENT PROGRAM IMPLEMENTATION REQUIREMENTS (continued)

b) Control through permit or similar means the contribution to the POTW by each SIU to ensure compliance with applicable pretreatment standards and requirements. Permits shall contain limitations, sampling frequency and type, reporting and self-monitoring requirements as described below, requirements that limitations and conditions be complied with by established deadlines, an expiration date not later than five years from the date of permit issuance, a statement of applicable civil and criminal penalties and the requirement to comply with Local Limits and any other requirements in accordance with 40 CFR 403.8(f)(1).

3. Monitoring and Inspection: To provide adequate, ongoing characterization of non-domestic users of the POTW, the permittee shall:
   a) Receive and analyze self-monitoring reports and other notices. The permittee shall require all SIUs to submit self-monitoring reports at least every six months unless the permittee collects all such information required for the report, including flow data.
   b) The permittee shall adequately inspect each SIU at a minimum frequency of once per year.
   c) The permittee shall collect and analyze samples from each SIU for all priority pollutants that can reasonably be expected to be detectable at levels greater than the levels found in domestic sewage at a minimum frequency of once per year.
   d) Require, through permits, each SIU to collect at least one 24 hour, flow proportioned composite (where feasible) effluent sample every six months and analyze each of those samples for all priority pollutants that can reasonably be expected to be detectable in that discharge at levels greater than the levels found in domestic sewage. The permittee may perform the aforementioned monitoring in lieu of the SIU except that the permittee must also perform the compliance monitoring described in 3.c.

4. Enforcement: To assure adequate, equitable enforcement of the industrial pretreatment program the permittee shall:
   a) Investigate instances of noncompliance with pretreatment standards and requirements, as indicated in self-monitoring reports and notices or indicated by analysis, inspection and surveillance activities. Sample taking and analysis and the collection of other information shall be performed with sufficient care to produce evidence admissible in enforcement proceedings or in judicial actions. Enforcement activities shall be conducted in accordance with the permittee's Enforcement Response Plan developed and approved in accordance with 40 CFR Part 403.
   b) Enforce compliance with all national pretreatment standards and requirements in 40 CFR Parts 406 - 471.
   c) Provide public notification of significant non-compliance as required by 40 CFR 403.8(f)(2)(viii).
   d) Pursuant to 40 CFR 403.5(e), when either the Department or the USEPA determines any source contributes pollutants to the POTW in violation of Pretreatment Standards or Requirements the Department or the USEPA shall notify the permittee. Failure by the permittee to commence an appropriate investigation and subsequent enforcement action within 30 days of this notification may result in appropriate enforcement action against the source and permittee.

5. Recordkeeping: The permittee shall maintain and update, as necessary, records identifying the nature, character, and volume of pollutants contributed by SIUs. Records shall be maintained in accordance with 6 NYCRR 750-2.5(c).

6. Staffing: The permittee shall maintain minimum staffing positions committed to implementation of the Industrial Pretreatment Program in accordance with the approved pretreatment program.

C. SLUDGE DISPOSAL PLAN. The permittee shall notify NYSDEC, and USEPA as long as USEPA remains the approval authority, 60 days prior to any major proposed change in the sludge disposal plan. NYSDEC may require additional pretreatment measures or controls to prevent or abate an interference incident relating to sludge use or disposal.

INDUSTRIAL PRETREATMENT PROGRAM IMPLEMENTATION REQUIREMENTS (continued)

D. REPORTING: The permittee shall provide to the offices listed on the Monitoring, Reporting and Recording page of this permit and to the Chief-Water Compliance Branch, USEPA Region II, 290 Broadway, New York, NY 10007, a periodic report that briefly describes the permittee's program activities over the previous year. This report shall be submitted in accordance with the Schedule of Submittals to the above noted offices within 60 days of the end of the reporting period. The reporting period shall be annual with reporting period(s) ending on September 30th of each year. The periodic report shall include:

1. Industrial Survey: Updated industrial survey information in accordance with 40 CFR 403.12(i)(1) (including any NYS Industrial Chemical Survey forms updated during the reporting period).

2. Implementation Status: Status of Program Implementation, to include:
   a) Any interference, upset or permit violations experienced at the POTW directly attributable to industrial users.
   b) Listing of SIUs issued permits.
   c) Listing of SIUs inspected and/or monitored during the previous reporting period and summary of results.
   d) Listing of SIUs notified of promulgated pretreatment standards or applicable local standards who are on compliance schedules. The listing should include for each facility the final date of compliance.
   e) Summary of POTW monitoring results not already submitted on Discharge Monitoring Reports and toxic loadings from SIU's organized by parameter.
   f) A summary of additions or deletions to the list of SIUs, with a brief explanation for each deletion.

3. Enforcement Status: Status of enforcement activities to include:
   a) Listing of SIUs in significant non-compliance (as defined by 40 CFR 403.8(f)(2)(viii) with federal or local pretreatment standards at end of the reporting period.
   b) Summary of enforcement activities taken against non-complying SIUs. The permittee shall provide a copy of the public notice of significant violators as specified in 40 CFR 403.8(f)(2)(viii).

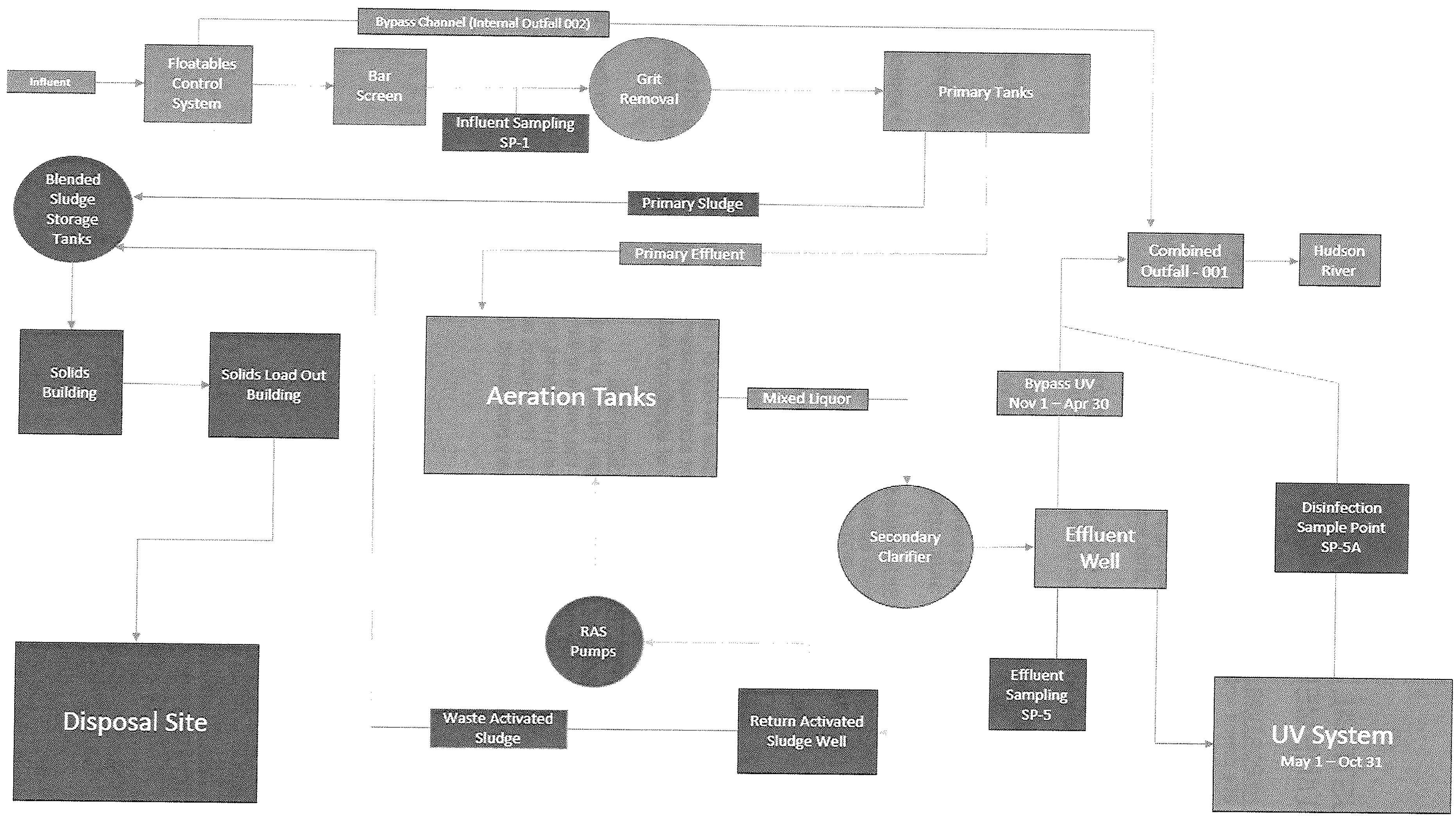
E. ADDITIONAL PRETREATMENT CONDITIONS:
1. Notification of Material Change: Facility shall notify the NYSDEC prior to the addition of any SIUs or CIUs which may materially change the nature of the discharge from the POTW or increase the discharge of one or more substances authorized in this permit or discharge a substance not currently authorized in this permit (6 NYCRR Part 750-2.9(a)(1)). The noticed act is prohibited until the Department determines whether a permit modification is necessary pursuant to 750-2.9(a)(2).

MONITORING LOCATIONS

The permittee shall take samples and measurements, to comply with the monitoring requirements specified in this permit, at the locations(s) specified below:

Influent: Influent Sampling SP-1

Effluent: Effluent Sampling SP-5 and Disinfection Sample Point SP-5A



GENERAL REQUIREMENTS

A. The regulations in 6 NYCRR Part 750 are hereby incorporated by reference and the conditions are enforceable requirements under this permit. The permittee shall comply with all requirements set forth in this permit and with all the applicable requirements of 6 NYCRR Part 750 incorporated into this permit by reference, including but not limited to the regulations in paragraphs B through I as follows:

B. <u>General Conditions</u>	
1. Duty to comply	6 NYCRR 750-2.1(e) & 2.4
2. Duty to reapply	6 NYCRR 750-1.16(a)
3. Need to halt or reduce activity not a defense	6 NYCRR 750-2.1(g)
4. Duty to mitigate	6 NYCRR 750-2.7(f)
5. Permit actions	6 NYCRR 750-1.1(c), 1.18, 1.20 & 2.1(h)
6. Property rights	6 NYCRR 750-2.2(b)
7. Duty to provide information	6 NYCRR 750-2.1(i)
8. Inspection and entry	6 NYCRR 750-2.1(a) & 2.3
C. Operation and Maintenance	
1. Proper Operation & Maintenance	6 NYCRR 750-2.8
2. Bypass	6 NYCRR 750-1.2(a)(17), 2.8(b) & 2.7
3. Upset	6 NYCRR 750-1.2(a)(94) & 2.8(c)
D. Monitoring and Records	
1. Monitoring and records	6 NYCRR 750-2.5(a)(2), 2.5(a)(6), 2.5(c)(1), 2.5(c)(2), & 2.5(d)
2. Signatory requirements	6 NYCRR 750-1.8 & 2.5(b)
E. Reporting Requirements	
1. Reporting requirements	6 NYCRR 750-2.5, 2.7 & 1.17
2. Anticipated noncompliance	6 NYCRR 750-2.7(a)
3. Transfers	6 NYCRR 750-1.17
4. Monitoring reports	6 NYCRR 750-2.5(e)
5. Compliance schedules	6 NYCRR 750-1.14(d)
6. 24-hour reporting	6 NYCRR 750-2.7(c) & (d)
7. Other noncompliance	6 NYCRR 750-2.7(e)
8. Other information	6 NYCRR 750-2.1(f)
9. Additional conditions applicable to a POTW	6 NYCRR 750-2.9

F. Planned Changes

1. The permittee shall give notice to the Department as soon as possible of planned physical alterations or additions to the permitted facility when:

   a. The alteration or addition to the permitted facility may meet any of the criteria for determining whether facility is a new source in 40 CFR §122.29(b); or
   b. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject either to effluent limitations in the permit, or to notification requirements under 40 CFR §122.42(a)(1); or
   c. The alteration or addition results in a significant change in the permittee's sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan.

In addition to the Department, the permittee shall submit a copy of this notice to the United States Environmental Protection Agency at the following address: U.S. EPA Region 2, Clean Water Regulatory Branch, 290 Broadway, 24th Floor, New York, NY 10007-1866.

GENERAL REQUIREMENTS (continued)

2. Notification Requirement for POTWs
All POTWs shall provide adequate notice to the Department and the USEPA of the following:

   a. Any new introduction of pollutants into the POTW from an indirect discharger which would be subject to section 301 or 306 of CWA if it were directly discharging those pollutants; or
   b. Any substantial change in the volume or character of pollutants being introduced into that POTW by a source introducing pollutants into the POTW at the time of issuance of the permit.
   c. For the purposes of this paragraph, adequate notice shall include information on:
      i. the quality and quantity of effluent introduced into the POTW, and
      ii. any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.

POTWs shall submit a copy of this notice to the United States Environmental Protection Agency, at the following address:
U.S. EPA Region 2, Clean Water Regulatory Branch, 290 Broadway, 24th Floor, New York, NY 10007-1866

G. Sludge Management
The permittee shall comply with all applicable requirements of 6 NYCRR Part 360.

H. SPDES Permit Program Fee
The permittee shall pay to the Department an annual SPDES permit program fee within 30 days of the date of the first invoice, unless otherwise directed by the Department, and shall comply with all applicable requirements of ECL 72-0602 and 6 NYCRR Parts 480, 481 and 485. Note that if there is inconsistency between the fees specified in ECL 72-0602 and 6 NYCRR Part 485, the ECL 72-0602 fees govern.

I. Water Treatment Chemicals (WTCs)
New or increased use and discharge of a WTC requires prior Department review and authorization. At a minimum, the permittee must notify the Department in writing of its intent to change WTC use by submitting a completed *WTC Notification Form* for each proposed WTC. The Department will review that submittal and determine if a SPDES permit modification is necessary or whether WTC review and authorization may proceed outside of the formal permit administrative process. The majority of WTC authorizations do not require SPDES permit modification. In any event, use and discharge of a WTC shall not proceed without prior authorization from the Department. Examples of WTCs include biocides, coagulants, conditioners, corrosion inhibitors, defoamers, deposit control agents, flocculants, scale inhibitors, sequestrants, and settling aids.
1. WTC use shall not exceed the rate explicitly authorized by this permit or otherwise authorized in writing by the Department.
2. The permittee shall maintain a logbook of all WTC use, noting for each WTC the date, time, exact location, and amount of each dosage, and, the name of the individual applying or measuring the chemical. The logbook must also document that adequate process controls are in place to ensure that excessive levels of WTCs are not used.
3. The permittee shall submit a completed WTC Annual Report Form each year that they use and discharge WTCs. This form shall be submitted in electronic format and attached to either the December DMR or the annual monitoring report required below. The *WTC Notification Form and WTC Annual Report Form* are available from the Department's website at: http://www.dec.ny.gov/permits/93245.html

RECORDING, REPORTING AND ADDITIONAL MONITORING REQUIREMENTS

A. The monitoring information required by this permit shall be retained for a period of at least five years from the date of the sampling for subsequent inspection by the Department or its designated agent.

B. Discharge Monitoring Reports (DMRs): Completed DMR forms shall be submitted for each one (1) month reporting period in accordance with the DMR Manual available on Department's website.

DMRs must be submitted electronically using the electronic reporting tool (NetDMR) specified by NYSDEC. Instructions on the use of NetDMR can be found at https://www.dec.ny.gov/chemical/103774.html. **Hardcopy paper DMRs will only be received at the address listed below, directed to the Bureau of Water Compliance, if a waiver from the electronic submittal requirements has been granted by DEC to the facility.**

Attach the monthly "Wastewater Facility Operation Report" (form 92-15-7) and any required DMR attachments electronically to the DMR or with the hardcopy submittal.

The first monitoring period begins on the effective date of this permit, and, unless otherwise required, the reports are due no later than the 28th day of the month following the end of each monitoring period.

C. Additional information required to be submitted by this permit shall be summarized and reported to the RWE and Bureau of Water Permits at the following addresses:

Department of Environmental Conservation
Division of Water, Bureau of Water Permits
625 Broadway, Albany, New York 12233-3505 Phone: (518) 402-8111

Department of Environmental Conservation
Regional Water Engineer, Region 5
232 Golf Course Road, Warrensburg, New York, 12885-1172 Phone: (518) 623-1200

D. Bypass and Sewage Pollutant Right to Know Reporting: In accordance with the Sewage Pollutant Right to Know Act (ECL § 17-0826-a), Publicly Owned Treatment Works (POTWs) are required to notify DEC and Department of Health within two hours of discovery of an untreated or partially treated sewage discharge and to notify the public and adjoining municipalities within four hours of discovery. Information regarding reporting and other requirements of this program may be found on the Department's website. In addition, POTWs are required to provide a five-day incident report and supplemental information to the DEC in accordance with Part 750-2.7(d) by utilizing the Division of Water Report of Noncompliance Event form unless waived by DEC on a case-by-case basis.

E. Schedule of Additional Submittals:
The permittee shall submit the following information to the Regional Water Engineer and to the Bureau of Water Permits, unless otherwise instructed:

SCHEDULE OF ADDITIONAL SUBMITTALS		
Outfall(s)	**Required Action**	**Due Date**
001	WATER TREATMENT CHEMICAL (WTC) ANNUAL REPORT FORM The permittee shall submit a completed WTC Annual Report Form each year that Water Treatment Chemicals are used. The form shall be attached to the December DMR.	Attached to the December DMR
001	ANNUAL FLOW CERTIFICATION The permittee shall submit an Annual Flow Certification form each year in accordance with 750-2.9(C)(4). The form shall be attached to the February DMR or submitted through nForm.	March 28th Each Year

SCHEDULE OF ADDITIONAL SUBMITTALS		
Outfall(s)	**Required Action**	**Due Date**
001	BIENNIAL POLLUTANT SCAN The permittee shall implement an ongoing monitoring program and perform effluent sampling every two years as specified in footnote of the permit limits table.	Retain and submit with next NY-2A Application
001	WHOLE EFFLUENT TOXICITY (WET) TESTING WET testing shall be performed as required in the footnote of the permit limits table. The toxicity test report including all information requested of this permit shall be attached to your WET DMRs and sent to the WET@dec.ny.gov email address.	Within 60 days following the end of each monitoring period
N/A	STORMWATER NO EXPOSURE CERTIFICATION Permittee must recertify every five years a condition of no exposure to stormwater in order to continue to qualify for the no exposure exclusion. The No Exposure Certification Form can be found on the NYSDEC website.	1/6/2027, and every 5 years thereafter
001	COMBINED SEWER OVERFLOW (CSO) ANNUAL REPORT The permittee shall submit a Combined Sewer Overflows (CSO) Annual Report, which summarizes the implementation of BMPs and the Long-Term Control Plan (if applicable). The CSO Annual Report is available from DEC on-line at https://www.dec.ny.gov/docs/water_pdf/csobmp.pdf.	January 31st Each Year
001	POST-CONSTRUCTION COMPLIANCE MONITORING PLAN (PCCMP) The permittee shall submit an approvable PCCMP that (a) is adequate to ascertain the effectiveness of the CSO controls and (b) can be used to verify attainment of water quality standards. The PCCMP must include the proposed sampling locations, sampling schedule, details on how effectiveness of the CSO controls will be assessed, and a Quality Assurance Project Plan (QAPP) that details the monitoring protocols to be followed, where appropriate, including CSO and ambient monitoring	EDPM + 12 Months
001	POST-CONSTRUCTION COMPLIANCE MONITORING (PCCM) PROGRAM REPORT The permittee shall submit a PCCM Program Report as detailed in the SPECIAL CONDITIONS: CSO CONTROL POLICY section of this permit. The PCCM Program Reports shall be submitted by March 31st in years ending in 2 and 7.	After PCCMP Approval, March 31st in years ending in 2 and 7
001	MERCURY MINIMIZATION PLAN The permittee must complete and maintain onsite an annual mercury minimization status report in accordance with the requirements of this permit.	***Maintained Onsite*** February 1st annually
001	PRETREATMENT PROGRAM Submit a report that briefly describes the permittee's program activities over the previous year. The report shall follow the guidelines contained in this permit and be submitted to the Regional Water Engineer and the Bureau of Water permits as well as the USEPA Region II office.	November 28th Each Year

Unless noted otherwise, the above actions are one-time requirements. The permittee shall submit the results of the above actions to the satisfaction of the Department. When this permit is administratively renewed by NYSDEC letter entitled "SPDES NOTICE/RENEWAL APPLICATION/PERMIT", the permittee is not required to repeat the above submittal(s), unless noted otherwise. The above due dates are independent from the effective date of the permit stated in the letter of "SPDES NOTICE/RENEWAL APPLICATION/PERMIT."

F. Monitoring and analysis shall be conducted using sufficiently sensitive test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit.

G. More frequent monitoring of the discharge(s), monitoring point(s), or waters of the State than required by the permit, where analysis is performed by a certified laboratory or where such analysis is not required to be performed by a certified laboratory, shall be included in the calculations and recording of the data on the corresponding DMRs.

H. Calculations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified in this permit.

I. Unless otherwise specified, all information recorded on the DMRs shall be based upon measurements and sampling carried out during the most recently completed reporting period.

J. Any laboratory test or sample analysis required by this permit for which the State Commissioner of Health issues certificates of approval pursuant to section 502 of the Public Health Law shall be conducted by a laboratory which has been issued a certificate of approval. Inquiries regarding laboratory certification should be directed to the New York State Department of Health, Environmental Laboratory Accreditation Program.

Appendix 3

DECLARATION OF EMILY GRUBERT

Qualifications

1. My name is Emily Grubert. I am a decarbonization expert with specific expertise in greenhouse gas life cycle analysis, particularly related to waste management, methane, and counterfactual scenario evaluation.

2. I am an Associate Professor of Sustainable Energy Policy at the University of Notre Dame, with a concurrent appointment as Associate Professor of Civil and Environmental Engineering and Earth Sciences. My duties include research and teaching on life cycle assessment, energy systems, and decarbonization.

3. I received my PhD in Environment and Resources from Stanford University in 2017, followed by a postdoctoral fellowship in Civil and Environmental Engineering at the University of California, Berkeley. In both roles, my supervisors were nationally recognized life cycle assessment experts, and my work focused largely on life cycle evaluation of greenhouse gases and other impacts. Prior to joining Notre Dame, I was Assistant Professor of Civil and Environmental Engineering at the Georgia Institute of Technology. I also spent approximately two years at the US Department of Energy on an academic secondment through the Intergovernmental Personnel Act, during which I served as the Deputy Assistant Secretary for Carbon Management (2021-2022) and Senior Advisor for Energy Asset Transformation (2022-2023) in the Office of Fossil Energy and Carbon Management. At DOE, I focused substantially on research and development efforts related to carbon management and decarbonization, including greenhouse gas life cycle analysis. I am a licensed Professional Engineer in the State of Georgia.

4. I have reviewed and assessed materials made public by the New York State Department of Environmental Conservation ("DEC") regarding the proposed Saratoga Biochar Solutions ("SBS") Pyrolysis Facility, to be located in Moreau, NY. Specifically, I have reviewed Section 9.0 and Appendix 7 of SBS's September 6, 2023, Air Facility Permit Application. I have also reviewed excerpts from correspondence between SBS and DEC noting that SBS intends to monetize GHG emission reductions through the carbon credit market and Appendix D of SBS' Petition for Case-specific Beneficial Use Determination, prepared by Sterling Environmental Engineering, P.C. in May 2023.

Summary of Opinions

5. The Application for Air Facility Permit includes two separate estimates of the carbon intensity of biochar produced by the proposed project. These estimates are contained in Section 9.0 and Appendix 7 of the application.

6. In this declaration I will evaluate the analytical choices and methodological questions associated with both Section 9.0 and Appendix 7. I will also raise holistic questions about claims made in both the section and the appendix regarding greenhouse gas emissions intensity of the proposed Pyrolysis Facility and the final biochar product.

7. In my expert opinion, the greenhouse gas life cycle analyses contained in SBS's permit application materials are not sufficiently detailed to establish that the proposed Pyrolysis Facility will have net negative GHG emissions.

A. SBS's Plans to Sell Carbon Credits Will Lead to Double-Counting Emissions Reductions.

8. Appendix 7 appears to contemplate the possibility of selling environmental attributes associated with produced biochar in carbon credit markets. It is in the State's interest to understand the ultimate fate of environmental attributes associated with the biochar project. If credits are generated and sold, any emissions reduction benefits cannot be claimed by the project for purposes of CLCPA compliance or other GHG considerations.

9. Notably, SBS explicitly states in other documentation, including correspondence to DEC, that it intends to sell carbon credits associated with the project. In this case, SBS will have sold the right to claim emission reductions and cannot also claim the benefits of emission reductions without double counting.

B. Notwithstanding Any Plans to Do So, It Is Unclear if SBS Will Be Able to Sell Its Carbon Credits Out-Of-State.

10. This project might not qualify for carbon credits based on claimed emission reduction outside of New York State, even relative to the highest emission counterfactual of biosolids landfilling.

11. This is because of New York's unusual use of the 20-year global warming potential for calculating the CO_2e intensity of methane and other gases. Emissions reductions associated with methane as claimed in New York would typically be credited at much lower values for the purpose of carbon credit sales.

12. Based on Table AC (Section 9.2), using the more common carbon dioxide equivalent multiplier of 29.8 for methane (100-year global warming potential) would suggest biosolids landfill disposal GHG emissions of 0.59 MT CO_2e/dry ton, which is substantially lower than the Facility's estimated GHG emissions (comprised of CO_2 emissions that would not be adjusted downwards to account for alternative carbon dioxide equivalent multipliers) of 1.36 MT CO_2e/dry ton.

C. Appendix 7 Fails to Account for the Fact that Land Application of Biochar Could Actually Increase GHG Emissions Associated With Soils.

13. SBS's project should not be credited with GHG reductions at high numerical fidelity unless the company can provide robust estimates of the full life cycle impacts of both its facility and its biochar product—including critical GHG impacts of land application of biochar. Appendix 7 presents a life cycle analysis that explicitly excludes the GHG implications of biochar application.

14. The analysts concede that GHG implications of land application of biochar (including CO_2 storage, methane dynamics, and N_2O dynamics of soils with biochar applications) are highly uncertain. However, Appendix 7 does not sufficiently address this point. Land application of biochar could either increase or decrease GHG emissions associated with soils.[1] Impacts on GHG emissions depend on multiple issues, including feedstocks, soil characteristics, climate, and others.[2]

D. SBS's Life Cycle Analysis in Section 9.0 Of The Air Facility Permit Is Unreliable Because It Fails To Account For Alternative Biosolids Management Strategies.

15. Section 9.0 of the Air Facility Permit estimates that GHG emissions from SBS's proposal would be lower than GHG emissions from the stated alternative management strategy of biosolids landfilling. Specifically, SBS claims that the project would generate in-state emissions of 1.36 metric tons ("MT") of CO2e per dry ton of biosolids, relative to 1.99 net MT of CO2e per dry ton of biosolids from landfilling.[3] Based on this comparison SBS argues that the facility would deliver in-state emissions reductions.

16. SBS's argument fails to account for the fact that a significant portion of biosolids in New York are already subject to alternative management practices, rather than landfilling. In fact, 32% of New York's biosolids are not landfilled.[4] Uncaptured methane is the dominant source of emissions from landfilling. Some alternative management strategies, like composting or anaerobic digestion, dramatically reduce such emissions.

17. A complete life cycle analysis would not assume that every single ton of biosolids recycled at SBS's pyrolysis facility would have been destined for a landfill in the alternative. Rather, a complete life cycle analysis would account for the wide portfolio of alternative management practices biosolids might be subject to.

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[1] Subin Kalu et al., *Potential of Biochar to Reduce Greenhouse Gas Emissions and Increase Nitrogen Use Efficiency in Boreal Arable Soils in the Long-Term*, Frontiers Env't Sci., May 17, 2022, at 1, https://www.frontiersin.org/articles/10.3389/fenvs.2022.914766/full.
[2] *Id*.
[3] Sterling Env't Eng'g, P.C., Application for Air Facility Permit for Saratoga Biochar Solutions, LLC Carbon Fertilizer Manufacturing Facility Moreau, NY at 34 (Sept. 6, 2023).
[4] *See* N.Y. Dep't of Env't Conservation, *Biosolids Management*, https://dec.ny.gov/environmental-protection/recycling-composting/organic-materials-management/technologies/biosolids-management (last visited Feb. 27, 2024).

18. In other words, a careful life cycle analysis would provide a realistic estimate of the percentage of recycled biosolids that would never have been landfilled in the first place, and account for the emissions that would be associated with those alternative management strategies. For example, an individual conducting a life cycle analysis on SBS's facility could reasonably assume that 32% of the biosolids destined for the SBS facility would not have been landfilled in the first place, in New York or otherwise. This assumption is reasonable because that is the percentage of biosolids diverted from landfills statewide.

19. The individual conducting this life cycle analysis would then estimate the GHG emissions intensity of the alternative management practices and compare their intensity with that of the SBS's facility. The intensity of these alternative management practices would likely be above 0 MT of CO_2e per dry ton of biosolids. But there is a good chance that many of them would have a lower GHG intensity than the 1.99 MT of CO_2e per dry ton of biosolids associated with landfilling, as alternative management strategies typically do not generate substantial quantities of methane.

20. Because SBS has failed to account for these alternative management strategies, the company's life cycle analysis is not reliable. Specifically, the life cycle analysis of Section 9.0 likely overestimates the emissions avoided by processing biosolids at the proposed pyrolysis facility.

E. The Life Cycle Analysis in Section 9.0 Of The Air Facility Permit Is Also Unreliable Because It Has Failed To Demonstrate That Wood Waste Would Have High Emissions Unless Recycled.

21. In addition to processing ~55,000 dry tons of biosolids per year at the proposed pyrolysis facility, SBS hopes to process 35,280 dry tons of wood waste. However, the life cycle analysis in Section 9.0 does not give due attention to the GHG implications of subjecting this large amount of wood waste to pyrolysis.

22. Accounting also for wood wastes would further reduce the average GHG intensity of managing feedstocks for SBS as they currently are managed. Even assuming all biosolids are landfilled (with attendant methane emissions leading to high GHG intensity relative to alternative strategies), accounting for wood waste (assuming alternative management emissions of 0) would bring the overall average counterfactual GHG intensity to about 1.2 MT CO_2e per dry ton of processed solids for the project alternative. This value is even lower if the non-landfilled portion of biosolids is assumed to have lower GHG intensity than the landfilled portion, which is probable.

23. The Facility's GHG emissions would exceed that of the no action alternative even if we conservatively estimated that the emissions for unrecycled wood waste were .35 MT CO_2e. This is true, again, even if we assume that all the biosolids in the mix are

landfilled. Using these conservative assumptions, the Facility's GHG intensity would fall below that of the no action alternative only if we assume that unrecycled wood has emissions higher than 0.4 MT CO_2e per dry ton of processed solids.

Emily Grubert (signature) — 6 March 2024

Emily Grubert — Date

Appendix 4

Exhibit 1

EUROPEAN
COMMISSION

Brussels, 7.7.2021
C(2021) 4764 final

ANNEXES 1 to 3

ANNEXES

to the

Commission Delegated Regulation

amending Annexes II, III and IV to Regulation (EU) 2019/1009 of the European Parliament and of the Council for the purpose of adding pyrolysis or gasification materials as a component material category in EU fertilising products

ANNEX I

Annex II to Regulation (EU) 2019/1009 is amended as follows:

(1) In Part I, the following point is added:

"CMC 14: Pyrolysis and gasification materials";

(2) Part II is amended as follows:

(a) In CMC 1, point 1, the following sub-point (k) is added:

"(k) pyrolysis and gasification materials, which are recovered from waste or are by-products within the meaning of Directive 2008/98/EC.";

(b) In CMC 11, point 1, the following sub-point (g) is added:

"(g) pyrolysis and gasification materials, which are recovered from waste or are by-products within the meaning of Directive 2008/98/EC.";

(c) The following CMC 14 is added:

"CMC 14: PYROLYSIS AND GASIFICATION MATERIALS

1. An EU fertilising product may contain pyrolysis or gasification materials obtained through the thermochemical conversion under oxygen-limiting conditions of exclusively one or more of the following input materials:

(a) living or dead organisms or parts thereof, which are unprocessed or processed only by manual, mechanical or gravitational means, by dissolution in water, by flotation, extraction with water, by steam distillation or by heating solely to remove water, or which are extracted from air by any means, except (*):

- materials originating from mixed municipal waste,
- sewage sludge, industrial sludge or dredging sludge, and
- animal by-products or derived products within the scope of Regulation (EC) No 1069/2009;

(b) vegetable waste from the food processing industry and fibrous vegetable waste from virgin pulp production and from production of paper from virgin pulp, if not chemically modified;

(c) processing residues within the meaning of Article 2, point (t) of Directive 2009/28/EC from the production of bioethanol and biodiesel, derived from materials referred to in sub-points (a), (b) and (d);

(d) bio-waste within the meaning of Article 3, point 4 of Directive 2008/98/EC resulting from separate bio-waste collection at source, other than animal by-products or derived products within the scope of Regulation (EC) No 1069/2009 or

(e) pyrolysis or gasification additives which are necessary to improve the process performance or the environmental performance of the pyrolysis or gasification process, provided that those additives are consumed in chemical processing or used for such processing and that total concentration of all additives do not exceed 25 % of the fresh matter of the total input material, with the exception (*) of:

- input materials referred to in sub-points (a) to (d),
- waste within the meaning of Article 3, point 1 of Directive 2008/98/EC,

– substances or mixtures which have ceased to be waste in one or more Member States by virtue of the national measures transposing Article 6 of Directive 2008/98/EC,

– substances formed from precursors which have ceased to be waste in one or more Member States by virtue of the national measures transposing Article 6 of Directive 2008/98/EC, or mixtures containing such substances,

– non-biodegradable polymers, and

– animal by-products or derived products within the scope of Regulation (EC) No 1069/2009.

An EU fertilising product may contain pyrolysis or gasification materials obtained through thermochemical conversion under oxygen-limiting conditions of any input material referred to in sub-points (a) to (e), or combination thereof, processed by manual, mechanical or gravitational means, by solid-liquid fractionation using biodegradable polymers, by dissolution in water, by flotation, by extraction with water, by steam distillation or by heating solely to remove water, by composting or by anaerobic digestion.

2. The thermochemical conversion process shall take place under oxygen-limiting conditions in such a way that a temperature of at least 180°C for at least two seconds is reached in the reactor.

The pyrolysis or gasification reactor may only process input materials, which are not contaminated with other material streams, or input materials, other than animal by-products or derived products within the scope of Regulation (EC) No 1069/2009, which have been contaminated with other material streams unintentionally in a one-off incident resulting only in trace levels of exogenous compounds.

In the plant where the pyrolysis or gasification takes place, physical contacts between input and output materials shall be avoided after the thermochemical process, including during storage.

3. The pyrolysis and gasification materials shall have a molar ratio of hydrogen (H) to organic carbon (H / C_{org}) of less than 0,7, with testing to be performed in the dry and ash-free fraction for materials that have an organic carbon (C_{org}) content of less than 50 %. They shall have no more than:

(a) 6 mg/kg dry matter of PAH_{16} (**),

(b) 20 ng WHO toxicity equivalents (***) of PCDD/F(****) /kg dry matter,

(c) 0,8 mg/kg dry matter of ndl-PCB(*****),

4. Notwithstanding point 1, an EU fertilising product may contain pyrolysis or gasification materials obtained through the thermochemical conversion under oxygen-limiting conditions of Category 2 or Category 3 materials or derived products thereof, in accordance with the conditions set out in Article 32(1) and (2) of Regulation (EC) No 1069/2009 and in the measures referred to in Article 32(3) of that Regulation, alone or mixed with input materials referred to in point 1, provided that both of the following conditions are fulfilled:

(a) the end point in the manufacturing chain has been determined in accordance with Article 5(2), third subparagraph of Regulation (EC) No 1069/2009;

(b) the conditions in points 2 and 3 are met.

5. In the plant where the pyrolysis or gasification takes place, the production lines for the processing of input materials referred to in points 1 and 4 shall be clearly separated from production lines for the processing of other input materials.

6. In an EU fertilising product containing or consisting of pyrolysis and gasification materials:

(a) the chlorine (Cl^-) content shall not be higher than 30 g/kg dry matter and

(b) the thallium (Tl) content shall not be higher than 2 mg/kg dry matter , in case more than 5 % of pyrolysis or gasification additives relative to the fresh weight of total input material have been applied.

7. The pyrolysis and gasification material shall have been registered pursuant to Regulation (EC) No 1907/2006, in a dossier containing:

(a) the information provided for by Annex VI, VII and VIII of Regulation (EC) No 1907/2006, and

(b) a chemical safety report pursuant to Article 14 of Regulation (EC) No 1907/2006 covering the use as a fertilising product,

unless explicitly covered by one of the registration obligation exemptions provided for by Annex IV to Regulation (EC) No 1907/2006 or by points 6, 7, 8 or 9 of Annex V to that Regulation.

(*) The exclusion of an input material from a sub-point does not prevent it from being an eligible input material by virtue of another sub-point.

(**) Sum of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, indeno[1,2,3-cd]pyrene, dibenzo[a,h]anthracene and benzo[ghi]perylene.

(***) van den Berg M., L.S. Birnbaum, M. Denison, M. De Vito, W. Farland, et al. (2006) The 2005 World Health Organization Re-evaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-like Compounds. Toxicological sciences: an official journal of the Society of Toxicology 93:223-241. doi:10.1093/toxsci/kfl055.

(****) Polychlorinated dibenzo-p-dioxins and dibenzofurans.

(*****) Sum of congeners PCB 28, 52, 101, 138, 153, 180.

ANNEX II

In Annex III, Part I to Regulation (EU) 2019/1009, the following point is inserted :

"7a. Where the EU fertilising product contains or consists of thermal oxidation materials and derivates as referred to in CMC 13 in Part II in Annex II or pyrolysis or gasification materials as referred to in CMC 14 in Part II of that Annex and has a manganese (Mn) content above 3,5 % by mass, the manganese content shall be declared.".

ANNEX III

In Annex IV, Part II of Regulation (EU) 2019/1009, Module D1 (Quality assurance of the production process) is amended as follows:

(1) In point 2.2, sub-point (d) is replaced by the following:

"(d) drawings, schemes, descriptions and explanations necessary for the understanding of the manufacturing process of the EU fertilising product, and, in relation to materials belonging to CMCs 3, 5, 12, 13 or 14 as defined in Annex II, a written description and a diagram of the production process, where each treatment, storage vessel and area is clearly identified,";

(2) In point 5.1.1.1, the introductory wording is replaced by the following:

"5.1.1.1. For materials belonging to CMCs 3, 5, 12, 13 and 14, as defined in Annex II, senior management of the manufacturer's organisation shall:";

(3) Point 5.1.2.1 is replaced by the following:

"5.1.2.1. For materials belonging to CMCs 3, 5, 12, 13 and 14, as defined in Annex II, the quality system shall ensure compliance with the requirements specified in that Annex.";

(4) Point 5.1.3.1 is amended as follows:

(a) The introductory wording is replaced by the following:

"5.1.3.1. For materials belonging to CMCs 3, 5, 12, 13 and 14, as defined in Annex II, the examinations and tests shall comprise the following elements:";

(b) Sub-points (b) and (c) are replaced by the following:

"(b) Qualified staff shall carry out a visual inspection of each consignment of input materials and verify compatibility with the specifications of input materials in CMCs 3, 5, 12, 13 and 14 laid down in Annex II.

(c) The manufacturer shall refuse any consignment of any given input material where visual inspection raises any suspicion of any of the following:

– the presence of hazardous or damageable substances for the process or for the quality of the final EU fertilising product,

– incompatibility with the specifications of CMCs 3, 5, 12, 13 and 14 in Annex II, in particular by presence of plastics leading to exceedance of the limit value for macroscopic impurities.";

(c) Sub-point (e) is replaced by the following:

"(e) Samples shall be taken on output materials, to verify that they comply with the specifications laid down in CMCs 3, 5, 12, 13 and 14, as defined in Annex II, and that the properties of the output material do not jeopardise the EU fertilising product's compliance with the relevant requirements laid down in Annex I.";

(d) In sub-point (fa), the introductory wording is replaced by the following:

"(fa) For materials belonging to CMCs 12, 13 and 14, the output material samples shall be taken with at least the following default frequency, or sooner than scheduled in case of any significant change that may affect the quality of the EU fertilising product:";

(e) Sub-point (fb) is replaced by the following:

“(fb) For materials belonging to CMCs 12, 13 and 14, each batch or portion of production shall be assigned a unique code for quality management purposes. At least one sample per 3000 tonnes of these materials or one sample per two months, whichever occurs sooner, shall be stored in good condition for a period of at least two years.”;

(f) Sub-point (g)(iv) is replaced by the following:

“(iv) for materials belonging to CMCs 12, 13 and 14, measure retainer samples referred to in sub-point (fb) and take the necessary corrective actions to prevent possible further transport and use of that material.”;

(5) In point 5.1.4.1, the introductory wording is replaced by the following:

“5.1.4.1. For materials belonging to CMCs 3, 5, 12, 13 and 14, as defined in Annex II, the quality records shall demonstrate effective control of input materials, production, storage and compliance of input and output materials with the relevant requirements of this Regulation. Each document shall be legible and available at its relevant place(s) of use, and any obsolete version shall be promptly removed from all places where it is used, or at least identified as obsolete. The quality management documentation shall at least contain the following information:”.

(6) In point 5.1.5.1, the introductory wording is replaced by the following:

“5.1.5.1. For materials belonging to CMCs 3, 5, 12, 13 and 14, as defined in Annex II, the manufacturer shall establish an annual internal audit program in order to verify the compliance of the quality system, with the following components:”;

(7) In point 6.3.2 , the introductory wording is replaced by the following:

“6.3.2. For materials belonging to CMCs 3, 5, 12, 13 and 14, as defined in Annex II, the notified body shall take and analyse output material samples during each audit, and those audits shall be carried out with the following frequency:”.

Exhibit 2

EUROPEAN
COMMISSION

Brussels, 7.7.2021
C(2021) 4764 final

COMMISSION DELEGATED REGULATION (EU) …/...

of 7.7.2021

amending Annexes II, III and IV to Regulation (EU) No 2019/1009 of the European Parliament and of the Council for the purpose of adding pyrolysis and gasification materials as a component material category in EU fertilising products

(Text with EEA relevance)

EXPLANATORY MEMORANDUM

1. CONTEXT OF THE DELEGATED ACT

According to Article 42(1) of the Fertilising Products Regulation ([1]), the Commission is empowered to adopt delegated acts in accordance with Article 44 amending Annex II for the purposes of adapting the Annex to technical progress and of facilitating internal market access and free movement for EU fertilising products, which have a potential to be the subject of significant trade on the internal market and for which there is scientific evidence that they do not present a risk to human, animal or plant health, to safety or to the environment and that they do ensure agronomic efficiency. Regulation (EU) 2019/1009 repeals Regulation (EC) No 2003/2003 ([2]) and shall apply from 16 July 2022.

Further, Article 42(2) of Regulation (EU) 2019/1009 obliges the Commission to assess STRUvite, BIochar and ASh-based products (hereinafter jointly referred to as 'STRUBIAS') without undue delay after the date of entry into force and to adopt delegated acts to include those materials in Annex II if the abovementioned criteria pertaining to scientific evidence are fulfilled.

Such an assessment has been concluded by the Commission based on a report by the Commission's Joint Research Centre ('JRC') on technical and market conditions for a possible legal framework for the manufacturing and placing on the market of specific safe and effective fertilising products derived from STRUBIAS. The report includes technical proposals on eligible input materials and process conditions for STRUBIAS production pathways, quality requirements for STRUBIAS materials, and quality management systems. The report also provides information on the added value that the STRUBIAS materials could provide for food security, food safety, environmental protection, and the EU fertilising and agricultural sector.

In accordance with Article 42(3) of Regulation (EU) 2019/1009, the Commission may only adopt delegated acts pursuant to that Article to include materials in Annex II to the Regulation that cease to be waste following a recovery operation, if recovery rules in that Annex, adopted no later than the inclusion, ensure that the materials comply with the conditions laid down in Article 6 of Directive 2008/98/EC ([3]). This delegated regulation establishes recovery operations for pyrolysis and gasification materials, ensuring that they comply with the conditions laid down in Directive 2008/98/EC. Consequently, the requirement set out in Article 42(3) of Regulation (EU) 2019/1009 is fulfilled.

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[1] Regulation (EU) 2019/1009 of the European Parliament and of the Council of 5 June 2019 laying down rules on the making available on the market of EU fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009 and repealing Regulation (EC) No 2003/2003, OJ L 170, 25.6.2019, p. 1–114.

[2] Regulation (EC) No 2003/2003 of the European Parliament and of the Council of 13 October 2003 relating to fertilisers (OJ L 304, 21.11.2003, p. 1).

[3] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives, OJ L 312, 22.11.2008, p. 3–30.

In this context, this delegated regulation amends Annex II to Regulation (EU) 2019/1009 by adding pyrolysis and gasification materials as a new Component Material Category, Annex III by adding labelling requirements to EU fertilising products containing pyrolysis and gasification materials and Annex IV to the Regulation by setting the legal framework for the relevant conformity assessment for such products.

2. CONSULTATIONS PRIOR TO THE ADOPTION OF THE ACT

Pursuant to Article 44(4) of Regulation (EU) 2019/1009, experts designated by each Member State were consulted in the Commission expert group on Fertilising Products (E01320) according to the rules of the Interinstitutional Agreement on Better Law-Making of 13 April 2016.

Details of these consultations can be found in the minutes of the meetings held on 7 November 2019 and 24 November 2020, as well as in the various position papers of interested stakeholders publicly available on the CIRCABC page of the group, at the following link:

https://circabc.europa.eu/ui/group/36ec94c7-575b-44dc-a6e9-4ace02907f2f/library/b8e01334-4d39-445d-bf4e-589356d55b1f

Member States and interested stakeholders were largely supportive of the adoption of this delegated Regulation.

The draft delegated Regulation has been published for feedback on the Better Regulation portal. The three dozens of contributions received were largely supportive. However, concerns were expressed for some of the requirements for the input materials and their processing methods.

On the input materials, one recurrent concern was that, given that sewage sludge is not included in the exhaustive list, the opportunity of recovering nutrients from this important waste stream is missed. On the contrary, some contributions welcomed the exclusion of the sewage sludge from the input materials for pyrolysis and gasification materials.

The exhaustive list of input materials has been a key element in determining the safety and agronomic efficiency criteria for pyrolysis and gasification materials. This list includes those waste streams for which sufficient information exists on the possible risks and the safety parameters to be checked. Sewage sludge is and should remain excluded from the list because it is, for the moment, unclear whether contaminants of emerging concern, such as pharmaceuticals, contained therein are completely eliminated following the processing methods for pyrolysis and gasification materials.

Given the optional harmonisation in the field of fertilising products allowing the coexistence of the Fertilising Products Regulation with national rules, it is to be expected that some input materials regulated at national level are not covered by the harmonisation rules and *vice-versa*. The intention with this Regulation is to cover those materials which have the potential to be subject to significant trade on the internal market and for which solid scientific data attests their safety and agronomic efficiency.

In some contributions, it was stated that input materials with biomass should primarily be used in processes that would not destroy the so much needed organic matter (such as composting or digestion). However, the Commission’s mandate when adapting the Fertilising Products Regulation to technical progress and facilitate market access for fertilising products is merely to ensure that those products have a significant trade potential and are safe and efficient. The question whether an alternative use of the raw material would be better is not part of that assessment, in principle. In addition, depending on the process conditions, organic matter can be partially retained in materials covered under this CMC.

On the process conditions, it has been mentioned in the public feedback that the requirement of 180˚C for at least 2 seconds is not adequate.

The processing conditions and supplementary requirements (e.g. on H / C_{org} ratio) have been laid down in such a way as to include the majority of the processing methods already existent on the market and make the products safe.

The draft delegated Regulation has also been notified based on Article 2(9)(2) of the Agreement on Technical Barriers to Trade. No comments have been received.

3. LEGAL ELEMENTS OF THE DELEGATED ACT

The legal act amends Regulation (EU) 2019/1009. The legal basis of this delegated act is Article 42(1) of Regulation (EU) 2019/1009.

COMMISSION DELEGATED REGULATION (EU) …/...

of 7.7.2021

amending Annexes II, III and IV to Regulation (EU) No 2019/1009 of the European Parliament and of the Council for the purpose of adding pyrolysis and gasification materials as a component material category in EU fertilising products

(Text with EEA relevance)

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Regulation (EU) 2019/1009 of the European Parliament and of the Council of 5 June 2019 laying down rules on the making available on the market of EU fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009 and repealing Regulation (EC) No 2003/2003([1]), and in particular Article 42(1) thereof,

Whereas:

(1) Regulation (EU) 2019/1009 lays down rules on the making available on the market of EU fertilising products. EU fertilising products contain component materials of one or more of the categories listed in Annex II to that Regulation.

(2) Article 42(2) of Regulation (EU) 2019/1009 read in conjunction with Article 42(1), first subparagraph, point (b) of that Regulation requires the Commission to assess biochar without undue delay after 15 July 2019, and to include it in Annex II to that Regulation if that assessment concludes that EU fertilising products containing that material do not present a risk to human, animal or plant health, to safety or to the environment, and ensure agronomic efficiency.

(3) Biochar can be waste, and can in accordance with Article 19 of Regulation (EU) 2019/1009 cease to be waste if it is contained in a compliant EU fertilising product. Pursuant to Article 42(3) of Regulation (EU) 2019/1009 read in conjunction with Article 6 of Directive 2008/98/EC of the European Parliament and of the Council([2]), the Commission may therefore include biochar in Annex II to Regulation (EU) 2019/1009 only if recovery rules in that Annex ensure that the material is to be used for specific purposes, that a market or demand exists for it, and that its use will not lead to overall adverse environmental or human health impacts.

(4) The Commission’s Joint Research Centre (’JRC’) began its assessment of biochar in anticipation of the adoption of Regulation (EU) 2019/1009, and concluded it in 2019. Throughout the assessment, the scope was widened to include the broad spectrum of pyrolysis and gasification materials.

(5) JRC’s assessment report([3]) concludes that pyrolysis and gasification materials, if produced following the recovery rules suggested in the report, provide plants with

[1] OJ L 170, 25.6.2019, p. 1.

[2] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (OJ L 312, 22.11.2008, p. 3).

[3] Huygens D, Saveyn HGM, Tonini D, Eder P, Delgado Sancho L, Technical proposals for selected new

nutrients or improve their nutrition efficiency and therefore ensure agronomic efficiency.

(6) JRC's assessment report furthermore concludes that there is an existing and growing market demand for pyrolysis and gasification materials, and that those materials are likely to be used to provide nutrient inputs to European agriculture. It further concludes that the use of pyrolysis and gasification materials produced following the recovery rules suggested in the assessment report does not lead to overall adverse environmental or human health impacts.

(7) The recovery rules suggested in the JRC's assessment report include measures to limit the risks of recycling or producing contaminants, such as creating an exhaustive list of eligible input materials and excluding, for example, mixed municipal waste, and laying down specific processing conditions and product quality requirements. That assessment report also concludes that the fertilising products containing pyrolysis and gasification materials should follow specific labelling rules and that the conformity assessment rules applicable to such products should include a quality system assessed and approved by a notified body.

(8) Based on the above, the Commission concludes that pyrolysis and gasification materials, if produced following the recovery rules suggested in JRC's report, ensure agronomic efficiency within the meaning of Article 42(1), first subparagraph, point (b)(ii) of Regulation (EU) 2019/1009. Furthermore, they comply with the criteria laid down in Article 6 of Directive 2008/98/EC. Finally, if compliant with the other requirements laid down in Regulation (EU) 2019/1009 in general and in Annex I to that Regulation in particular, they would not present a risk to human, animal or plant health, to safety or to the environment, within the meaning of Article 42(1), first subparagraph, point (b)(i) of Regulation (EU) 2019/1009. Therefore, pyrolysis and gasification materials should be included in Annex II to Regulation (EU) 2019/1009 subject to those recovery rules.

(9) In particular, animal by-products or derived products within the meaning of Regulation (EC) No 1069/2009 of the European Parliament and of the Council([4]) should only be allowed as input materials for pyrolysis and gasification materials governed by Regulation (EU) 2019/1009, if and when their end points in the manufacturing chain have been determined in accordance with Article 5(2), third subparagraph of Regulation (EC) No 1069/2009 and will be reached at the latest by the end of the production process of the EU fertilising product containing the pyrolysis or gasification materials.

(10) Furthermore, given the fact that pyrolysis and gasification materials can be considered to be recovered waste or by-products within the meaning of Directive 2008/98/EC, such materials should be excluded from component material categories 1 and 11 of Annex II to Regulation (EU) 2019/1009 pursuant to Article 42(1), third subparagraph of that Regulation.

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fertilising materials under the Fertilising Products Regulation (Regulation (EU) 2019/1009) - Process and quality criteria, and assessment of environmental and market impacts for precipitated phosphate salts & derivates, thermal oxidation materials & derivates and pyrolysis & gasification materials, EUR 29841 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-76-09888-1, doi:10.2760/186684, JRC117856.

4 Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 laying down health rules as regards animal by-products and derived products not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Animal by-products Regulation) (OJ L 300, 14.11.2009, p. 1).

(11) It is important to ensure that fertilising products containing pyrolysis and gasification materials follow specific labelling rules and are subject to a conformity assessment procedure including a quality system assessed and approved by a notified body. It is therefore necessary to amend Annex III and Annex IV to Regulation (EU) 2019/1009 to provide for labelling requirements and for a conformity assessment appropriate for such fertilising products.

(12) Given that the requirements set out in Annexes II and III to Regulation (EU) 2019/1009 and the conformity assessment procedures set out in Annex IV to that Regulation are to apply as of 16 July 2022, it is necessary to defer the application of this Regulation to the same date,

HAS ADOPTED THIS REGULATION:

Article 1

Regulation (EU) 2019/1009 is amended as follows:

(1) Annex II is amended in accordance with Annex I to this Regulation;

(2) Annex III is amended in accordance with Annex II to this Regulation;

(3) Annex IV is amended in accordance with Annex III to this Regulation.

Article 2

This Regulation shall enter into force on the twentieth day following that of its publication in the *Official Journal of the European Union*.

It shall apply from 16 July 2022.

This Regulation shall be binding in its entirety and directly applicable in all Member States.

Done at Brussels, 7.7.2021

For the Commission
The President
Ursula VON DER LEYEN

Appendix 5

Re: Inquiry regarding biochar

[redacted]

Mon 1/29/2024 3:44 AM

To:Michael Youhana <myouhana@earthjustice.org>

External Sender

Dear Michael Youhana,

you can submitt my comments.
I have added references, because these facts do not come from me, I cite just science.

Best, Andrea Beste

Dr. Andrea Beste
Büro für Bodenschutz &
Ökologische Agrarkultur

Analyse, Beratung, Training
Mainz
www.gesunde-erde.net

Member of the EU Commission's Expert Advisory Group on Organic Agriculture (EGTOP).

Member of ENSSER, the European Network of Scientists for Social and Environmental Responsibility.

Soil Ambassador of the Swiss Organic Foundation.

Member of the Soil Expert Group, Friends of the Earth Germany

Member of the advisory board of IG Gesunder Boden eV

Member of the European Land & Soil Alliance (ELSA).

Member of the German Soil Science Society (DBG).

Member of the Global Soil Biodiversity Initiative (GSBI).

Am 27.01.2024 21:09 schrieb Michael Youhana:

> Dear Dr. Beste,
>
> I am submitting comments to a New York regulatory agency considering the issuance of a permit/approval for biochar production in our state. Would it be alright if I quoted some of your general observations on biochar below?
>
> Best,
> Michael
>
> ---
>
> **From:** Dr. Andrea Beste [redacted]
> **Sent:** Tuesday, April 18, 2023 6:11 AM

To: Michael Youhana <myouhana@earthjustice.org>
Subject: Re: Inquiry regarding biochar

External Sender

Dear Michael Youhana,

from my point of view, the question is not whether and under what circumstances municipal waste can be turned into biochar, but whether biochar is a useful product at all.

After all, the pollutants do not come from the starting material, but mainly from the pyrolysis process.

First of all, Biochar is a highly technologically produced substrate, which has nothing in common with the natural humification process of "Terra Preta" and also with its chemical composition, which is often referred to in the Biochar industry - especially with product names - it is not the humic substances of the classic "Terra Preta" formed over centuries, see appendix.
https://humictrade.org/wp-content/uploads/2022/03/Biochar-Report-HPTA-Science-Committee.pdf

The application can also not be called "nature based solution", which should be preferred for agricultural climate protection and humus formation, because it is a highly technological process with a technical end product as substrate, which occurs in nature only very rarely (in forest fire situations under exclusion of air).

Furthermore, 50% of the C is released again during the pyrolysis process, which makes the efficiency very questionable.
https://www.energie-experten.ch/de/wissen/detail/pflanzenkohle-klimapositive-energie-mit-co2-speicherung.html

Pollutants:
There is a permanent potential for pollutants in pyrolyzed vegetable charcoal. In pyrolysis technology, organic material is carbonized at temperatures > 350°C and oxygen contents of < 2%. The higher the temperatures, the more stable the char. During this process of pyrolysis, a variety of aromatic organic substances are always formed, regardless of the starting materials. These include a number of pollutants that are difficult to break down, such as polycyclic aromatic hydrocarbons (PAHs) in particular, which are carcinogenic and mutagenic. These pollutants cannot be removed because they are too strongly bound to the material. For the same reason, measuring methods do not detect them or do not detect them sufficiently, which is why measured values and certificates have little informative value about the actual pollutant load.
https://www.sciencedirect.com/science/article/abs/pii/S0048969719309313

For expertise on this risk I recommend to contact Prof. Große-Ophoff, chemist, pyrolysis expert and since 2001 head of the Center for Environmental Communication of the Deutsche Bundesstiftung Umwelt and member of the scientific advisory board of Friends of the Earth Germany.
https://www.hs-osnabrueck.de/hon-prof-dr-markus-grosse-ophoff/

Its use is viewed extremely critically by leading scientific institutions and environmental NGOs:

- Statement by Friends of the Earth Germany on the EU consultation Fertilizer products - Materials from pyrolysis and gasification :
https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12136-Dungeprodukte-Materialien-aus-Pyrolyse-und-Vergasung-/F1798083_de

European Environmental Bureau, EEB (2021): Carbon Farming for Climate, Nature, and Farmers report.
https://eeb.org/library/carbon-farming-for-climate-nature-and-farmers/

Geoengineering Monitor:
https://www.geoengineeringmonitor.org/wp-content/uploads/2021/04/biochar.pdf

More on that you can find here:
https://www.gesunde-erde.net/en/soil-management/terra-preta-biochar/

Best regards

Andrea Beste

Dr. Andrea Beste
Büro für Bodenschutz &

Ökologische Agrarkultur

Analyse, Beratung, Fortbildung
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Member of the EU Commission's Expert Advisory Group on Organic Agriculture (EGTOP).

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Member of the advisory board of IG gesunder Boden e.V.

Member of the European Land & Soil Alliance (ELSA).

Member of the German Soil Science Society (DBG).

Member of the Global Soil Biodiversity Initiative (GSBI).

Am 17.04.2023 21:40 schrieb Michael Youhana:

> Thank you for putting us in touch, [redacted]
>
> Dear Dr. Beste,
>
> I am wondering if you have any time next week to chat about the risks associated with the production and use of biochar from municipal waste? I am conducting research on behalf of Earthjustice's Northeast Regional Program. Earthjustice is a large legal non-profit in the United States.We're hoping to talk to experts to better understand the science behind emerging technologies to produce biochar. We came across your EGTOP report on biochar from 2018, and thought you might have some ideas on this issue.
>
> Best,
> Michael

Appendix 6

Exhibit 1

2016 WL 11527029 (Neb.Dept.Env.Control)

Nebraska Department of Environmental Quality

State of Nebraska

IN THE MATTER OF GREENCYCLE SOLUTIONS, LLC (OWNER),
ALTEN, LLC (OPERATOR), FID## 111532, 84069, RESPONDENT

Case No. 3469
November 20, 2016

COMPLAINT, COMPLIANCE ORDER AND NOTICE OF OPPORTUNITY FOR HEARING

I. INTRODUCTION

***1** 1. This Complaint, Compliance Order and Notice of Opportunity for Hearing is issued pursuant to Neb. Rev. Stat. § 81-1507 (Reissue 2014). The Complainant is the Director, State of Nebraska Department of Environmental Quality (hereinafter "NDEQ" or "Department"). The Respondents are Greencycle Solutions, LLC (hereinafter "Greencycle"), and AltEn, LLC (hereinafter "AltEn") whose facilities # 111532 and 84069 are located in Mead, Saunders County, Nebraska. Complainant has determined that the Respondents are in violation of the Nebraska Environmental Protection Act (NEPA), Neb. Rev. Stat. § 81-1501 et. seq. (Reissue 2014, Cum. Supp. 2016) and Title 129, Nebraska Air Quality Regulations.

2. The Department is the agency of the State of Nebraska charged with the duty, pursuant to Neb. Rev. Stat. § 81-1504, of exercising exclusive general supervision, administration, and enforcement of the Nebraska Environmental Protection Act, and all rules and regulations and orders promulgated under such act.

3. The Complaint below establishes the violations, and the Compliance Order establishes a schedule for corrective actions to be taken by the Respondents.

II. COMPLAINT

4. Respondents are Greencycle, which owns a **biochar** unit, and AltEn, operator of the **biochar** unit, at 1344 County Road 10, Mead, Nebraska 68041. The legal description is N SW Section 12 Township N 14 Range E 08, Saunders County, Nebraska.

5. Pursuant to the Nebraska Environmental Quality Council's authority to adopt rules and regulations for the purpose of air pollution control, as expressed in Neb. Rev. Stat. §§ 81-1505(1), (12), the Council adopted rules and regulations codified as Neb. Adm. Code, Title 129, Nebraska Air Quality Regulations.

6. Nebraska Administrative Code, Title 129, Nebraska Air Quality Regulations, Chapter 20, Section 004, states that:
"No person shall cause or allow emissions, from any source, which are of an opacity equal to or greater than twenty percent (20%), as evaluated by an EPA-approved method, or recorded by a continuous opacity monitoring system operated and maintained pursuant to 40 CFR Part 60 Appendix B except as provided for in section 005 of this chapter."

7. Nebraska Administrative Code, Title 129, Nebraska Air Quality Regulations, Chapter 30, Section 001, states that "No person shall cause or allow any open fires."

8. On July 7, 2017, an email was sent from NDEQ staff to Tanner Shaw at tshaw @mrgkc.com. The email requested additional information regarding VOC/HAP emissions from the WDG dryer and whether the potential emissions from the dryer were evaluated by Mead Cattle Company, LLC; AltEn; or Greencycle. Data from dryers have shown to have emissions in the range of 2.5 lb/hr individual HAP and 108 lb/hr VOC, very significant emissions.

***2** 9. On July 14, 2017, an email was sent from NDEQ staff to Tanner Shaw at tshaw@mrgkc.com. The email again requested additional information originally requested in the email cited in Paragraph #8 above. The July 14, 2017, email also questioned the potential CO emissions from this unit.

10. A Notice of Violation (NOV) was issued by NDEQ on August 9, 2018, and received by Greencycle on August 10, 2018, finding Greencycle in violation of the following requirements:
"1. Causing or allowing emissions from a source at an opacity equal to or greater than twenty percent (20%), as evaluated by an EPA-approved method [[[Title 129 - Chapter 20 - 004], On July 13, 2018 opacity of emissions from Greencycle's **biochar** emission stack, which is operated by AltEn, were determined to have an average opacity of 30.4%, according to EPA Method 9 testing.

2. Causing or allowing an open fire without the written permission of the Director [Title 129 - Chapter 30]. The Department documented smoldering of **biochar** product during a facility tour on July 19, 2018."

11. The August 9, 2018, NOV required Greencycle, within 60 days of receipt of the NOV, to:
"1. Submit a timeline for proposed emission testing for the **biochar** emission unit using test methodologies found in Title 129, Chapter 34, to determine emission rates for particulate matter with an aerodynamic diameter less than or equal to 10 micrometers (PM_{10}), volatile organic compounds (VOC), and hazardous air pollutants (HAPs).

Testing must be performed under worst-case conditions, which the Department believes to be while charging fresh wet cake into the **biochar** emission unit for all test runs.

2. Perform maintenance on the **biochar** unit and submit a record of corrective and preventive actions taken to ensure the emission unit is in compliance with Title 129 - Chapter 20 opacity limits."

12. As of today's date, Greencycle has failed to respond to the July 7 and July 14, 2017, emails and to comply with the August 9, 2018, NOV.

13. The Director of the NDEQ is authorized pursuant to Neb. Rev. Stat. § 81-1504(1), (7), and (13) to issue this order requiring enforcement of the Nebraska Environmental Protection Act.

III. COMPLIANCE ORDER

14. Within 30 days of receipt of this order, Greencycle and AltEn shall bring their facilities into compliance with all requirements of the Nebraska Environmental Protection Act and all rules and regulations and orders promulgated under such acts, including, but not limited to completing the following:
A. Conduct emission testing on the **biochar** unit for PM_{10}, CO, mass of VOC, and speciated HAPs while operating under worst-case conditions (while charging fresh wet cake into the **biochar** emission unit for all test runs). Testing must be performed within 60 days of receipt of this order or the next time the unit is operated. Notice must be given to the NDEQ 30 days prior to the testing pursuant to Neb. Admin. Code Title 129, Chapter 34, Section 003.

***3** B. Provide documentation of maintenance and/or other corrective actions performed on the **biochar** unit required by the NOV, as well as maintenance records back to the date of installation.

C. Submit information requested in facility correspondence on July 7 (email to Tanner Shaw) and July 14, 2017 (email to Tanner Shaw).

D. Provide documentation on date of installation of the **biochar** unit.

15. Respondents shall report to NDEQ within 30 days of receipt of this order, documenting how compliance with paragraph 14 of this Order has been achieved.

16. Respondents shall report to NDEQ within 60 days of receipt of this order, documenting how compliance with paragraph 14(A) of this Order has been achieved.

17. Respondents shall respond promptly to any written communication by the NDEQ. Any delay in responding to such communication shall be construed as non-compliance with this Order.

18. Information to be submitted under this Order shall refer to FID## 111532 and 84069 and shall be sent to:
Air Quality Division

Nebraska Department of Environmental Quality

PO Box 98922

Lincoln, NE 68509-8922

IV. NOTICE OF OPPORTUNITY TO REQUEST A HEARING

19. This Order shall become final, pursuant to Neb. Rev. Stat. § 81-1507(1), unless Respondents file an answer and request, in writing, a hearing no later than thirty days after receipt of this Order. Failure to answer within thirty days shall be deemed an admission of the allegations of the Complaint.

20. A written answer to the Complaint, Compliance Order and Notice of Opportunity for Hearing must conform to the requirements of Title 115, Neb. Admin. Code, Rules of Practice and Procedure, Chapter 7. The answer and request for hearing may be filed by mail to: Jim Macy, Director, State of Nebraska Department of Environmental Quality, P.O. Box 98922, Lincoln, Nebraska 68509-8922, or may be delivered to the Department's Lincoln office located at 1200 N Street, Suite 400, Lincoln, Nebraska.

V. SETTLEMENT CONFERENCE

21. Whether or not Respondents request a hearing, an informal settlement conference may be requested by writing to Susan M. Ugai, Attorney, Nebraska Department of Environmental Quality, P.O. Box 98922, Lincoln, Nebraska 68509-8922, or have your attorney make such a request.

22. A request for settlement conference does not extend the thirty (30) day period during which a written answer and request for hearing must be submitted or otherwise delay the final effective date of this Order.

VI. INJUNCTIVE RELIEF AND PENALTY PROVISIONS

23. The NDEQ reserves the right to pursue enforcement in the proper court of law for injunctive relief or to seek civil or criminal penalties for any violations that are the subject of this Complaint, Compliance Order and Notice of Opportunity for Hearing. Nothing in this Complaint, Compliance Order and Notice of Opportunity for Hearing precludes the NDEQ from pursuing such enforcement.

Dated this 20th day of November, 2018.

***4** BY THE DIRECTOR:

Jim Macy
Director

2016 WL 11527029 (Neb.Dept.Env.Control)

End of Document

Exhibit 2

2018 WL 10447024 (Neb.Dept.Env.Control)

Nebraska Department of Environmental Quality

State of Nebraska

IN THE MATTER OF ALTEN OPERATING COMPANY, LLC, FID # 84069, RESPONDENT

Case No. 3476
December 21, 2018

COMPLAINT, COMPLIANCE ORDER AND NOTICE OF OPPORTUNITY FOR HEARING

I. INTRODUCTION

***1** 1. This Complaint, Compliance Order and Notice of Opportunity for Hearing is issued pursuant to Neb. Rev. Stat. § 81-1507 (Reissue 2014). The Complainant is the Director, State of Nebraska Department of Environmental Quality (hereinafter "NDEQ" or "Department"). The Respondent is AltEn Operating Company, LLC (hereinafter "Operator") whose facility # 84069 is located in Mead, Saunders County, Nebraska. Complainant has determined that the Respondent is in violation of the Nebraska Environmental Protection Act (NEPA), Neb. Rev. Stat. § 81-1501 et. seq. (Reissue 2014, Cum. Supp. 2016) and Title 129, Nebraska Air Quality Regulations.

2. The Department is the agency of the State of Nebraska charged with the duty, pursuant to Neb. Rev. Stat. § 81-1504, of exercising exclusive general supervision, administration, and enforcement of the Nebraska Environmental Protection Act, and all rules and regulations and orders promulgated under such act.

3. The Complaint below establishes the violations, and the Compliance Order establishes a schedule for corrective actions to be taken by the Respondent.

II. COMPLAINT

4. Respondent is Operator, operator of the **biochar** unit at 1344 County Road 10, Mead, Nebraska 68041. The owner of the **biochar** unit is Greencycle Solutions, LLC ("Greencycle"), and the subject of NDEQ Case No. 3469. The legal description is N SW Section 12 Township N 14 Range E 08, Saunders County, Nebraska.

5. Pursuant to the Nebraska Environmental Quality Council's authority to adopt rules and regulations for the purpose of air pollution control, as expressed in Neb. Rev. Stat. §§ 81-1505(1), (12), the Council adopted rules and regulations codified as Neb. Adm. Code, Title 129, Nebraska Air Quality Regulations.

6. Nebraska Administrative Code, Title 129, Nebraska Air Quality Regulations, Chapter 20, Section 004, states that:
"No person shall cause or allow emissions, from any source, which are of an opacity equal to or greater than twenty percent (20%), as evaluated by an EPA-approved method, or recorded by a continuous opacity monitoring system operated and maintained pursuant to 40 CFR Part 60 Appendix B except as provided for in section 005 of this chapter."

7. Nebraska Administrative Code, Title 129, Nebraska Air Quality Regulations, Chapter 30, Section 001, states that "No person shall cause or allow any open fires."

8. On July 7, 2017, an email was sent from NDEQ staff to Tanner Shaw at tshaw @mrgkc.com. The email requested additional information regarding VOC/HAP emissions from the WDG dryer and whether the potential emissions from the dryer were evaluated by Mead Cattle Company, LLC; AltEn; or Greencycle. Data from dryers have shown to have emissions in the range of 2.5 Ib/hr individual HAP and 108 Ib/hr VOC, very significant emissions.

***2** 9. On July 14, 2017, an email was sent from NDEQ staff to Tanner Shaw at tshaw@mrgkc.com. The email again requested additional information originally requested in the email cited in Paragraph #8 above. The July 14, 2017, email also questioned the potential CO emissions from this unit.

10. A Notice of Violation ("NOV) was issued by NDEQ on August 9, 2018, and received by Greencycle on August 10, 2018, finding Greencycle in violation of the following requirements:
"1. Causing or allowing emissions from a source at an opacity equal to or greater than twenty percent (20%), as evaluated by an EPA-approved method [[Title 129 - Chapter 20 - 004]. On July 13, 2018 opacity of emissions from Greencycle's **biochar** emission stack, which is operated by AltEn, were determined to have an average opacity of 30.4%, according to EPA Method 9 testing.

2. Causing or allowing an open fire without the written permission of the Director [Title 129 - Chapter 30]. The Department documented smoldering of **biochar** product during a facility tour on July 19, 2018."

11. The August 9, 2018, NOV required Greencycle, within 60 days of receipt of the NOV, to:
"1. Submit a timeline for proposed emission testing for the **biochar** emission unit using test methodologies found in Title 129, Chapter 34, to determine emission rates for particulate matter with an aerodynamic diameter less than or equal to 10 micrometers (PM10), volatile organic compounds (VOC), and hazardous air pollutants (HAPs).

Testing must be performed under worst-case conditions, which the Department believes to be while charging fresh wet cake into the **biochar** emission unit for all test runs.

2. Perform maintenance on the **biochar** unit and submit a record of corrective and preventive actions taken to ensure the emission unit is in compliance with Title 129 - Chapter 20 opacity limits."

12. As of today's date, Greencycle has failed to respond to the July 7 and July 14, 2017, emails and to comply with the August 9, 2018, NOV.

13. The Director of the NDEQ is authorized pursuant to Neb. Rev. Stat. § 81-1504(1), (7), and (13) to issue this order requiring enforcement of the Nebraska Environmental Protection Act.

III. COMPLIANCE ORDER

14. Within 30 days of receipt of this order, Operator shall bring their facility into compliance with all requirements of the Nebraska Environmental Protection Act and all rules and regulations and orders promulgated under such acts, including, but not limited to completing the following:
A. Conduct emission testing on the **biochar** unit for PM10, CO, mass of VOC, and speciated HAPs while operating under worst-case conditions (while charging fresh wet cake into the **biochar** emission unit for all test runs). Testing must be performed within 60 days of receipt of this order or the next time the unit is operated. Notice must be given to the NDEQ 30 days prior to the testing pursuant to Neb. Admin. Code Title 129, Chapter 34, Section 003.

***3** B. Provide documentation of maintenance and/or other corrective actions performed on the **biochar** unit required by the NOV, as well as maintenance records back to the date of installation.

C. Submit information requested in facility correspondence on July 7 (email to Tanner Shaw) and July 14, 2017 (email to Tanner Shaw).

D. Provide documentation on date of installation of the **biochar** unit.

15. Respondents shall report to NDEQ within 30 days of receipt of this order, documenting how compliance with paragraph 14 of this Order has been achieved.

16. Respondents shall report to NDEQ within 60 days of receipt of this order, documenting how compliance with paragraph 14(A) of this Order has been achieved.

17. Respondents shall respond promptly to any written communication by the NDEQ. Any delay in responding to such communication shall be construed as non-compliance with this Order.

18. Information to be submitted under this Order shall refer to FID # 84069 and shall be sent to:
Air Quality Division

Nebraska Department of Environmental Quality

PO Box 98922

Lincoln, NE 68509-8922

IV. NOTICE OF OPPORTUNITY TO REQUEST A HEARING

19. This Order shall become final, pursuant to Neb. Rev. Stat. § 81-1507(1), unless Respondent files an answer and request, in writing, a hearing no later than thirty days after receipt of this Order. Failure to answer within thirty days shall be deemed an admission of the allegations of the Complaint.

20. A written answer to the Complaint, Compliance Order and Notice of Opportunity for Hearing must conform to the requirements of Title 115, Neb. Admin. Code, Rules of Practice and Procedure, Chapter 7. The answer and request for hearing may be filed by mail to: Jim Macy, Director, State of Nebraska Department of Environmental Quality, P.O. Box 98922, Lincoln, Nebraska 68509-8922, or may be delivered to the Department's Lincoln office located at 1200 N Street, Suite 400, Lincoln, Nebraska.

V. SETTLEMENT CONFERENCE

21. Whether or not Respondent requests a hearing, an informal settlement conference may be requested by writing to Susan M. Ugai, Attorney, Nebraska Department of Environmental Quality, P.O. Box 98922, Lincoln, Nebraska 68509-8922, or have your attorney make such a request.

22. A request for settlement conference does not extend the thirty (30) day period during which a written answer and request for hearing must be submitted or otherwise delay the final effective date of this Order.

VI. INJUNCTIVE RELIEF AND PENALTY PROVISIONS

23. The NDEQ reserves the right to pursue enforcement in the proper court of law for injunctive relief or to seek civil or criminal penalties for any violations that are the subject of this Complaint, Compliance Order and Notice of Opportunity for Hearing. Nothing in this Complaint, Compliance Order and Notice of Opportunity for Hearing precludes the NDEQ from pursuing such enforcement.

Dated this 21st day of December, 2018.

***4** Jim Macy
Director

2018 WL 10447024 (Neb.Dept.Env.Control)

End of Document

Exhibit 3

2018 WL 10447023 (Neb.Dept.Env.Control)

Nebraska Department of Environmental Quality

State of Nebraska

IN THE MATTER OF ALTEN, LLC, FID # 84069, RESPONDENT

Case No. 3475
December 28, 2018

COMPLAINT, COMPLIANCE ORDER AND NOTICE OF OPPORTUNITY FOR HEARING

I. INTRODUCTION

***1** 1. This Complaint, Compliance Order and Notice of Opportunity for Hearing is issued pursuant to Neb. Rev. Stat. § 81-1507 (Reissue 2014). The Complainant is the Director, State of Nebraska Department of Environmental Quality (hereinafter "NDEQ" or "Department"). The Respondent is AltEn, LLC (hereinafter "AltEn") whose facility # 84069 is located in Mead, Saunders County, Nebraska. Complainant has determined that the Respondent is in violation of the Nebraska Environmental Protection Act (NEPA), Neb. Rev. Stat. § 81-1501 et. seq. (Reissue 2014, Cum. Supp. 2016), Neb. Admin. Code, Title 119, Rules and Regulations Pertaining to the Issuance of Permits under the National Pollutant Discharge Elimination Section, and Neb. Admin. Code, Title 123, Rules and Regulations for the Design, Operation, and Maintenance of Wastewater Works.

2. The Department is the agency of the State of Nebraska charged with the duty, pursuant to Neb. Rev. Stat. § 81-1504, of exercising exclusive general supervision, administration, and enforcement of the Nebraska Environmental Protection Act, and all rules and regulations and orders promulgated under such act.

3. The Complaint below establishes the violations, and the Compliance Order establishes a schedule for corrective actions to be taken by the Respondent.

II. COMPLAINT

4. Respondent is AltEn, LLC, operator of the ethanol plant at 1344 County Road 10, Mead, Nebraska 68041. The legal description is N SW Section 12 Township N 14 Range E 08, Saunders County, Nebraska. AltEn, LLC, is a limited liability company registered to do business in Nebraska and incorporated in the state of Kansas.

5. AltEn has authorization to discharge storm water under the terms and conditions of the National Pollutant Discharge Elimination System (NPDES) Industrial Storm Water General Permit NER910000, pursuant to authorization number NER910444, issued by NDEQ on April 20, 2017.

6. AltEn was issued NPDES Permit Number NE0137634, effective July 1, 2017.

7. Pursuant to the Nebraska Environmental Quality Council's authority to adopt rules and regulations for the purpose of water pollution control, as expressed in Neb. Rev. Stat. §§ 81-1505(1), (8), (11), (12), (15), (16), (20), the Council adopted rules and regulations codified as Neb. Admin. Code, Title 119, Rules and Regulations Pertaining to the Issuance of Permits under the National Pollutant Discharge Elimination Section and Neb. Admin. Code, Title 123, Rules and Regulations for the Design, Operation, and Maintenance of Wastewater Works.

8. Neb. Admin. Code, Title 119, Rules and Regulations Pertaining to the Issuance of Permits under the National Pollutant Discharge Elimination Section, Chapter 14, Section 001.01, states that:
"Duty to comply. The permittee must comply with all conditions of the permit. Any permit noncompliance constitutes a violation of the Federal and State Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application."

***2** 9. Neb. Admin. Code, Title 123, Rules and Regulations for the Design, Operation, and Maintenance of Wastewater Works, Chapter 11 states:
"008 The operation and maintenance of wastewater lagoons shall be conducted in the following manner:
008.01 Lagoon dikes shall be maintained with grass to minimize soil erosion, except for areas protected by rip rap or other stabilization methods. The grassed dikes shall be mowed to prevent growth of trees or woody plants. Cattails, reeds and other emergent vegetation shall be removed from the lagoons promptly as they appear.

...

008.05 Damage to lagoon dikes and liners caused by muskrats or other rodents, erosion, tree roots, animal hooves, or any other source shall be promptly repaired.

008.06 The liners of wastewater lagoons shall be maintained so that wastewater seepage does not exceed the rate approved by the Department in the construction plans and specifications. Where no record of approved plans and specifications exist, the lagoon liner shall be maintained to meet the seepage rate prescribed by the Department for the specific wastewater being treated. The owner shall perform seepage testing when requested by the Department.

008.07 Wastewater lagoons shall be operated so that the water level is not maintained in the area designed for freeboard."

10. AltEn is required to dispose of all solid wastes and sludges in accordance with State and Federal Regulations pursuant to Part III.E. and F of NPDES Permit Number NE0137634 and the Construction and Development Point Source Category Effluent Limitation Guidelines at 40 CFR 450.

11. AltEn is required meet the Control Measures listed in Part 2.1 of NPDES Industrial Storm Water General Permit NER910000.

12. A Notice of Violation (NOV) was issued by NDEQ on July 23, 2018, and received by AltEn on July 28, 2018, finding AltEn in violation of the following requirements:
A. Failure to utilize construction storm water control best management practices (BMPs) required by Part III.E. and F of NPDES Permit Number NE0137634 and the Construction and Development Point Source Category Effluent Limitation Guidelines at 40 CFR 450, as evidenced by the following observations:
a. Sediment discharges from the site are not minimized.

b. Controls are not implemented for disturbed slopes.

c. Temporary construction control BMPs are not installed.

d. Notice of Intent (NOI) and Storm Water Pollution Prevention Plan (SWPPP) are not posted or available when requested.

B. Failure to utilize and maintain industrial storm water control best management practices as required by part 2.1 of NPDES Industrial Storm Water General Permit NER910000, as evidenced by the following observations:
a. Berm used to control wet cake runoff is breached and discharging into neighboring property.

b. SWPPP not provided when requested.

13. The July 23, 2018, NOV required AltEn to:
A. Immediately implement and maintain temporary or permanent stabilization measures for disturbed portions of the site as required by the NPDES Permit Number NE0137634. Implement the required corrective action for the removal of offsite accumulations of sediment.

***3** B. Immediately submit the construction storm water pollution prevention plan (SWPPP) to the NDEQ.

C. Within 15 days of the NOV, submit in writing a description of the corrective actions implemented to mitigate the above reference violations of NPDES Permit Number NE0137634.

D. Immediately implement and maintain NPDES Industrial Storm Water General Permit NER910000 best management practices around the **BioChar** wet cake storage area.

E. Within 15 days from the receipt of this notification, submit in writing a description of the corrective actions implemented to mitigate the above referenced NPDES Industrial Storm Water General Permit NER910000 violations. Include photo documentation of the corrective actions.

14. As of today's date, AltEn has failed to respond to the July 23, 2018, NOV.

15. On August 1, 2018, NDEQ inspectors conducted sampling at AltEn. During an examination of the outdated seed corn storage, the inspectors found other types of seed, including Sudan grass and sorghum.

16. On October 11, 2018, an NDEQ inspector and an engineer conducted a site visit at AltEn and noted the following: missing industrial storm water (ISW) inspection reports, SWPPP not updated with NPDES Industrial Storm Water General Permit NER910000, improper good housekeeping measures, chemicals not stored in proper containment, uncontrolled storm water discharges, starch totes not properly labelled and improper cleaning of spills and leaks. Two storage lagoons were found to have operated within the area for freeboard, and there were tears in the lagoon liners and dike erosion noted.

17. The items noted in Paragraph 16 above are violations of Neb. Admin. Code, Title 119, Chapter 14, Section 001.01 and Title 123, Chapter 11, Sections 008.01, 008.05, 008.06, and 008.07.

18. On October 25, 2018, two NDEQ inspectors and an engineer conducted a site visit and sampling at AltEn. Strong odors associated with manure, chemical cleaner, and ethanol were noted. They also found the two storage lagoons have extensive liner damage, extensive vegetative growth, burrowing animals, and a layer of solids floating on the surface that appears to be in a septic state. The emergency lagoon has holes and tearing in the liner, a layer of solids, and is operating within the area designated for freeboard. Sample results indicated an overloading of the two storage lagoons.

19. The stormwater inspection revealed passively discharged material from a manhole entering the lagoons, starch totes leaking on the north and south sides of the facility, uncontrolled contaminated stormwater discharging tar like material, and thin stillage discharging from a black pipe entering the digesters.

20. AltEn could not produce discharge monitoring reports (DMRs) or records of ISW inspections, sampling, and training.

21. The items noted in Paragraphs 18, 19, and 20 above are violations of Neb. Admin. Code, Title 119, Chapter 14, Section 001.01 and Title 123, Chapter 11, Sections 008.01, 008.05, 008.06, and 008.07.

***4** 22. The Director of the NDEQ is authorized pursuant to Neb. Rev. Stat. § 81- 1504(1), (7), and (13) to issue this order requiring enforcement of the Nebraska Environmental Protection Act.

III. COMPLIANCE ORDER

23. AltEn shall bring their facility into compliance with all requirements of the Nebraska Environmental Protection Act and all rules and regulations and orders promulgated under such acts, including, but not limited to completing the following:
A. Within thirty (30) days, submit in writing a description of the corrective actions implemented to mitigate the referenced General NPDES Permit Number NER910000 violations. Photographic documentation of the corrective actions must be submitted to NDEQ.

B. Within thirty (30) days, submit to the NDEQ all missing storm water inspections and training records from July 2017 to the present. Provide a corrective action report identifying the condition triggering the need for corrective action. The report shall include control measures used to ensure that facility inspections and employee training is being completed, documented and filed for inspection.

C. Within thirty (30) days, submit to the NDEQ an updated SWPPP that references the General NPDES Permit Number NER910000.

D. Within fifteen (15) days, submit to the NDEQ the required Best Management Practices (BMPs) for land application. The BMPs must include all requirements set forth in Part II. of the NPDES Permit Number NE0137634.

E. Within fifteen (15) days, submit to the NDEQ the laboratory results for land application from July 2017 to the present. The results must include documentation that no measureable residues of pesticides from seed corn remain in ethanol by-products that are used for agronomic practice. Notify NDEQ at least 48 hours prior to doing future land applications.

F. Within ninety (90) days, submit to the NDEQ an independent professional engineering evaluation for the repair of the two-cell lagoon and emergency lagoon liners along with a timeline for the repair completion. Also, provide documentation that vegetation has been removed, animal burrows repaired, and the lagoons are not operating within the area designated for freeboard.

G. Immediately stop the use of evaporator/misters in the storage lagoon system until receiving written approval from the NDEQ.

H. Within one hundred twenty (120) days, submit to the NDEQ a ground water monitoring plan of the facility including the storage lagoons. The facility must identify the chemicals that are present in the seed coating prior to ethanol production. The facility must continue to monitor for these chemicals.

24. Respondents shall respond promptly to any written communication by the NDEQ. Any delay in responding to such communication shall be construed as non-compliance with this Order.

25. Information to be submitted under this Order shall refer to FID # 84069 and shall be sent to:
NDEQ Water Quality Division

Nebraska Department of Environmental Quality

***5** PO Box 98922

Lincoln, NE 68509-8922

IV. NOTICE OF OPPORTUNITY TO REQUEST A HEARING

26. This Order shall become final, pursuant to Neb. Rev. Stat. § 81-1507(1), unless Respondents file an answer and request, in writing, a hearing no later than thirty days after receipt of this Order. Failure to answer within thirty days shall be deemed an admission of the allegations of the Complaint.

27. A written answer to the Complaint, Compliance Order and Notice of Opportunity for Hearing must conform to the requirements of Title 115, Neb. Admin. Code, Rules of Practice and Procedure, Chapter 7. The answer and request for hearing may be filed by mail to: Jim Macy, Director, State of Nebraska Department of Environmental Quality, P.O. Box 98922, Lincoln, Nebraska 68509-8922, or may be delivered to the Department's Lincoln office located at 1200 N Street, Suite 400, Lincoln, Nebraska.

V. SETTLEMENT CONFERENCE

28. Whether or not Respondents request a hearing, an informal settlement conference may be requested by writing to Susan M. Ugai, Attorney, Nebraska Department of Environmental Quality, P.O. Box 98922, Lincoln, Nebraska 68509-8922, or have your attorney make such a request.

29. A request for settlement conference does not extend the thirty (30) day period during which a written answer and request for hearing must be submitted or otherwise delay the final effective date of this Order.

VI. INJUNCTIVE RELIEF AND PENALTY PROVISIONS

30. The NDEQ reserves the right to pursue enforcement in the proper court of law for injunctive relief or to seek civil or criminal penalties for any violations that are the subject of this Complaint, Compliance Order and Notice of Opportunity for Hearing. Nothing in this Complaint, Compliance Order and Notice of Opportunity for Hearing precludes the NDEQ from pursuing such enforcement.

Dated this 28th day of December, 2018.

Jim Macy
Director

2018 WL 10447023 (Neb.Dept.Env.Control)

Exhibit 4

2021 WL 1536693 (Neb.Dept.Env.Control)

Department of Environmental Control

State of Nebraska

STATE OF NEBRASKA, EX REL., JIM MACY, DIRECTOR, NEBRASKA DEPARTMENT OF ENVIRONMENT AND ENERGY, PLAINTIFF
v.
ALTEN, LLC, DEFENDANT

Case No. 84069
March 1, 2021

COMPLAINT

***1** COMES NOW Jim Macy, Director of the Nebraska Department of Environment and Energy, who institutes this action through Douglas J. Peterson, Nebraska Attorney General, on behalf of the State of Nebraska, as Plaintiff, and alleges as follows:

PARTIES AND INTERESTS

1. Plaintiff Nebraska Department of Environment and Energy ("Department") [1] is the agency of the State of Nebraska charged with the duty, pursuant to Neb. Rev. Stat. § 81-1504, to administer and enforce the Nebraska Environmental Protection Act ("NEPA"), Neb. Rev. Stat. § 81-1501 *et seq.*, the Integrated Solid Waste Management Act ("ISWMA"), Neb. Rev. Stat. § 13-2001 *et seq.*, and all rules, regulations, orders, and permits issued pursuant to NEPA. [2]

2. Under NEPA, the Department is further charged with the duty to "act as the water pollution, air pollution, and solid waste control agency for all purposes of the Clean Water Act [("CWA")], as amended, 33 U.S.C. [§] 1251 *et seq.*, the Clean Air Act [("CAA")], as amended, 42 U.S.C. [§] 7401 *et seq.*, [and] the Resource Conservation and Recovery Act [("RCRA")], as amended, 42 U.S.C. [§] 6901 *et seq.*" Neb. Rev. Stat. § 81-1504(4). The Department is also charged with the duty to issue, revoke, modify, or deny permits consistent with rules and regulations. Neb. Rev. Stat. § 81-1504(11).

3. Defendant AltEn, LLC ("AltEn") is a Kansas limited liability company with its principal office in Shawnee, Kansas. AltEn is registered as a foreign limited liability company in Nebraska. AltEn owns and operates an ethanol plant in and/or near Mead, Nebraska ("Facility"). An overview of the Facility is hereto attached to this Complaint as **Attachment B**. Another overview showing the location of relevant areas and buildings at the Facility is hereto attached to this Complaint as **Attachment C**.

4. AltEn is considered a "person" for purposes of NEPA. Neb. Rev. Stat. § 81-1502(10).

JURISDICTION AND VENUE

5. The District Court has jurisdiction over the subject-matter of this action, pursuant to Neb. Rev. Stat. § 24-302, and over the parties to this action.

6. Venue is proper pursuant to Neb. Rev. Stat. § 25-403.01, as AltEn's Facility is located in Saunders County and the events at issue took place in Saunders County.

LEGAL BACKGROUND

A. General.

7. The Department administers NEPA, ISWMA, and the rules and regulations implementing those Acts. Neb. Rev. Stat. § 81-1504(1). NEPA also provides the Department with the power to act as the state water, air, and waste pollution control agency for all purposes of the CWA, CAA, and RCRA. *Id.* § 81-1504(4). The Department has authority to, *inter alia*, issue air construction and air operating permits, National Pollutant Discharge Elimination System ("NPDES") permits, permits for solid waste management facilities, and permits for wastewater works, such as lagoons.

***2** 8. Pursuant to its authority under Neb. Rev. Stat. § 81-1505, the Nebraska Environmental Quality Council ("council") promulgated the following relevant rules and regulations:
a. Title 119 of the Nebraska Administrative Code, *NPDES Regulations*;

b. Title 123 of the Nebraska Administrative Code, *Nebraska Department of Environment and Energy Regulations ("Department Regulations")*,

c. Title 129 of the Nebraska Administrative Code, *Nebraska Air Quality Regulations*, and

d. Title 132 of the Nebraska Administrative Code, *ISWMA Regulations*.

9. *A* primary purpose of NEPA is to protect the water, land, and air of the state from pollution. Neb. Rev. Stat. § 81-1501. NEPA achieves this purpose by prohibiting pollution of the State's resources, as well as empowering the Department to administer permit programs and pursue environmental enforcement of violations. *See* Neb. Rev. Stat. § 81-1504.

10. Under NEPA, it is unlawful for any person "[t]o cause pollution of any air, waters, land of the state or to place or cause to be placed any wastes in a location where they are likely to cause pollution of any air, waters, or land of the state." Neb. Rev. Stat. § 1506(1).

11. "Land pollution" means "the presence upon or within the land resources of the state of one or more contaminants or combinations of contaminants, including, but not limited to, refuse, garbage, rubbish, or junk, in such quantities and of such quality as will or are likely to (a) create a nuisance, (b) be harmful, detrimental, or injurious to public health, safety, or welfare, (c) be injurious to plant and animal life and property, or (d) be detrimental to the economic and social development, the scenic beauty, or the enjoyment of the natural attractions of the state." Neb. Rev. Stat. § 81-1502(19).

12. "Water pollution" means "the manmade or man-induced alteration of the chemical, physical, biological, or radiological integrity of water." Neb. Rev. Stat. § 81-1502(20).

13. NEPA makes it unlawful "[t]o violate ... any permit or license condition or limitation, any order of the director, or any monitoring, reporting, or record-keeping requirements contained in or issued or entered into pursuant to [[NEPA], [ISWMA] ... or the rules and regulations adopted and promulgated pursuant to such acts." Neb. Rev. Stat. § 81-1508.02(1)(b); *see also* Neb. Rev. Stat. § 81-1506(4)(b) (making it unlawful to violate "any term or condition of an air pollution permit or any emission limit set in the permit").

14. NEPA also makes it unlawful "[t]o violate any other provision of or fail to perform any other duty imposed by [NEPA, ISWMA], rules, or regulations." Neb. Rev. Stat. § 81-1508.02(1)(e); *see also* Neb. Rev. Stat. § 81-1506(3)(c) (making it unlawful to violate "any rule or regulation adopted and promulgated by the council pursuant to [NEPA] or [ISWMA]").

B. Solid Waste.

***3** 15. NEPA and ISWMA work in tandem to ensure solid wastes that represent potential hazards to the environment and public health and welfare are disposed of properly. *See* Neb. Rev. Stat. §§ 13-2002 & 81-1504.

16. Under NEPA, it is "unlawful for any person to ... [c]onstruct or operate a solid waste management facility without first obtaining a permit required under [NEPA] or under [ISWMA] and the rules and regulations adopted and promulgated by the council pursuant to the acts." Neb. Rev. Stat. § 81-1506(3)(a); *see also* 132 Neb. Admin. Code § 2-001. It is also "unlawful for any person to ... [a]fter October 1, 1993, dispose of any solid waste at any location other than a solid waste management facility holding a current permit issued by the [Department] pursuant to [ISWMA]." Neb. Rev. Stat. § 81-1506(3)(d).

17. A "solid waste management facility" is defined as "any site owned or operated or utilized by any person for the collection, source separation, storage, transportation, transfer, processing, treatment, or disposal of solid waste and shall include a solid waste landfill." Neb. Rev. Stat. § 13-2010.

18. "Wastes" mean "sewage, industrial waste, and all other liquid, gaseous, solid, radioactive, or other substances which may pollute or tend to pollute any air, land, or waters of the state." Neb. Rev. Stat. § 81-1502(14).

19. "Solid waste" means "any garbage, refuse, or sludge ... and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, and mining operations and from community activities." Neb. Rev. Stat. § 81-1502(26).

C. Water.

General

20. In addition to NEPA's general prohibition on causing pollution of any waters of the state, it is also unlawful to "[d]ischarge any pollutant into waters of the state without obtaining a permit as required by the [NPDES] created by the [CWA] ... and by rules and regulations adopted and promulgated pursuant to section 81-1505." Neb. Rev. Stat. § 81-1506(2)(a); *see also* 119 Neb. Admin. Code § 2-001.

21. "Waters of the state" mean "all waters within the jurisdiction of this state, including all streams, lakes, ponds, impounding reservoirs, marshes, wetlands, watercourses, waterways, wells, springs, irrigation systems, drainage systems, and all other bodies or accumulations of water, surface or underground, natural or artificial, public or private, situated wholly or partially within or bordering upon the state." Neb. Rev. Stat. § 81-1502(21).

22. The Department has authority to issue and enforce NPDES permits, which are required for, *inter alia*, discharges of storm water and discharges of wastewater from industrial activities. *See* 119 Neb. Admin. Code §§ 2-002, 6-002, 8-001, 10-002 & 10-003. NPDES permits can either be general or individual permits.

***4** 23. It is unlawful to violate any NPDES permit condition or limitation. Neb. Rev. Stat. § 81-1508.02(l)(b).

Storm Water Discharges

24. Under Title 11*9-NPDES Regulations*, "[n]o person shall discharge storm water containing any pollutant except as authorized by a NPDES permit." 119 Neb. Admin. Code § 10-002.01.

25. The Department has authority to issue and enforce individual and general NPDES storm water permits for construction activities and industrial activities. *See, e.g.*, Neb. Rev. Stat. §§ 81-1504(11), 81-1505(11) & 81-1505(20); 119 Neb. Admin. Code §§ 10-003.01 & 10-005.

26. “Storm water” means “storm water runoff, snow melt runoff, and surface runoff and drainage.” 119 Neb. Admin. Code § 1-112.

27. “Storm water discharge associated with industrial activity” means “the discharge from any conveyance that is used for collecting and conveying storm water and that is directly related to manufacturing, processing or raw materials storage areas at an industrial facility.” 119 Neb. Admin. Code § 1-113.

28. “‘Storm water discharge associated with small construction activity” means “the discharge of storm water from ... [c]onstruction activities including clearing, grading, and excavating that result in land disturbance of equal to or greater than one acre and less than five acres.” 119 Neb. Admin. Code §§ 1-114 & 1-114.01.

29. Generally, NPDES storm water permits require the permittee to prepare and implement a Storm Water Pollution Prevention Plan (“SWPPP”) that identifies potential pollutant sources, minimizes erosion on disturbed areas and discharges of sediment and other pollutants in storm water runoff, describes controls to be used to reduce pollutants in storm water discharges, and assures compliance with permit conditions. *See, generally* 40 C.F.R. § 122.44. Best management practices (“BMPs”) and pollution control measures used to minimize or prevent prohibited discharges of non-storm water or storm water mixed with pollutants must be implemented and maintained. *Id.* SWPPPs must be updated as necessary.

30. “BMPs” mean “schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the State.... BMPs also include treatment requirements, operating and maintenance procedures, schedules of activities, prohibitions of activities, and other management practices to control plant site runoff, spillage, leaks, sludge or waste disposal or drainage from raw material storage.” 119 Neb. Admin. Code § 1-016.

Wastewater Discharges and Land Application

31. The Department has authority to issue and enforce individual and general NPDES permits for discharge of wastewater and/or land application of wastewater effluent.

32. Generally, NPDES permits for discharge of wastewater and/or land application of wastewater have discharge limitations and monitoring requirements, require BMPs for land application of wastewater effluent, and have other requirements and conditions.

***5** 33. Under Title 119-*NPDES Regulations*, “[t]he discharge of any pollutant not identified and authorized by the NPDES permit or the discharge of any pollutant more frequently than or at a level in excess of that identified and authorized by the permit shall constitute a violation of the terms and conditions of the permit.” 119 Neb. Admin. Code § 14-003.

34. “Discharge” means “accidental or intentional spilling, leaking, pumping, pouring, emitting, emptying, or dumping of pollutants into any waters of the State or in a place which will likely reach waters of the state.” 119 Neb. Admin. Code § 1-038.

35. “Pollutant” means, *inter alia*, “solid waste ... and industrial, municipal, and agricultural waste discharged into water.” 119 Neb. Admin. Code § 1-087.

36. “Discharge of a pollutant” means “any addition of any pollutant or combination of pollutants to waters of the state from any point source. This includes discharge into waters of the state from surface runoff which is collected or channeled by man; discharges through pipes, sewers, or other conveyances owned by a state, municipality or other party which do not lead to treatment systems ....” 119 Neb. Admin. Code § 1-040.

37. “Effluent” means “wastewater ... discharging from a wastewater treatment works and/or cooling equipment, a boiler, or any manmade device that discharges or has the potential to discharge.” 119 Neb. Admin. Code § 1-041.

38. “Land Application” means “the controlled application of effluent onto the land surface to achieve a designed degree of treatment through natural physical, chemical and biological processes within the plant-soil-water matrix.” 119 Neb. Admin. Code § 1-058.

Operation and Maintenance of Lagoon Systems

39. In some cases, NPDES permits include the use of a lagoon system for treatment and storage of wastewater. For example, a “control discharge lagoon” is “a discharging wastewater lagoon system operated to store wastewater for extended periods and to periodically discharge treated effluent in accordance with permits.” 123 Neb. Admin. Code § 1-010. These lagoons have liners, meaning “the compacted soil or other material used to seal the bottom or sides of a wastewater lagoon ... so that the seepage rate of liquids from the treatment unit into the surrounding soil is controlled.” 123 Neb. Admin. Code § 1-026.

40. The construction, installation, modification, and alteration of lagoon systems require a construction permit authorized by the Department. 123 Neb. Admin. Code § 3-001.

41. Title 123-*Department Regulations* require liners of wastewater lagoons to be properly operated and maintained. *See* 123 Neb. Admin. Code § 11-001; *see also* 119 Neb. Admin. Code § 14-001.05. Proper operation and maintenance include promptly repairing damage caused by animals or vegetation and maintaining liners, so seepage does not exceed the rate approved by the Department. 123 Neb. Admin Code §§ 11-008.05 & 11-008.06. Wastewater lagoons must also “be operated so the water level is not maintained in the area designated for freeboard.” 123 Neb. Admin. Code § 11-008.07.

***6** 42. Lagoon systems used to store and treat wastewater must also be ““operated in a manner to meet all NPDES permit requirements and not result in a prohibited bypass or an unauthorized discharge.” 123 Neb. Admin. § 11-001.

43. Under NEPA, it is unlawful for any person to “violate any ... rules, or regulations,” including the rules and regulations in Title 119 and Title 123. Neb. Rev. Stat. § 81-1508.02(1)(e).

D. Air.

44. Under NEPA, it is unlawful to “[v]iolate any term or condition of an air pollution permit or any emission limit set in the permit; or ... [v]iolate any emission limit or air quality standard established by the council.” Neb. Rev. Stat. §§ 81-1506(4)(b) & (c); *see also* 129 Neb. Admin. Code § 8-007.01.

45. Generally, owners or operators of stationary sources must apply for air construction permits and air operating permits. *See* 129 Neb. Admin. Code § 5-001 *et seq.* & 129 Neb. Admin. Code § 17-001 *et seq.* A “stationary source” is “any building, structure, facility, or installation which emits or may emit any air pollutant subject to regulation under [Title 129].” 129 Neb. Admin. Code § 1-154.

46. Applicants for these permits are under a continuing obligation to ““promptly submit ... supplementary facts or corrected information” in a permit application when the applicant becomes aware that relevant facts were not submitted or incorrect information was submitted. *See* 129 Neb. Admin. Code § 17-006.

47. Air construction permits contain general and specific conditions that are standard for stationary sources, as well as specific conditions related to, *inter alia*, emission points and control equipment used by the particular stationary source. For example, standard general conditions include prohibitions on open fires, timeline for commencement of construction, and compliance with Title 129 regulations and other local, state, or federal laws. *See, e.g.*, 129 Neb. Admin. Code § 30-001 *et seq.* (open fires). Standard specific conditions include required notifications regarding operational status and operational changes; recordkeeping; proper installation, operation, and maintenance of emission units and control equipment; performance tests; and maintenance

of a site survey containing stack heights and other information. *See, e.g.*, 129 Neb. Admin. Code §§ 34-001 *et seq.* & 35-001 *et seq.* Specific conditions for emission points and control equipment include emission limitations and testing requirements; reporting and recordkeeping requirements; and pavement of haul roads. *See, e.g.*, 129 Neb. Admin. Code §§ 34-001 *et seq.* & 35-001 *et seq.*

48. Air operating permits contain terms and conditions similar to air construction permits, but generally contain more terms and conditions. *See* 129 Neb. Admin. Code § 8-001 *et seq.*

E. Enforcement.

***7** 49. Under NEPA, the Department, through the Attorney General's Office, is empowered to file an enforcement action seeking civil penalties and/or injunctive relief. *See* Neb. Rev. Stat. §§ 81-1508 & 81-1508.02.

50. When the Director of the Department "has reason to believe any person, firm, or corporation is violating or threatening to violate any provision of the acts, any rule or regulation adopted and promulgated thereunder, or any order of the director, [the director] may petition the district court for an injunction." Neb. Rev. Stat. § 81-1508(2).

51. If the Director has "evidence that the handling, storage, treatment, transportation, or disposal of solid or hazardous waste is presenting an imminent and substantial endangerment to the health of humans or animals or to the environment, the director may petition the district court for an injunction to immediately restrain any person from contributing to the alleged acts, to stop such handling, storage, treatment, transportation, or disposal, and to take such other action as may be necessary." Neb. Rev. Stat. § 81-1508(3).

52. Each violation of NEPA subjects "a person to a civil penalty of no more than ten thousand dollars per day. In the case of a continuing violation, each day shall constitute a separate offense. In assessing the amount of the fine, the court shall consider the degree and extent of the violation, the size of the operation, and any economic benefit derived from noncompliance." Neb. Rev. Stat. § 81-1508.02(2).

FACTUAL BACKGROUND

A. General.

AltEn's Ethanol Manufacturing Process

53. AltEn operates a denatured anhydrous ethanol manufacturing plant that produces approximately 24,000,000 gallons of ethanol annually.

54. AltEn began ethanol manufacturing operations under its ownership on or about January 9, 2015.

55. At the time AltEn submitted an Air Construction Permit Modification Application to the Department on February 14, 2013, AltEn stated "Grain (mainly com) will continue to be the primary raw material and the facility will keep the ability to produce wet distiller's grain and solubles ... for animal feed."

56. Ethanol plants normally use grain, such as field com, as the primary feedstock for ethanol production. Ethanol plants also normally produce byproducts known as thin stillage (process wastewater) and distiller's grain (spent grain from the ethanol process that is yellow or brown in color). The process wastewater generated by a normal ethanol plant using field com may generally be treated and land applied or may be potentially reused. The distiller's grain generated by a normal ethanol plant using field com may be used to feed animals, land applied, or landfilled depending on quality.

57. The Department discovered in 2015 that AltEn was using discarded seed com that had been treated with pesticides as its feedstock rather than normal field com. The Department, however, did not know until 2018 that the byproducts from AltEn's ethanol production could contain measurable residues of pesticides.

***8** 58. Discarded, treated seed com contains pesticides in its seed coating, including but not limited to chemicals known as azoxystrobin, clothianidin, thiabendazole, and thiamethoxam.

59. A pesticide is generally a chemical that destroys insects or other organisms that are harmful to cultivated plants or animals. Pesticides include, but are not limited to, insecticides, herbicides, rodenticides, and fungicides.

60. AltEn generates both thin stillage (process wastewater) and distiller's grain as byproducts. Unlike the byproducts of a normal ethanol plant, AltEn's byproducts from using treated seed com contain concentrations of pesticides, including azoxystrobin, clothianidin, glyphosate, thiabendazole, and thiamethoxam. The concentrations of these pesticides in AltEn's byproducts are elevated relative to the pesticides in the coating of the seed com itself because the pesticides become more concentrated through ethanol production. The Department discovered AltEn's byproducts had elevated concentrations of these pesticides in 2019. Because of the treated seed com, AltEn's process wastewater and distiller's grain are green in color unlike a normal ethanol plant.

61. Since May 2019, AltEn has been prohibited from land applying the distiller's grain as a soil conditioner and cannot otherwise land apply the distiller's grain due to, *inter alia*, elevated concentrations of pesticides present in the distiller's grain.

62. Since September 2019, AltEn has not been allowed to land apply the process wastewater due to the elevated concentrations of pesticides present in the wastewater.

63. Upon information and belief, AltEn is the only ethanol plant in Nebraska that uses treated seed com as an ethanol feedstock and one of two in the nation using treated seed com as an ethanol feedstock.

Layout of AltEn's Facility

64. AltEn's ethanol plant functions similar to a normal ethanol plant in terms of its ethanol manufacturing process although AltEn uses treated seed com as a feedstock and generates byproducts containing measurable residues of pesticides that restrict the use and usefulness of the byproducts.

65. Upon information and belief, AltEn generally hauls the treated seed com from the hoop buildings (Landmarks 11 and 12 on Attachment C) to the grain receiving/unloading area (landmark 9 on Attachment C). From the grain receiving/unloading area, the treated seed com is put into a hopper and used as a feedstock for ethanol production.

66. Upon information and belief, the thin stillage (process wastewater) generated by AltEn is transferred to a three-celled lagoon system, which includes the west cell ("west lagoon"), northeast cell ("northeast lagoon"), and southeast cell ("southeast lagoon"). An overview showing the Facility's lagoon system is hereto attached to this Complaint as **Attachment D**. The process wastewater is pumped by a lift station and transferred by pipe to the west lagoon in the system. *See* Attachment D. The lagoon system is interconnected. The process wastewater has the ability to travel from the west lagoon to the northeast lagoon and from the northeast lagoon to the southeast lagoon. *See* Attachment D.

***9** 67. Upon information and belief, the distiller's grain generated by AltEn is conveyed to a wet distiller's grain ("WDG") loadout (Landmark 14 on Attachment C). An overview showing the WDG loadout at the Facility is hereto attached to this Complaint as **Attachment E**. From the WDG loadout area, AltEn hauls the distiller's grain out and piles it in various locations (Areas marked "WDG" on Attachment C).

68. Upon information and belief, AltEn puts a portion of its distiller's grain through an on-site **biochar** unit (Landmark 5 on Attachment C). The **biochar** unit heats the material to create another byproduct known as **biochar**. **Biochar** is generally a charcoal-like byproduct, which AltEn stores in large totes made of a flexible, woven fabric called super sacks.

69. AltEn has two digesters on site (Landmarks 7 and 8 on Attachment C), an emergency lagoon (Landmark 4 on Attachment C) next to the digesters, a cooling tower (Landmark 6 on Attachment C), and a compost area to the south (Landmark 13 on Attachment C). *See also* Attachment E.

70. Normal ethanol plants generally do not use digesters in the ethanol manufacturing process.

71. AltEn's ethanol manufacturing process is regulated by the Department. The Department regulates AltEn's air emissions through air permits, water discharges through NPDES permits, and the solid waste generated by AltEn as a result of the ethanol manufacturing process.

B. Waste.

72. On October 23, 2018, AltEn applied to the Nebraska Department of Agriculture ("NDA") to register its distiller's grain byproduct as a soil conditioner. AltEn received a label for use of its distiller's grain as a soil conditioner.

73. NDA collected a sample of AltEn's distiller's grain and submitted the sample to a laboratory to be analyzed for pesticide residues on March 29, 2019. The lab analysis report for the sample of distiller's grain was received in April 2019 and showed elevated concentrations of pesticides known as azoxystrobin (2,340 ppb), clothianidin (427,000 ppb), and thiamethoxam (85,100 ppb).

74. Based in part on the lab results, NDA determined the registered soil conditioner was adulterated and issued a Stop-Use and Stop-Sale Order that prohibited the distribution of AltEn's distiller's grain as a soil conditioner on May 17, 2019. As set forth in the Order, NDA found, *inter alia*, that if 20 tons per acre of the distiller's grain were applied, as proposed, then the concentration of clothianidin would be 85 times higher than the maximum annual field load allowed by a typical registered pesticide label. AltEn voluntarily cancelled the registration of its distiller's grain as a soil conditioner on August 14, 2019.

75. On June 26, 2019, the Department informed AltEn it was aware of the Stop-Use and Stop-Sale Order and notified AltEn that the distiller's grain was a solid waste requiring disposal at a permitted solid waste management facility.

76. On July 31, 2019, the Department conducted an investigation at AltEn. Department inspectors observed piles of distiller's grain being stockpiled in areas east and north of the hoop buildings and west of the compost pad. There were approximately 26,000 tons of the distiller's grain onsite at the time.

***10** 77. On September 23, 2019, the Department issued a Notice of Violation ("NOV") to AltEn based on the complaint investigation conducted on July 31, 2019. The NOV informed AltEn it was violating NEPA by disposing of solid waste at a location other than a permitted solid waste management facility and by operating a solid waste management facility on its property without a permit. The Department notified AltEn that the distiller's grain and super sacks of starch are solid waste.

78. The September 23, 2019 NOV prohibited AltEn from stockpiling the distiller's grain onsite and required disposal of the distiller's grain at a permitted solid waste management facility. AltEn was asked to submit a plan outlining disposal of the distiller's grain within 30 days of receipt of the NOV.

79. AltEn responded to the September 23, 2019 NOV on October 25, 2019. In its response, AltEn argued the distiller's grain was not a solid waste and did not provide a plan for disposal of the distiller's grain.

80. On January 30, 2020, the Department responded to AltEn's October 25, 2019 letter. The Department responded that AltEn" s activities of piling significant quantities of distiller's grain on site for long periods of time without protection from the elements supports the Department's detennination that the distiller's grain is a solid waste.

81. The Department also determined:
AltEn must immediately comply with the requirements of the September 23, 2019 NOV. Furthermore, AltEn must provide a detailed plan for disposing of all solid waste, including [the distiller's grain], **within 15 days of receipt of this letter**. Disposal of waste materials must begin no later than March 1, 2020, and all material must be removed from the site no later than March 1, 2021.

(Emphasis in original).

82. AltEn again argued in a February 18, 2020 letter that the distiller's grain was not a solid waste and again did not provide a plan for disposal of the distiller's grain at a permitted solid waste management facility.

83. On May 21, 2020, the Department conducted a complaint investigation. During the investigation, Department inspectors observed distiller's grain was still stockpiled west of the compost pads, north of the office building, and east of the hoop buildings. Department inspectors also observed distiller's grain was now being stockpiled in the northeast comer of the Facility. AltEn indicated about 4,000 tons of distiller's grain was piled in the northeast comer.

84. On September 14, 2020, the Department conducted another site visit at AltEn. Department inspectors observed distiller's grain was still being stockpiled east of the hoop buildings, the northeast comer of the property, and west of the compost pads. AltEn was also now stockpiling distiller's grain north of the hoop buildings, on all three compost pads, and in areas adjacent to cattle pens.

85. Although Department inspectors observed some distiller's grain had been removed from areas west of the compost pads and by the hoop buildings, a significant amount of distiller's grain was still stockpiled onsite. An AltEn representative stated the removed distiller's grain was taken to a landfill.

***11** 86. On November 17, 2020, the Department received a letter from EPA in response to its inquiry about distiller's grain that "contains very high levels of pesticide residues." Based on NDA's April 2019 lab results and an estimated application rate of 15 to 20 tons per acre, EPA concluded "that it is likely that land application of the [distiller's grain] material will result in application of these [pesticides] to farm lands at rates that far exceed the registered application rates for which EPA has conducted safety assessments for products containing these pesticides." EPA could not "conclude that land application of the [distiller's grain] [would] not result in unreasonable adverse effects on humans or the environment."

87. On February 1, 2021, the Department conducted a site visit at AltEn. Department inspectors observed AltEn continued to stockpile distiller's grain onsite north of the hoop buildings, east of the hoop buildings, and in the northeast comer. *See* Attachment C (areas marked as WDG). These areas covered approximately 14 acres, 12, acres, and 4 acres, respectively. An AltEn representative estimated there were 60,000 cubic yards of distiller's grain on site, which is approximately 84,000 tons of material.

88. Upon information and belief, AltEn has not disposed of the distiller's grain stockpiled at its Facility by taking it to a permitted solid waste management facility.

89. Upon information and belief, there is over 84,000 tons of distiller's grain stockpiled onsite at AltEn.

C. Water.

90. At all times material herein, AltEn held three NPDES permits:
a. Authorization NER910444 to Discharge under the NPDES General NPDES Permit Number NER910000 for Storm Water Discharges from Industrial Activity to Waters of the State of Nebraska, which was issued on April 20, 2017 ("ISW Permit NER910000");

b. Authorization to Discharge under the NPDES Individual Permit Number NE0137634, which was issued on June 21, 2017 and modified on October 28, 2020 ("NPDES Permit NE0137634"); and

c. Authorization CSW-201802742 to Discharge under the NPDES General Permit Number NER160000 for Storm Water Discharges from Construction Sites to Waters of the State of Nebraska, which was issued on May 30, 2018 ("CSW Permit NER160000"). Authorization CSW-201802742 was terminated in October 2018 when construction of the west lagoon was complete.

91. AltEn continues to hold ISW Permit NER910000 and NPDES Permit NE0137634.

92. These NPDES permits cover storm water discharges and discharges of wastewater. *See* Attachment D (showing wastewater lagoons). An overview showing storm water outfalls and the storm water flowline at the Facility is hereto attached to this Complaint as **Attachment F**.

93. On July 3, 2018, the Department conducted a complaint investigation to examine possible storm water discharges from distiller's grain stockpiled onsite at AltEn. At the time, AltEn held both CSW Permit NER160000 and ISW Permit NER910000 so the Department inspectors requested AltEn to provide SWPPPs for both storm water permits but AltEn was unable to provide either SWPPP upon request. Department inspectors further observed there was no sign or notice posted onsite indicating AltEn was authorized under CSW Permit NER160000 for construction of the west lagoon or that AltEn had a SWPPP.

***12** 94. Department inspectors also observed AltEn was not using or maintaining BMPs to eliminate track out or minimize sediment discharges from the construction site of the west lagoon. AltEn also had not implemented BMPs for disturbed slopes or installed any silt fences, waddles, or other temporary control measures to minimize discharges from the construction site for the west lagoon. Away from the construction site, Department inspectors observed the berm used to control runoff from the distiller's grain piles by the **biochar** unit had breached and was discharging runoff onto a neighboring property. There were no BMPs or secondary controls in place to prevent runoff in the event the berm breached. The breached berm was reestablished by AltEn on July 3, 2018.

95. On July 23, 2018, the Department issued an NOV to AltEn. The NOV notified AltEn of its failure to meet the terms and conditions of CSW Permit NER 160000 by not using and maintaining BMPs, by not providing the SWPPP when requested, and failing to post that AltEn had authorization under CSW Permit NER 160000. The Department also notified AltEn of its failure to meet the terms and conditions of its ISW Permit NER910000 by not using or maintaining BMPs and by not immediately providing the SWPPP when requested.

96. On April 8, 2019, the Department had a contracted third-party conduct sampling at AltEn. Samples of the wastewater in the west lagoon, as well as the distiller's grain onsite were collected. While onsite, Department inspectors observed the west lagoon had a floating liner known as a "whale," animal burrows had damaged the liner, and the liner was also tom and damaged in another spot.

97. On April 24, 2019, the Department issued an NOV to AltEn. The NOV notified AltEn of its failure to comply with lagoon operation and maintenance regulations, because the west lagoon was damaged and there was evidence of animal burrows. The Department required AltEn to fix the damage to the west lagoon liner, including the tear, the "whale", and the animal burrows.

AltEn repaired the animal burrow damage to the west lagoon on or about April 30, 2019, and the liner tear on or about May 15, 2019.

98. The Department and AltEn also entered into a Consent Order on April 24, 2019. A true and accurate copy of the April 24, 2019 Consent Order is hereto attached to this Complaint as **Attachment G**. The Consent Order required AltEn to:
a. Submit the land application site requirements and set-back information required by NPDES Permit NE0137634 within fifteen days of the signing of the Consent Order.

b. Submit an independent engineering evaluation for the repair of the northeast and southeast lagoon liners and the emergency lagoon liner that also includes an additional review by another independent engineering firm within 60 days of the signing of the Consent Order. Vegetation must be removed, animal burrows repaired, and lagoons must not be operating in the area designed for freeboard.

***13** c. Enter into a binding contract to begin implementation of the repair plan for the southeast lagoon and the emergency lagoon within 30 days of receiving approval of the repair plan.

d. Determine whether to repair the northeast lagoon and/or whether to use another method of water treatment or storage within 30 days after receiving approval of the repair plan for the northeast lagoon.

e. Submit a ground water monitoring plan of the Facility including the lagoons to the Department for review and approval within 60 days of the consent order. The ground water monitoring plan must include, at a minimum, the identification and installation of four monitoring wells, identification of all constituents to be monitored, and quarterly monitoring.

f. Fully implement the repairs to the southeast lagoon and the emergency lagoon and the ground water monitoring plan by October 1,2019.

g. Determine the completion date for the repairs of the northeast lagoon or the use of water treatment or storage at the time a final decision and plan is accepted by the Department.

See Attachment G at 5-6.

99. AltEn consented to complete requirements (A) through (G) within the timeframes specified by signing the Consent Order on April 24, 2019. None of the timeframes in the Consent Order were amended by the parties.

100. On April 29, 2019, the Department received the lab results from the samples collected on April 8, 2019. The west lagoon sample showed elevated concentrations of pesticides: azoxystrobin (99.3 ppb); clothianidin (58,400 ppb); glyphosate (124 ppb); thiabendazole (8,450 ppb); and thiamethoxam (35,400 ppb). The distiller's grain sample also showed elevated concentrations of pesticides: azoxystrobin (1,430 ppb); clothianidin (112,000 ppb); thiabendazole (55,600 ppb); and thiamethoxam (30,500 ppb). The Department provided these results to AltEn on May 2, 2019.

101. On May 9, 2019, AltEn provided a BMP plan for application of lagoon wastewater, but the BMP did not address any pesticides and did not include lab results analyzing the presence of pesticides in the wastewater.

102. AltEn provided a response to the Consent Order on June 21, 2019. The response included a bid proposal for the repairs of the northeast and southeast lagoons from an engineering firm, but it was not an engineering evaluation and did not contain an additional review by another engineering firm. AltEn also provided a groundwater monitoring plan, but the plan proposed installing three monitoring wells, instead of the four monitoring wells required by the Consent Order. AltEn further notified

the Department the repairs to the emergency lagoon were complete, vegetation causing damage was removed, animal burrows were repaired, and the lagoons were no longer operating in the areas designed for freeboard.

103. On July 31, 2019, the Department conducted an inspection. In regard to storm water, Department inspectors observed there was a pool of water that was not contained where distiller's grain was piled south of the west lagoon. There were tom and leaking bags of starch that were exposed to the elements and the starch that had spilled from the tom and leaking bags was mixing with storm water and discharging into a storm water conveyance. Department inspectors observed condensate was discharging from the top of the building to the ground. On the ground, the condensate was encountering treated seed com that had been spilled on the ground by the grain receiving/unloading area. After running over the spilled treated seed com, the condensate flowed to a drainage area. Department inspectors also observed track out of distiller's grain on the haul road going to and from the WDG loadout area. Department inspectors observed another discharge, this time from the cooling tower that joined other discharges flowing south. The discharge from the cooling tower was forming a filamentous bacteria growth and hypochlorite odor. An AltEn representative stated the cooling tower had been leaking since June 2019. Both of these discharges appeared to have been ongoing. Department inspectors observed that no berms or other storm water controls existed along the haul road or east of the hoop buildings where distiller's grain was piled. Department inspectors also learned AltEn was sampling from a location over a mile away instead of a closer location that would capture a representative sample of authorized storm water discharges. Department inspectors took a sample of a brown, greenish liquid next to the cooling tower and a sample from outfall 001 for benchmark sampling under ISW Permit NER910000.

***14** 104. In regard to the lagoon system, Department inspectors observed "“whales” in the liner of the northeast lagoon, a rotary drum separator was being used to jet wastewater into the air in the northeast lagoon, and an air relief vent was damaged and leaking wastewater onto the ground next to it. Department inspectors also observed the levels of the lagoons were lower than previously observed.

105. On August 27, 2019, the Department received lab results from the benchmark sampling conducted on July 31, 2019. The lab results for the sample of the brown, greenish liquid showed 468 mg/L of Chemical Oxygen Demand (“COD”), which exceeded the 120 mg/L quarterly benchmark value for COD in ISW Permit NER910000.

106. On September 6, 2019, the Department conducted a site visit at AltEn to observe liner repair of the southeast lagoon. While onsite, Department inspectors observed the cooling tower had been repaired, the starch bags were consolidated in a central location, and the previously observed spills of starch had been cleaned up.

107. On September 13, 2019, the Department issued an NOV to AltEn. The NOV notified AltEn of its failure to comply with operation and maintenance regulations because the use of a rotary drum separator in the northeast lagoon had not been authorized and the air relief vent by the southeast lagoon was leaking wastewater to the ground next to the air relief vent. The NOV required AltEn to immediately cease using the rotary drum until receiving authorization from the Department and to repair the air relief vent.

108. AltEn was notified of its failure to meet the terms and conditions of its ISW Permit NER910000:
a. Failing to use or maintain BMPs to meet non-numeric technology-based effluent limits in the permit by allowing spilled treated seed com to come into contact with condensate discharge, starch spills that mix with storm water discharges, lack of control of track out of distiller's grain, a leaking hypochlorite tote, and not implementing controls for all distiller's grain storage areas.

b. Failing to adequately maintain or use required monitoring practices by not monitoring at a point where discharges to waters of the State are representative, exceeding the COD benchmark in the permit, and the SWPPP does not address distiller's grain containing pesticides as a pollutant.

109. The September 13, 2019 NOV also notified AltEn that the discharges from the cooling tower were mixing with other industrial materials and storm water discharges, which is not allowed under ISW Permit NER910000. The discharges from the cooling tower were also a violation of NPDES Permit NE0137634. The NOV stated AltEn's May 2019 BMP plan failed to address the short-term and long-term surface water and ground water contamination from lagoon wastewater containing pesticides.

110. Further, the September 13, 2019 NOV required AltEn to:
Immediately, cease land application of lagoon wastewater. **Within 30 days of the date of this notification**, submit a BMP for the land application of wastewater that includes sampling and analysis for Azoxystrobin, Clothianidin, Glyphosate, Thiabendazole, and Thiamethoxam. The BMP must include how the agronomic rate for each of these compounds will be met to protect ground and surface water contamination. This request does not preclude you from the requirements of NPDES Permit NE0137634. In addition to lowering the lagoon liquid levels for the purpose of maintenance and repair, solids removal from the lagoons may be required. Lagoon solids may contain pesticides or other pollutants. Prior to removal and disposal, the solids must be analyzed for the above pesticides and Toxicity Characteristic Leaching Procedure (TCLP); and the results must be reported to [the Department], [The Department] must provide prior approval of the disposal method.

***15** (Emphasis in original).

111. AltEn's registered agent received the September 13, 2019 NOV on September 19, 2019.

112. On September 30, 2019, the Department conducted a site visit at AltEn. During the site visit, the Department inspectors observed the southeast lagoon had been repaired, which was required by the Consent Order. Department inspectors also observed a storm water berm was installed to the south of the west lagoon, the rotary drum was not in use, and the air relief vent was repaired. Department inspectors further observed the west and northeast lagoons were operating near the area designed for freeboard, the west lagoon now had three whales, and no groundwater monitoring wells were installed.

113. Department inspectors also noted the area where the starch bags were stored did not have storm water controls implemented and there was track out where distiller's grain was stored.

114. On October 18, 2019, AltEn provided, *inter alia*, corrective action reports showing the following industrial storm water violations were addressed:
a. Seed com on the ground that could mix with storm water and discharge was cleaned up on July 31, 2019;

b. Leaking starch bags that could mix with storm water and discharge were removed on August 23, 2019 and damaged bags would be disposed of or used in ethanol manufacturing process in the future. A silt fence was also installed on August 23, 2019;

c. Vehicle tracking of wet cake was addressed on July 31, 2019 and would be monitored;

d. The hypochlorite tote that was not contained was moved into the process building and put in a containment area on July 31, 2019;

e. Controls for the wet cake storage areas were implemented, including berms repaired or installed on July 31, 2019, routine observations will be performed, and a wet cake management plan would be addressed; and

f. The leaking cooling tower was repaired on August 23, 2019 and future leaks would be addressed immediately and the pumps would be taken offline if necessary for replacement.

115. On November 12, 2019, the Department conducted sampling of wastewater from AltEn's lagoon system. Composite wastewater samples were taken from the northeast and west lagoons.

116. On December 4, 2019, the Department received lab results for the samples of wastewater taken at AltEn on November 12, 2019. The northeast lagoon sample showed elevated concentrations of pesticides: azoxystrobin (33.9 ppb); clothianidin (7,070 ppb); glyphosate (206 ppb); thiabendazole (2,450 ppb); and thiamethoxam (2,400 ppb). The west lagoon sample showed elevated concentrations of pesticides: azoxystrobin (111 ppb); clothianidin (31,000 ppb); glyphosate (116 ppb); thiabendazole (2,160 ppb); and thiamethoxam (24,000 ppb). These lab results were sent to AltEn on December 16, 2019.

117. On February 18, 2020, the Department conducted a site visit at AltEn. Department inspectors observed runoff discharging from the distiller's grain stockpiled to the north of the hoop buildings to other areas and evidence showing the berm on the east side of the stockpiled distiller's grain had overtopped.

***16** 118. On March 2, 2020, AltEn submitted a Revised Groundwater Monitoring Plan that called for four monitoring wells as required by the Consent Order.

119. The Department received a corrective action report from AltEn on March 5, 2020. The berm on the east side of the distiller's grain stockpiled north of the hoop buildings was repaired on February 20, 2020 and a berm was constructed on the west side of the property to contain relocated distiller's grain on February 20, 2020.

120. On April 2, 2020, the Department approved AltEn's Revised Groundwater Monitoring Plan, which was required by the Consent Order. Under this Plan, four monitoring wells would be drilled, and monitoring would be conducted on a quarterly basis.

121. On May 1, 2020, the Department issued an NOV to AltEn. The NOV notified AltEn that it needs to update its SWPPP because the SWPPP did not adequately cover unpermitted or ineligible discharges of runoff from distiller's grain containing pesticides. The NOV required AltEn to submit corrective action reports and to update its SWPPP.

122. The Department received AltEn's corrective action reports in response to the May 1, 2020 NOV on June 8, 2020. AltEn stated its SWPPP was updated to provide:

Storm water that falls north of the WDG holding berms to the north of the hoop buildings [would] flow along the northern edge of the two northern lagoons, and then south to Outfall 001. Typically, any storm water that falls within the wet cake berms [would] flow south and southeast where it [would] collect in an area north of the tank farm, where it will evaporate. However, if the berm surrounding the WDG storage areas near the northwest comer of the northwest lagoon were to fail, water that may come in contact with WDG in that area could flow east, north of the two northern lagoons, before traveling to Outfall 001.

The corrective action reports indicated the SWPPP was updated to address the distiller's grain storage area has a high potential to impact storm water and changed the language to reflect that a compromised berm “will be repaired as soon as possible” instead of “should be repaired as soon as possible.”

123. In August 2020, the Department began the process of modifying NPDES Permit NE0137634 to add the requirement for AltEn to implement and maintain the Revised Groundwater Monitoring Plan, including completion of monitoring well installation and quarterly monitoring.

124. On August 31, 2020, the Department received another corrective action report from AltEn responding to the May 1,2020 NOV. This corrective action report indicated the SWPPP was updated to document how unpermitted discharges from distiller's grain containing pesticides are being addressed. The updated language further provided: “AltEn understands that any unauthorized discharge of storm water co-mingled with non-storm water is considered a violation of the [ISW] Permit [NER910000].”

***17** 125. On September 11, 2020, the Department conducted a site visit at AltEn. While inspecting the lagoons, Department inspectors observed the levels of the west and northeast lagoons were lower than observed in November 2019, but the levels of the southeast lagoon were higher because wastewater was being transferred into this lagoon from the northeast lagoon. An AltEn representative told Department inspectors AltEn had been land applying lagoon wastewater in 2020 to lower the lagoon levels. The Department had not approved any land application of wastewater since it issued the September 13, 2019 NOV, which prohibited land application of the lagoon wastewater.

126. Department inspectors further observed the west and northeast lagoons still had "whales," which could further damage the liners if not repaired. The liner of the northeast lagoon was also completely tom and the liner of the west lagoon had small tears.

127. In regard to the storm water inspection on September 11, 2020, Department inspectors observed no silt fence was installed around the **biochar** unit although the SWPPP indicated a silt fence should have been installed. Department inspectors observed runoff from distiller's grain was discharging into two separate areas—a ditch leading to Outfall 001 and a conveyance system west of the **biochar** unit. There were no BMPs installed to control runoff from distiller's grain in the staging area. Department inspectors further observed two separate spills of liquid. For the first spill, a green hose attached to a pumping system was releasing thin stillage. For the second spill, there was a pump failure that caused thin stillage to be pumped into a secondary containment area. During the transfer, thin stillage spilled to the ground. Department inspectors also observed unlabeled chemical totes and fuel tanks, unsecured hoses, and tom and spilled super sacks of **biochar**.

128. On September 25, 2020, installation of the four ground water monitoring wells was completed.

129. On October 2, 2020, the Department issued a Letter of Noncompliance ("LNC")[3] to AltEn. The LNC reiterated that AltEn had not addressed continuing violations of the Consent Order or the September 19, 2019 NOV and notified AltEn of new violations based on the September 11, 2020 site visit. The continuing violations outlined in the LNC were:
a. Failing to submit an engineering evaluation of the northeast lagoon that includes an additional review completed by an independent engineering firm within 60 days of the Consent Order;

b. Land applying wastewater from the lagoons despite the prohibition on land application of the wastewater, as set forth in the September 13, 2019 NOV; and

c. Failing to submit a land application BMP for the lagoon wastewater within 30 days of the September 13, 2019 NOV.

130. The new violations were:
a. Failing to comply with operation and maintenance requirements of Title 123 due to the badly damaged liners for the west and northeast lagoons;

***18** b. Failing to use or maintain BMPs to meet non-numeric technology effluent limits in ISW Permit NER910000 because no BMPs were installed to prevent discharges of distiller's grain residue from the staging area, no silt fence was installed around the **biochar** unit, tom and leaking bags were observed, distiller's grain runoff from the **biochar** unit was not addressed, unlabeled totes were observed, two liquid spills and one granular material spill was observed; and

c. Failing to have a BMP plan to prevent short-term and long-term surface water and ground water contamination by lagoon wastewater that contains pesticides.

131. The October 2, 2020 LNC also requested AltEn to immediately submit an independent engineering evaluation of the northeast and west lagoons along with an additional review by another independent engineering firm to the Department for

review, install BMPs to control distiller's grain runoff and update the SWPPP to include this BMP, install a silt fence around the **biochar** unit, and submit corrective action reports. Finally, the October 2, 2020 LNC provided:

Immediately, cease land application of lagoon wastewater. Wastewater should not be land applied per [an NOV] sent by the Department on September 13, 2019. Submit a BMP for the land application of wastewater that includes how the agronomic rate for Azoxystrobin, Clothianidin, Glyphosate, Thiabendazole, and Thiamethoxam will be met to protect ground and surface water contamination. This should be submitted by a certified agronomist. Please submit all land application dates, land application sites, and the amount of wastewater applied at each site. Please also provide the wastewater sampling locations and all lab analysis results for each of the five compounds above. This request does not preclude you from the requirements of NPDES Permit NE0137634. Land application of lagoon wastewater may not occur until the Department has provided written approval as previously set forth in the [NOV] dated September 13, 2019. This approval will be contingent upon the review of the requested information and AltEn's ability to demonstrate that wastewater containing pesticides can be land applied at an agronomic rate, and that doing so will not contaminate ground or surface water.

(Emphasis in original).

132. On October 12, 2020, AltEn conducted sampling of the ground water for monitoring for the quarter ending December 31, 2020.

133. On October 15, 2020, the Department received three corrective action reports from AltEn. One corrective action report addressed the first spill observed by the Department inspectors on September 11, 2020 and provided repairs were made and the spill was cleaned up. The other corrective action reports provided the silt fence around the **biochar** unit was "replaced" on September 16, 2020. The second spill of wastewater observed by the Department inspectors, on September 11, 2020, had been cleaned up by the next day and repairs would be made to the pipe that resulted in the spill. There was no corrective action report for the unlabeled totes and fuel tanks or unsecured hoses.

***19** 134. On October 16, 2020, the Department received a BMP for land application of the lagoon wastewater from AltEn.

135. In regard to the BMP, the Department sent a request for more information to AltEn on October 27, 2020. To help evaluate the BMP, the Department requested:

a. All wastewater sampling lab results for azoxystrobin, clothianidin, glyphosate, thiabendazole, and thiamethoxam from March 1, 2020 through present; and

b. All wastewater sampling information, including type of sample, sampling locations, sampling depths, sampling dates, and who collected the samples, as well as a standard operating procedure for sampling if one exists.

This letter also asked for the information previously requested in the October 2, 2020 LNC because it would expedite review.

136. On October 28, 2020, the Department issued NPDES Permit NE0137634 as modified to address groundwater monitoring.

137. On December 24, 2020, the Department received some of the information requested from AltEn in its October 27, 2020 letter. AltEn provided one page of a lab report for wastewater samples collected on July 31, 2020, which showed elevated concentrations of pesticides: azoxystrobin (44.4 ppb) and thiabendazole (2,410 ppb). Glyphosate was not tested for by the lab. AltEn's response also included a standard operating procedure showing how wastewater was sampled but did not include any of the land application information requested in the October 2, 2020 LNC.

138. By January 1, 2021, the Department had not received a ground water monitoring report from AltEn for the quarter ending on December 31, 2020.

139. On January 11, 2021, the Department emailed AltEn requesting the ground water monitoring report for the quarter ending on December 31, 2020. AltEn responded that it had received the ground water monitoring report from its consultant but had not reviewed the information yet. AltEn finally submitted the ground water monitoring report to the Department on January 19, 2021, which was dated January 4, 2021. The ground water monitoring report also indicated the lab results were received on January 4, 2021.

140. On January 13, 2021, the Department received a letter from EPA in response to its inquiry about land application of lagoon wastewater containing pesticides. Based on the concentrations of pesticides in the Department's November 2019 lab results for AltEn's lagoon wastewater, EPA concluded, *inter alia*, that "applying this wastewater to nearby fields [was] likely to result in application of these compounds to farmlands at rates that far exceed the registered application rates for which EPA has conducted safety assessments for products containing these pesticides." The EPA "could not conclude that discharging this water onto land [would] not result in unreasonable adverse effects on humans or the environment."

141. On February 1, 2021, the Department conducted a site visit at AltEn. Department inspectors observed the levels of each of the lagoons (west, northeast, and southeast) had exceeded maximum operating depths and were operating in the area designed for freeboard. Department inspectors also observed the liner of the northeast lagoon was still badly damaged and had not been repaired. The "whales" in the west lagoon were also still visible.

***20** 142. In regard to storm water, Department inspectors observed multiple piles of distiller's grain had no storm water containment to prevent runoff from mixing with storm water discharges. Department inspectors also noted that although AltEn had installed the silt fence around the **biochar** unit that was missing during the last inspection, AltEn had failed to label the unlabeled chemical totes on site, clean up spilled seed, and there was track out north of the **biochar** unit.

143. On February 3, 2021, the Department notified AltEn that the BMP for land application of lagoon wastewater was not approved.

144. On February 16, 2021, the Department issued an LNC to AltEn. The LNC notified AltEn of its failure to meet the conditions of ISW Permit NER910000 because AltEn had not labeled the unlabeled totes or secured hoses as required in the October 2, 2020 LNC, had not cleaned up the spills of treated seed com, and there were no BMPs to control storm water runoff from distiller's grain stockpiled on the east side of the Facility. The LNC required AltEn to, *inter alia*, immediately label the totes and secure the hoses, implement good housekeeping measures by cleaning up spills, and provide photographs showing the installation of berms to prevent runoff from distiller's grain piled on the east side of the Facility.

D. Air.

145. AltEn was issued Air Construction Permit CP13-010 on February 20, 2014 and was issued revised Air Construction Permit CP14-066 on October 9, 2015. CP14-066 superseded Permit Conditions III.(B) and III.(E) of CP 13-010.

146. AltEn submitted an air operating permit application on January 7, 2016 and was issued an Air Quality Class II Operating Permit OP16S2-001 on May 23, 2019.

147. On January 12, 2015, AltEn notified the Department that actual startup occurred on January 9, 2015. The notification did not contain a report describing or certifying control equipment, as required by 129 Neb. Admin. Code § 18-001.

148. The Department's first compliance inspection of the Facility under AltEn's ownership and operation occurred on May 28, 2015. As a result of this inspection, the Department issued an NOV to AltEn on June 8, 2015 for failing to maintain, and have available, records required by the permit. AltEn proposed corrective actions to address these violations, including that components of the Total Reduced Sulfur ("TRS") Continuous Emissions Monitoring System ("CEMS") would be replaced and

the unit would be operational on July 31, 2015. CP14-066 requires AltEn to install a TRS CEMS for its anaerobic digestion system.

149. AltEn was required to conduct a performance test of the digester flare by July 8, 2015, as required by CP 14-066. The Department had not receive any information that a performance stack test was performed or was completed.

150. On July 19, 2018, the Department conducted a compliance inspection of AltEn. During the inspection, Department inspectors observed beer, soda pop, industrial starch, and treated seed com were present at the Facility; and it looked like the items were being used as feedstock for the ethanol manufacturing process, but none of these items had been identified as feedstock in AltEn's permit application for CP 13-010. An AltEn representative stated beer and pop were being used in the ethanol manufacturing process. The Department notified AltEn the use of these items is a change in operations and a performance stack test of the scrubber would need to be conducted by September 30, 2018 and AltEn would need to correct the feedstock information in CP 13-010.

***21** 151. The Department had not received any notifications from AltEn regarding changes to its feedstock.

152. In regard to CEMS units, Department inspectors requested records showing a TRS CEMS and a methane CEMS were operating since May 1, 2017, but AltEn had no records available showing either CEMS was installed or operating. AltEn had not installed a TRS CEMS or a methane CEMS as required by CP 14-066.

153. CP 13-010 required onsite haul roads with production related truck traffic to be paved, but Department inspectors observed all haul roads were not paved and AltEn was not documenting the use of BMPs on the unpaved haul roads. As of the filing of this Complaint, AltEn has not paved all haul roads that have production-related truck traffic.

154. In regard to the fermentation and distillation scrubber, Department inspectors observed the scrubber stack on this unit was emitting water vapor and needed to be repaired. Department inspectors also requested various documents from AltEn, including the operation and maintenance manual; daily observation records for the scrubber; and corrective action and maintenance records for the scrubber. AltEn, however, had not been keeping the operation and maintenance manual or the daily observation records, or the corrective action and maintenance records for the scrubber.

155. Department inspectors also asked for other documents, such as the corrective action and maintenance records for the ethanol loadout system; the site survey showing as-built stack heights; records of emissions calculations; records of equipment failures, malfunctions, and other variations; records showing a flame present at the digester flare; and the drift loss design specification as required by CP 13-010, but AltEn was not keeping these records. AltEn also could not provide the site survey when requested.

156. The Department also observed distiller's grain was being used in the **biochar** unit and there were smoldering piles of **biochar** on the ground near the **biochar** unit. An AltEn representative stated a few of the **biochar** super sacks had started on fire.

157. On July 23, 2018, the Department issued an NOV to AltEn. The NOV notified AltEn of two permit violations:
a. Failure to notify the Department within 15 days of operational changes that may have caused previous testing to not represent current operating conditions or emissions; and

b. Failure to properly operate and maintain the fermentation and distillation scrubber.

158. The NOV required AltEn to conduct a performance stack test before September 30, 2018 and to provide the Department with a 30-day notice prior to testing. The NOV required AltEn to bring the fermentation and distillation scrubber back to proper operation. AltEn had the stack for the fermentation and distillation scrubber repaired on July 20, 2018.

159. On August 13, 2018, the Department issued an additional NOV to AltEn based on the July 13, 2018 site visit and the July 19, 2018 inspection. This NOV listed these relevant violations:

***22** a. Failure to submit relevant facts in the permit application about the feedstock process changes in the fermentation process from com as the primary feedstock, as stated in the permit, to using treated seed com, beer, pop, and industrial starch;

b. Causing or allowing an open fire from smoldering **biochar** product without the Director's written permission;

c. Failure to produce calculations required to be compiled and recorded by the 15th of each month since January 9, 2015 when the Facility started up;

d. Failure to provide the operation and maintenance manual for the fermentation and distillation scrubber;

e. Failure to provide a site survey documenting the as-built stack heights;

f. Failure to provide records of equipment failures, malfunctions, or other violations since Facility startup;

g. Failure to provide daily observations records for the fermentation and distillation scrubber since Facility startup;

h. Failure to provide any corrective action or maintenance records for the fermentation and distillation scrubber and the ethanol loadout system since Facility startup;

i. Failure to submit a report that describes the control equipment and certifies that the control equipment meets regulatory specifications since Facility startup;

j. Failure to conduct a performance test for the digester flare;

k. Failure to monitor and operate the TRS CEMS as shown by the absence of any records showing the TRS CEMS was operational from May 1, 2017 to July 19, 2018;

l. Failure to monitor and operate the methane CEMS as shown by the absence of any records showing the methane CEMS was operational from May 1, 2017 to July 19, 2018;

m. Failure to provide records since Facility startup;

n. Failure to pave all production-related truck traffic and record best management practices used onsite; and

o. Failure to provide the drift loss design specifications.

160. The NOV required AltEn to perform a number of tasks to correct these violations.

161. On September 14, 2018, AltEn provided certifications that it was documenting the use of BMPs on haul roads; it had the operation and maintenance manual for the fermentation and distillation scrubber; it was recording daily observations of the fermentation and distillation scrubber; it was keeping corrective action and maintenance records for the fermentation and distillation scrubber and the ethanol loadout system; it was keeping the site survey; it was keeping emissions records; it was keeping records of equipment failures, malfunctions, and other variations; and it was keeping records of the drift loss design specifications. AltEn also stated it had used only treated seed com the past year and 2,000 gallons of beer and pop were used in 2017.

162. On September 14, 2018, AltEn also finally submitted the report describing and certifying the control equipment meeting the specifications of 40 C.F.R. §§ 60.112b(a)(1) & 60.113b(a)(1), which was required to be submitted with the startup notification.

***23** 163. On October 2, 2018, the Department conducted another inspection. Department inspectors again asked for the site survey and stack heights for the boiler and digester flare, but the stack heights were not available. AltEn has since provided these stack heights. In regard to the flame for the digester flare, an AltEn representative stated AltEn was working on getting a monitoring system to show a flame was present on the digester flare.

164. On July 24, 2019, the Department conducted a site visit of AltEn to observe the initial certification testing of the OEMS unit installed by AltEn, which would allow AltEn to monitor emissions when changing up feedstock instead of needing to conduct more performance stack tests.

165. On March 13, 2020, AltEn submitted an application to modify its permit to limit the feedstock to the anaerobic digesters, to modify the requirements for a OEMS by allowing a methane/ H2S monitor instead, and to remove the requirement to conduct performance testing for the digester flare. AltEn subsequently submitted an amendment to this modification application. This modification request is currently under review by the Department.

166. On January 12, 2021, AltEn submitted an Air Operating Permit Significant Revision application, which is under review by the Department.

E. Recent Events.

167. On February 4, 2021, the Department issued an Emergency Complaint and Order requiring AltEn to, *inter alia*, "[i]mmediately cease discharge of industrial wastewater into its wastewater lagoons" and "not remove industrial wastewater from its wastewater lagoons except in accordance with standards and conditions for disposal of industrial wastewater laced with pesticides." The Director had found:

[E]very additional discharge ... to the lagoons [would] increase the lagoon levels, decrease the freeboard above max available in the lagoons, and take the lagoons further above their maximum operating depths, presenting an imminent and substantial danger to the structure and integrity of the lagoons, an imminent and substantial risk of an unpermitted and uncontrolled release of wastewater, and further damage to public health and the environment.

The Order also requires AltEn to submit a plan detailing a protocol for disposal of the lagoon wastewater by March 10, 2021.

168. On February 10, 2021, the Department confirmed AltEn was shut down and wastewater was no longer discharging into the lagoons.

169. On February 12, 2021, one of AltEn's four-million-gallon digesters began releasing waste materials that went off AltEn's property into a drainage ditch and onto neighboring property approximately 4.5 miles away from AltEn.

170. On February 20, 2021, the Department issued another Emergency Complaint and Order requiring AltEn to, *inter alia*, immediately prevent any further discharge of the waste materials from the digester and to take active steps to clean up the discharge of waste materials from the digester. The Order also prohibits AltEn from resuming operations until the discharged waste materials are sufficiently remediated. The Order also requires AltEn to provide the Department with daily reports regarding removal of the released waste materials.

***24** 171. Both Emergency Orders are still in effect as of the filing of this Complaint.

172. Upon information and belief, AltEn is not currently producing ethanol or generating new distiller's grain or process wastewater.

FIRST CAUSE OF ACTION

DISPOSAL OF SOLID WASTE AT A LOCATION OTHER THAN A SOLID WASTE MANAGEMENT FACILITY HOLDING A PERMIT IN VIOLATION OF NEB. REV. ST AT. § 81-1506(3)(d).

173. Plaintiff hereby realleges and incorporates by reference the allegations contained in Paragraphs 1-172 as though fully set forth herein.

174. Under NEPA, it is "unlawful for any person to ... dispose of any solid waste at any location other than a solid waste management facility holding a current permit issued by the Department pursuant to [ISWMA]." Neb. Rev. Stat. § 81-1506(3)(d).

175. On May 17, 2019, NDA issued a Stop-Use and Stop-Sale Order prohibiting AltEn from distributing the distiller's grain as a soil conditioner for land application. AltEn's distiller's grain is no longer registered as a soil conditioner.

176. AltEn's distiller's grain contains elevated levels of pesticides and cannot be land applied.

177. Since July 31, 2019, the amount of distiller's grain being stored onsite at AltEn has grown substantially. As of July 31, 2019, there was approximately 26,000 tons of distiller's grain onsite and, as of February 1, 2021, there was over 84,000 tons of distiller's grain onsite.

178. AltEn's distiller's grain is a solid waste as defined in Neb. Rev. Stat. § 81-1502(26).

179. Since June 26, 2019, AltEn has known its distiller's grain is a solid waste and must be disposed of at a permitted solid waste management facility. The Department issued an NOV on September 23, 2019 outlining this violation and, on January 30, 2020, the Department told AltEn it had until March 1, 2021 to remove all distiller's grain from onsite and dispose of it at a permitted solid waste management facility.

180. Despite these directives, AltEn has continued to store far more distiller's grain on site than it has taken to a permitted solid waste management facility.

181. By storing tens of thousands of tons of distiller's grain onsite at its Facility, AltEn is disposing of the solid waste at a location other than a permitted solid waste management facility.

182. AltEn does not hold, and has never held, a permit to operate as a solid waste management facility.

183. AltEn has not removed the distiller's grain from its property and continues to store this solid waste onsite at its Facility.

184. AltEn violated, and continues to violate, Neb. Rev. Stat. § 81-1506(3)(d) by disposing of the distiller's grain solid waste on its property instead of at a permitted solid waste management facility. AltEn has been in violation of this statute since at least June 26, 2019 and continues to unlawfully dispose of the distiller's grain solid waste onsite at its Facility.

185. Pursuant to Neb. Rev. Stat. § 81-1508.02(2), AltEn is subject to a civil penalty of not more than $10,000 per day for this violation.

***25** 186. Pursuant to Neb. Rev. Stat. § 81-1508, the foregoing cause of action presents an imminent and substantial endangerment to the health of humans or animals or to the environment and/or AltEn violated and/or threatens to violate NEPA.

This Court should issue an injunction immediately restraining AltEn from storing distiller's grain onsite, order AltEn to remove the distiller's grain stored on its property by disposing of this solid waste at a permitted solid waste management facility, and order such other actions as may be necessary.

SECOND CAUSE OF ACTION

OPERATING A SOLID WASTE MANAGEMENT FACILITY WITHOUT A PERMIT IN VIOLATION OF NEB. REV. STAT. § 81-1506(3)(a) AND 132 NEB. ADMIN. CODE § 2-001.

187. Plaintiff hereby realleges and incorporates by reference the allegations contained in Paragraphs 1 -172 as though fully set forth herein.

188. Under NEPA, it is "unlawful for any person to ... [c]onstruct or operate a solid waste management facility without first obtaining a permit required under [NEPA] or under [ISWMA] and the rules and regulations adopted and promulgated by the council pursuant to the acts." Neb. Rev. Stat. § 81-1506(3)(a); *see also* 132 Neb. Admin. Code § 2-001.

189. AltEn does not hold, and has never held, a permit to operate as a solid waste management facility.

190. Although AltEn is not a permitted solid waste management facility, it has been operating as a solid waste management facility, as defined in Neb. Rev. Stat. § 13-2010, by disposing of distiller's grain onsite at its Facility. The Department notified AltEn of this violation in the September 23, 2019 NOV. On January 30, 2020, the Department told AltEn it had until March 1, 2021 to remove all distiller's grain from onsite and dispose of it a permitted solid waste management facility.

191. AltEn's distiller's grain is a solid waste as defined in Neb. Rev. Stat. § 81-1502(26).

192. Since July 31, 2019, the amount of distiller's grain being stored onsite at AltEn has grown. As of July 31, 2019, there was approximately 26,000 tons of distiller's grain onsite and, as of February 1, 2021, there was over 84,000 tons of distiller's grain onsite.

193. By storing tens of thousands of tons of distiller's grain onsite at its Facility, AltEn is operating as a solid waste management facility without a permit.

194. AltEn has failed to remove the distiller's grain from its property and, instead, continues to operate as an unpermitted solid waste management facility by storing the distiller's grain solid waste at its Facility.

195. AltEn violated, and continues to violate, Neb. Rev. Stat. § 81-1506(3)(a) by operating as an unpermitted solid waste management facility by disposing of the distiller's grain solid waste onsite at its Facility. AltEn has been in violation of this statute since at least July 31, 2019 and continues to unlawfully operate as a solid waste management facility.

***26** 196. Pursuant to Neb. Rev. Stat. § 81-1508.02(2), AltEn is subject to a civil penalty of not more than $10,000 per day for this violation.

197. Pursuant to Neb. Rev. Stat. § 81-1508, the foregoing cause of action presents an imminent and substantial endangerment to the health of humans or animals or to the environment and/or AltEn violated and/or threatens to violate NEPA. This Court should issue an injunction immediately restraining AltEn from operating an unpermitted solid waste management facility, order AltEn to remove all distiller's grain stored on its property by disposing of this solid waste at a permitted solid waste management facility, and order such other actions as may be necessary.

THIRD CAUSE OF ACTION

CAUSING POLLUTION TO WATER AND LAND OF THE STATE IN VIOLATION OF NEB. REV. STAT. § 81-1506(1)(a).

198. Plaintiff hereby realleges and incorporates by reference the allegations contained in Paragraphs 1-172 as though fully set forth herein.

199. Under NEPA, it is "unlawful for any person ... [t]o cause pollution of any air, waters, or land of the state or to place or cause to be placed any wastes in a location where they are likely to cause pollution of any air, waters, or land of the state." Neb. Rev. Stat. § 81-1506(1)(a).

A. Distiller's Grain.

200. AltEn's distiller's grain contains elevated levels of pesticides and cannot be land applied.

201. AltEn's distiller's grain is a "waste," as defined in Neb. Rev. Stat. § 81-1502(14), and is contaminated with elevated concentrations of pesticides.

202. Since July 31, 2019, the amount of distiller's grain being stored onsite at AltEn has grown substantially. As of July 31, 2019, there was approximately 26,000 tons of distiller's grain onsite and, as of February 1, 2021, there was over 84,000 tons of distiller's grain onsite in three separate areas covering approximately 30 acres.

203. Department inspectors have repeatedly observed runoff from the areas where distiller's grain is stored mixing with storm water discharges, including but limited to observations in July 2018, February 2020, and September 2020.

204. The distiller's grain containing elevated concentrations of pesticides is also stored on the land of the state. There is no concrete pad or other liner between the distiller's grain and the ground.

205. AltEn's storage of distiller's grain containing elevated concentrations of pesticides on the ground and discharges of runoff from distiller's grain constitutes "water pollution" and/or "land pollution," as defined in Neb. Rev. Stat. §§ 81-1502(19) & 81-1502(20).

206. By storing tens of thousands of tons of distiller's grain containing elevated concentrations of pesticides onsite, AltEn caused pollution to the waters and/or lands of the state or caused the distiller's grain to be placed in locations where the pesticide-laden distiller's grain or its runoff was likely to cause pollution to the waters and/or lands of the state.

***27** 207. AltEn violated Neb. Rev. Stat. § 81-1506(1)(a) by storing distiller's grain containing elevated concentrations of pesticides in a manner that caused or was likely to cause pollution to waters and/or lands of the state from 2019 to present.

B. Lagoon Wastewater.

208. Based on lab results, the lagoon wastewater contains elevated concentrations of pesticides and is a "waste," as defined in Neb. Rev. Stat. § 81-1502(14), and a "pollutant," as defined in 119 Neb. Admin. Code § 1-087.

209. The Department told AltEn to "**Immediately**, cease land application of lagoon wastewater" in the September 13, 2019 NOV.

210. AltEn does not hold a permit authorizing it to discharge wastewater containing elevated concentrations of pesticides.

211. AltEn had received the September 13, 2019 NOV on September 19, 2019.

212. Although AltEn was prohibited from land applying the lagoon wastewater containing pesticides, the Department observed the lagoon levels were lower on September 11, 2020 than in November 2019.

213. An AltEn representative admitted to the Department, on September 11, 2020, that AltEn had been land applying lagoon wastewater in 2020 to lower the levels of the lagoon system.

214. AltEn did not have approval to land apply the lagoon wastewater containing pesticides in 2020.

215. The lagoons are currently operating in the areas designed for freeboard, which presents danger to the structure and integrity of the lagoons and substantially increases the risk of an unpermitted and uncontrolled release of lagoon wastewater.

216. Upon information and belief, AltEn land applied lagoon wastewater containing elevated concentrations of pesticides at locations that are lands of the state or "waters of the state," as defined in Neb. Rev. Stat. § 81-1502(21).

217. AltEn's land application of lagoon wastewater containing elevated concentrations of pesticides to the lands and/or waters of the state constitutes "water pollution" and/or "land pollution," as defined in Neb. Rev. Stat. §§ 81-1502(19) & 81-1502(20).

218. By land applying the lagoon wastewater containing elevated concentrations of pesticides without Department approval, AltEn caused pollution to the waters and/or lands of the state or caused the pesticide-laden lagoon wastewater to be placed in locations where the lagoon wastewater was likely to cause pollution to the waters and/or lands of the state.

219. AltEn violated Neb. Rev. Stat. § 81-1506(1)(a) by land applying lagoon wastewater containing elevated concentrations of pesticides that caused or was likely to cause pollution to waters and/or lands of the state in 2020.

220. AltEn violated Neb. Rev. Stat. § 81-1506(1)(a) by:
a. Causing pollution by storing distiller's grain or storing distiller's grain in a location likely to cause pollution to land and/or waters of the state from 2019 to present; and

***28** b. Causing pollution by land applying lagoon wastewater or land applying lagoon wastewater in a location likely to cause pollution of the land and/or waters of the state in 2020.

221. Pursuant to Neb. Rev. Stat. § 81-1508.02(2), AltEn is subject to a civil penalty of not more than $ 10,000 per day for each of these violations.

222. Pursuant to Neb. Rev. Stat. § 81-1508, the foregoing cause of action presents an imminent and substantial endangerment to the health of humans or animals or to the environment and/or AltEn violated and/or threatens to violate NEPA. This Court should issue an injunction to:
a. Immediately restrain AltEn from storing distiller's grain in a manner that causes pollution of the land or waters of the state by requiring storm water controls to be implemented, order AltEn to dispose of the distiller's grain at a permitted solid waste management facility, and order such other actions as may be necessary; and

b. Immediately restrain AltEn from operating the lagoon system in such a manner that causes pollution of the land or waters of the state by prohibiting land application or other disposal of the lagoon wastewater until approval by the Department, order AltEn to construct secondary containment around the lagoon system, and order such other actions as may be necessary.

FOURTH CAUSE OF ACTION

DISCHARGE OF A POLLUTANT INTO WATERS OF THE STATE WITHOUT A PERMIT IN VIOLATION OF NEB. REV. STAT. § 81-1506(2)(a).

223. Plaintiff hereby realleges and incorporates by reference the allegations contained in Paragraphs 1-172 as though fully set forth herein.

224. Under NEPA, it is "unlawful for any person to ... [d]ischarge any pollutant into waters of the State without obtaining a permit as required by the [NPDES] created by the [CWA] ... and by rules and regulations adopted and promulgated pursuant to section 81-1505[.]" Neb. Rev. Stat. § 81-1506(2)(a).

225. On June 21, 2017, the Department issued NPDES Permit NE0137634, which was modified on October 28, 2020.

226. Based on lab results, the lagoon wastewater contains elevated concentrations of pesticides and is a "waste," as defined in Neb. Rev. Stat. § 81-1502(14).

227. The lagoon wastewater is a "pollutant," as defined in 119 Neb. Admin. Code § 1-087.

228. NPDES Permit NE0137634 does not authorize land application of the lagoon wastewater that contains pesticides. AltEn has no other permit authorizing discharges of wastewater into waters of the state.

229. The Department told AltEn to **"Immediately**, cease land application of lagoon wastewater" in the September 13, 2019 NOV.

230. AltEn had received the September 13, 2019 NOV on September 19, 2019.

231. Although AltEn was prohibited from land applying the lagoon wastewater containing pesticides, the Department observed the lagoon levels were lower on September 11, 2020 than in November 2019.

***29** 232. An AltEn representative admitted to the Department, on September 11, 2020, that AltEn had been land applying lagoon wastewater in 2020 to lower the levels of the lagoon system.

233. AltEn's land application of lagoon wastewater was a "discharge of a pollutant," as defined in 119 Neb. Admin. Code § 1-040, and from a "point source," as defined in 119 Neb. Admin. Code § 1-086.

234. AltEn's land application sites are located near or adjacent to "waters of the state," as defined in Neb. Rev. Stat. § 81-1502(21).

235. AltEn violated Neb. Rev. Stat. § 81-1506(2)(a) by discharging a pollutant into a water of the state by land applying lagoon wastewater containing pesticides into waters of the state without a permit.

236. Pursuant to Neb. Rev. Stat. § 81-1508.02(2), AltEn is subject to a civil penalty of not more than $10,000 per day for this violation.

237. Pursuant to Neb. Rev. Stat. § 81-1508, the foregoing cause of action presents an imminent and substantial endangerment to the health of humans or animals or to the environment and/or AltEn violated and/or threatens to violate NEPA. This Court should issue an injunction immediately restraining AltEn from any action that would result in a discharge of lagoon wastewater into

waters of the state by prohibiting land application or other disposal of the lagoon wastewater until approval by the Department, and order such other actions as may be necessary.

FIFTH CAUSE OF ACTION

FAILURE TO COMPLY WITH NPDES PERMIT NE0137634 IN VIOLATION OF NEB. REV. STAT. § 81-1508.02(l)(b).

238. Plaintiff hereby realleges and incorporates by reference the allegations contained in Paragraphs 1-172 as though fully set forth herein.

239. Under NEPA, it is "unlawful for any person ... [t]o violate ... any permit or license condition or limitation ... issued ... pursuant to [NEPA] ... or the rules or regulations adopted and promulgated pursuant to such acts." Neb. Rev. Stat. § 81-1508.02(1)(b).

A. Discharge of Pollutant Not Authorized by NPDES Permit NE0137634.

240. 119 Neb. Admin. Code § 14-003 provides: "The discharge of any pollutant not identified and authorized by the NPDES permit ... shall constitute a violation of the terms and conditions of the permit."

241. On June 21, 2017, the Department issued NPDES Permit NE0137634, which was modified on October 28, 2020.

242. NPDES Permit NE0137634 authorized land application of the lagoon wastewater only under certain conditions. Part II.B required AltEn to prepare a BMP plan "for the application of treated effluent" that meets the requirements of the permit. Part II.B.3.a requires: "An assessment of wastewater characteristics to include a determination of the pollutant from the wastewater that requires the greatest land application area so that the wastewater can be applied at an agronomic rate." Part II.B.6 provides: "The BMP Plan shall provide a narrative explanation of the type of controls to be maintained by AltEn, LLC to prevent short-term and long-term surface and ground water contamination."

***30** 243. NPDES Permit NE0137634 does not authorize land application of the lagoon wastewater that contains pesticides, especially with the elevated concentrations of pesticides found in the lab results of the lagoon wastewater from April 2019 and November 2019.

244. The lagoon wastewater is a "pollutant," as defined in 119 Neb. Admin. Code § 1-087.

245. Although AltEn provided a BMP plan for application of its lagoon wastewater on May 9, 2019, the BMP did not address that the lagoon wastewater contained pesticides and did not include lab results showing samples were analyzed for pesticides.

246. In the September 13, 2019 NOV, the Department notified AltEn that the lagoon wastewater contained pesticides and the BMP plan submitted by AltEn did not address pesticides. AltEn was told to stop land applying lagoon wastewater immediately, and to "submit a BMP for land application of wastewater that includes sampling and analysis for Azoxystrobin, Clothianidin, Glyphosate, Thiabendazole, and Thiamethoxam" and "how the agronomic rate for each of these compounds will be met to protect ground and surface water contamination" within 30 days. The Department notified AltEn that prior approval would be necessary before AltEn could land apply the lagoon wastewater.

247. Although AltEn was prohibited from land applying the lagoon wastewater containing pesticides, the Department observed the lagoon levels were lower on September 11, 2020 than in November 2019.

248. AltEn's land application of lagoon wastewater was a "discharge of a pollutant," as defined in 119 Neb. Admin. Code § 1-040, and from a "point source," as defined in 119 Neb. Admin. Code § 1-086.

249. Because AltEn had been land applying lagoon wastewater despite the prohibition contained in the September 13, 2019 NOV, the Department sent the October 2, 2020 LNC telling AltEn, again, to cease land application of the lagoon wastewater. The Department also had not received the BMP plan for land application of wastewater requested under the September 13, 2019 NOV and, again, asked AltEn to submit a BMP plan.

250. AltEn finally submitted a BMP plan for land application of the lagoon wastewater on October 16, 2020.

251. On December 24, 2020, the Department received additional information from AltEn that it had requested on October 27, 2020.

252. The Department did not approve AltEn's BMP plan for land application of wastewater.

253. Because NPDES Permit NE0137634 did not, and does not, authorize land application of lagoon wastewater containing pesticides and AltEn did not have an approved BMP to land apply the lagoon wastewater, AltEn's land application of the lagoon wastewater was not authorized by NPDES Permit NE0137634.

254. AltEn violated the terms and conditions of NPDES Permit NE0137634 by land applying lagoon wastewater without authorization.

B. Failure to Meet Ground Water Monitoring Report Deadline.

***31** 255. NPDES Permit NE0137634, as modified in October 2020, required groundwater monitoring for pesticides to be conducted at AltEn on a quarterly basis. NPDES Permit NE0137634 requires AltEn to "follow the requirements of the [Revised] Ground Water Monitoring Plan received by the Department on March 5, 2020 and approved on April 2, 2020."

256. NPDES Permit NE0137634 required quarterly sampling to start in Fall 2020, which was October 1,2020 to December 31, 2020.

257. The Revised Ground Water Monitoring Plan required AltEn to submit a report, which included field sampling data, lab results, well construction records, and a narrative of site activities from each sampling event to the Department for review within 45 days following the sampling event.

258. AltEn conducted its first quarterly sampling event under NPDES Permit NE0137634 on October 12, 2020. The lab results were sent to AltEn on January 4, 2021 and AltEn received the ground water monitoring report prepared by its consultant on January 4, 2021.

259. The Department did not receive the groundwater monitoring report until January 19, 2021, which was due on or about November 26, 2020, as required by the Revised Ground Water Monitoring Plan.

260. Although AltEn had the ground water monitoring report with the results on January 4, 2021, AltEn waited 15 days to submit the already late ground water monitoring report to the Department.

261. AltEn violated Neb. Rev. Stat. § 81-1508.02(1)(b) by violating the terms and conditions of NPDES Permit NE0137634 by:
a. Land applying lagoon wastewater without an approved BMP in 2020; and

b. Waiting 15 days to provide an already late ground water monitoring report.

262. Pursuant to Neb. Rev. Stat. § 81-1508.02(2), AltEn is subject to a civil penalty of not more than $10,000 per day for each of these violations.

263. Pursuant to Neb. Rev. Stat. § 81-1508, the foregoing cause of action presents an imminent and substantial endangerment to the health of humans or animals or to the environment and/or AltEn violated and/or threatens to violate NEPA. This Court should issue an injunction immediately restraining AltEn from any action that would result in a discharge of lagoon wastewater into waters of the state or other disposal of the lagoon wastewater without authorization from the Department and order such other actions as may be necessary.

SIXTH CAUSE OF ACTION

FAILURE TO COMPLY WITH AN ORDER OF THE DIRECTOR IN VIOLATION OF NEB. REV. STAT. § 81-1508.02(l)(b).

264. Plaintiff hereby realleges and incorporates by reference the allegations contained in Paragraphs 1-172 as though fully set forth herein.

265. Under NEPA, it is "unlawful for any person ... [t]o violate ... any order of the director." Neb. Rev. Stat. § 81-1508.02(1)(b).

267. On April 24, 2019, AltEn entered into a Consent Order with the Department. This Consent Order is an order of the Director of the Department for purposes of NEPA.

***32** 268. The Consent Order required AltEn to:

a. Submit the land application site requirements and set-back information required by NPDES Permit NE0137634 within fifteen days of the signing of the Consent Order.

b. Submit an independent engineering evaluation for the repair of the northeast and southeast lagoon liners and the emergency lagoon liner that also includes an additional review by another independent engineering firm within 60 days of the signing of the Consent Order. Vegetation must be removed, animal burrows repairs, and lagoons must not be operating in the area designed for freeboard.

c. Enter into a binding contract to begin implementation of repair plan for the southeast lagoon and the emergency lagoon within 30 days of receiving approval of the repair plan.

d. Determine whether to repair the northeast lagoon and/or whether to use another method of water treatment or storage within 30 days after receiving approval of the repair plan for the northeast lagoon.

e. Submit a ground water monitoring plan of the facility including the lagoons to the Department for review and approval within 60 days of the consent order. The ground water monitoring plan must include, at a minimum, the identification and installation of four monitoring wells, identification of all constituents to be monitored, and quarterly monitoring.

f. Fully implement the repairs to the southeast lagoon and the emergency lagoon and the ground water monitoring plan by October 1, 2019.

g. Determine the completion date for the repairs of the northeast lagoon or the use of water treatment or storage at the time a final decision and plan is accepted by the Department.

269. AltEn voluntarily agreed to the timelines and requirements of the Consent Order.

270. AltEn completed items (A) and (C) of the Consent Order within the required timeframes, but not (B), (D), (E), (F) or (G).

A. Consent Order Item (B).

271. Item (B) required AltEn to submit an independent engineering evaluation for the repair of the northeast and southeast lagoons and the emergency lagoon, which included an additional review by another independent engineering firm within 60 days of the signing of the Consent Order.

272. AltEn submitted a bid proposal for the repairs of the northeast and southeast lagoons from an engineering firm on June 21, 2019.

273. The bid proposal for the repairs of the northeast and southeast lagoons did not comply with item (B) of the Consent Order because it was not a professional engineering evaluation and did not contain an additional review by another professional engineering firm.

274. Through the date of the filing of this Complaint, AltEn has not submitted a professional engineering evaluation with an additional review by another professional engineering firm for the northeast lagoon, as required by item (B) of the Consent Order.

B. Consent Order Item (D).

275. Item (D) required AltEn to determine whether to repair the northeast lagoon and/or whether to use another method of water treatment or storage within 30 days after receiving approval of the repair plan for the northeast lagoon.

***33** 276. As of the date of the filing of this Complaint, AltEn has not completed item (D) of the Consent Order.

C. Consent Order Items (E) & (F).

277. Item (E) required AltEn to submit a ground water monitoring plan that included four monitoring wells to the Department for review and approval within 60 days of the signing of the Consent Order. Item (F) required AltEn to have an approved ground water monitoring plan implemented by October 1, 2019.

278. AltEn did not submit a revised ground water monitoring plan that called for installation of the required four monitoring wells until March 2, 2020. The Department approved the revised ground water monitoring plan on April 2, 2020.

279. The four ground water monitoring wells were not completed until September 25, 2020 and sampling did not occur until October 12, 2020.

280. AltEn did not complete item (E) until March 2, 2020, despite the June 23, 2019 deadline in the Consent Order.

281. AltEn did not complete item (F)—implementation of the ground water monitoring plan—until October 12, 2020, despite the October 1, 2019 deadline in the Consent Order.

D. Consent Order Item (G).

282. Item (G) required AltEn to determine the completion date for the repairs of the northeast lagoon or the use of water treatment or storage at the time a final decision and plan is accepted by the Department.

283. AltEn still has not completed items (D) and (G) of the Consent Order and has not fully completed item (B) of the Consent Order because the northeast lagoon has not been repaired.

284. AltEn's failure to repair the damaged liner of the northeast lagoon compromises the integrity of the structure and the seepage rate may no longer be controlled.

285. Pursuant to Neb. Rev. Stat. § 81-1508.02(2), AltEn is subject to a civil penalty of not more than $ 10,000 per day for each violation of the Consent Order.

286. AltEn continues to violate Neb. Rev. Stat. § 81-1508.02(1)(b) because the following items of the Consent Order are still not completed:
a. AltEn has not submitted an engineering evaluation with an additional review for the northeast lagoon as required by item (B) from June 23, 2019 to present;

b. AltEn has failed to complete item (D) from June 23, 2019 to present; and

c. AltEn has failed to complete item (G) from June 23, 2019 to present.

287. Pursuant to Neb. Rev. Stat. § 81-1508, the foregoing cause of action presents an imminent and substantial endangerment to the health of humans or animals or to the environment and/or AltEn violated and/or threatens to violate NEPA. This Court should issue an injunction immediately ordering AltEn to complete items (B), (D), and (G) of the Consent Order and such other actions as may be necessary.

SEVENTH CAUSE OF ACTION

FAILURE TO COMPLY WITH TITLE 119 AND TITLE 123 REGULATORY REQUIREMENTS IN VIOLATION OF NEB. REV. STAT. § 81-1508.02(1)(e).

288. Plaintiff hereby realleges and incorporates by reference the allegations contained in Paragraphs 1-172 as though fully set forth herein.

***34** 289. Under NEPA, it is “unlawful for any person ... [t]o violate any other provision of or fail to perform any other duty imposed by such acts, rules, or regulations.” Neb. Rev. Stat. § 81-1508.02(l)(e).

A. Requirement to Fix Animal and Vegetation Damage.

290. 123 Neb. Admin. Code § 11-008.05 provides: “Damage to lagoon dikes and liners caused by muskrats or other rodents, erosion, tree roots, animal hooves, or any other source will be promptly repaired.”

291. On April 8, 2019, Department inspectors observed the existence of animal burrows on the west dike of the west lagoon.

292. The April 24, 2019 NOV required AltEn to repair the damage to the west lagoon.

293. AltEn repaired the damage to the west lagoon caused by animals on April 30, 2019.

294. AltEn violated 123 Neb. Admin. Code § 11-008.05 by failing to promptly repair the damage to the west lagoon caused by animals on or before April 8, 2019 until April 30, 2019.

295. On September 11, 2020, the Department inspectors observed damage to the liner of the northeast lagoon caused by vegetation.

296. The October 2, 2020 LNC required AltEn to repair the badly damaged liner for the northeast lagoon.

297. The Department observed the liner for the northeast lagoon was still badly damaged on February 1, 2021.

298. AltEn has not promptly repaired the badly damaged liner for the northeast lagoon.

299. AltEn's failure to repair the northeast lagoon's badly damaged liner impacts the integrity of the lagoon containing wastewater contaminated with pesticides.

300. AltEn violated 123 Neb. Admin. Code § 11-008.05 by failing to promptly repair the damage to the northeast lagoon caused by vegetation from on or before September 11, 2020 to present.

B. Requirement to Properly Operate and Maintain Lagoon Liners.

301. 123 Neb. Admin. Code § 11-008.06 provides: "The liners of wastewater lagoons will be maintained so that wastewater seepage does not exceed the rate approved by the Department in the construction plans and specifications." 119 Neb. Admin. Code § 14-001.05 provides: "The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit."

302. On April 8, 2019, Department inspectors observed the liner of the west lagoon was tom and damaged.

303. The April 24, 2019 NOV required AltEn to repair the west lagoon's damaged liner.

304. Although AltEn repaired the damaged liner on May 15, 2019, AltEn failed to properly operate and maintain the west lagoon on or before April 8, 2019 until May 15, 2019.

305. AltEn violated 123 Neb. Admin. Code § 11-008.06 and 119 Neb. Admin. Code § 14-001.05 by failing to maintain the west lagoon by not repairing tears to the liner on or before April 8, 2019 until May 15, 2019.

***35** 306. On April 8, 2019, Department inspectors observed one "whale" in the liner of the west lagoon.

307. On July 31, 2019, Department inspectors observed "whales" in the liner of the northeast lagoon.

308. On September 30, 2019, Department inspectors observed additional "whales" in the liner of the west lagoon.

309. On September 11, 2020, Department inspectors observed both the west and northeast lagoons still had "whales" in the liners and both lagoons also had tears in the liners.

310. The October 2, 2020 LNC required AltEn to submit an independent professional engineering evaluation with an additional review done by another firm to repair the northeast and west lagoons. The April 24, 2019 Consent Order already required AltEn to repair the northeast lagoon.

311. AltEn repaired the tears to the liner of the west lagoon discovered in 2019, but has not repaired the tears to liners of the west and northeast lagoons discovered in 2020.

312. Despite AltEn's regulatory obligation to properly operate and maintain its lagoon system, AltEn has not repaired the "whales" in the liners of the northeast and west lagoons and the "whales" continue to worsen in both lagoons.

313. AltEn's failure to repair the "whales" and tears in the liners of the northeast and west lagoons compromises the integrity of the structure and the seepage rate may no longer be controlled.

314. AltEn violated 123 Neb. Admin. Code § 11-008.06 and 119 Neb. Admin. Code § 14-001.05 by failing to maintain the northeast and west lagoons by not repairing liner damage caused by "whales" and tears from at least April 8, 2019 to present.

C. Construction Permit Requirement.

315. 123 Neb. Admin. Code § 3-001 provides: "No person shall construct, install, modify, or make additions to a wastewater works until a construction permit is issued authorizing the project."

316. On July 31, 2019, the Department inspectors observed a rotary drum separator was jetting wastewater into the air in the northeast lagoon.

317. No plans and specifications for installation of the rotary drum separator had been submitted to the Department.

318. No wastewater construction permit was issued authorizing the project.

319. The September 13, 2019 NOV required AltEn to immediately cease use.

320. AltEn ceased use of the rotary drum separator by September 30, 2019 and has not applied for a permit.

321. AltEn violated 123 Neb. Admin. Code § 3-001 by using the rotary drum separator without authorization on or before July 31, 2019 until September 30, 2019.

D. Operation of Wastewater Treatment Facilities.

322. 123 Neb. Admin. Code § 11-001 provides: "Wastewater treatment facilities will be maintained in proper operating condition in accordance with this chapter and operated in a manner to meet all NPDES permit requirements and not result in a prohibited bypass or an unauthorized discharge."

***36** 323. On July 31, 2019, Department inspectors observed an air relief vent was damaged and leaking wastewater to the ground next to the vent. The leaking wastewater from the air relief vent was an unauthorized discharge.

324. The September 13, 2019 NOV required AltEn to repair the air relief vent.

325. On September 30, 2019, Department inspectors observed the air relief vent had been repaired.

326. AltEn violated 123 Neb. Admin. Code § 11-001 by failing to maintain the air relief vent in proper operating condition to prevent it from causing an unauthorized discharge from July 31, 2019 until on or before September 30, 2019.

327. AltEn violated Neb. Rev. Stat. § 81-1508.02(1)(e) by failing to comply with the rules and regulations of the Department regarding operation and maintenance of the lagoon system:

a. Not promptly repairing the damage to the liner of the west lagoon caused by animals on or before April 8, 2019 until April 30, 2019;

b. Not promptly repairing the damage to the liner of the northeast lagoon caused by vegetation on or before September 11, 2020 to present;

c. Failing to maintain the northeast lagoon by repairing liner tears on or before April 8, 2019 until May 15, 2019;

d. Failing to maintain the northeast and west lagoons by repairing liner tears on or before September 11, 2020 to present;

e. Failing to maintain the northeast and west lagoons, which both have " "whales" in the liners, from at least April 8, 2019 to present;

f. Using the rotary drum separator without a permit on or before July 31, 2019 and until September 30, 2019;

g. Failing to properly maintain the air relief vent on or before July 31, 2019 until September 30, 2019.

328. Pursuant to Neb. Rev. Stat. § 81-1508.02(2), AltEn is subject to a civil penalty of not more than $10,000 per day for each of these violations.

329. Pursuant to Neb. Rev. Stat. § 81-1508, the foregoing cause of action presents an imminent and substantial endangerment to the health of humans or animals or to the environment and/or AltEn violated and/or threatens to violate NEPA. This Court should issue an injunction immediately ordering AltEn to repair the "whales" and any other liner damage to the northeast and west lagoons upon approval by the Department and order such other actions as may be necessary.

EIGHTH CAUSE OF ACTION

FAILURE TO COMPLY WITH INDUSTRIAL STORM WATER PERMIT CONDITIONS IN VIOLATION OF NEB. REV. STAT. § 81-1508.02(1)(b).

330. Plaintiff hereby realleges and incorporates by reference the allegations contained in Paragraphs 1-172 as though fully set forth herein.

331. Under NEPA, it is "unlawful for any person ... [t]o violate ... any permit or license condition or limitation." Neb. Rev. Stat. § 81 - 1508.02(1)(b); *see also* 119 Neb. Admin. Code § 14-001.01 ("The permittee must comply with all conditions of the permit.")

***37** 332. AltEn was issued ISW Permit NER910000 on April 20, 2017 regarding industrial activities at the Facility.

A. Requirement to Minimize Exposure.

333. ISW Permit NER910000(2.1.2.1) provides: "You must minimize the exposure of manufacturing, processing, and material storage areas (including loading and unloading, storage, disposal, cleaning, maintenance, and fueling operations) to rain, snow, snowmelt, and runoff by either locating these industrial materials and activities inside or protecting them with storm resistant coverings." Ways to minimize exposure include "grading, berming, or curbing to prevent runoff of contaminated flows and divert run-on away from these areas" and "clean up spills and leaks promptly using dry methods (e.g., absorbents) to prevent the discharge of pollutants."

334. On July 31, 2019, Department inspectors observed there was pooling of water that was not being contained in the south distiller's grain storage area. The Department inspectors also observed there were tom and leaking starch bags exposed to the elements.

335. AltEn removed the tom and leaking starch bags and installed a silt fence to contain runoff from the south distiller's grain storage area on August 23, 2019.

336. Although tom and leaking storage bags were cleaned up, the Department observed the starch bags were still exposed to the elements on September 6, 2019.

337. AltEn violated ISW Permit NER910000 by failing to minimize the exposure of the tom and leaking starch bags to rain and runoff and by failing to contain runoff from the south distiller's grain storage area on or before July 31, 2019 and until August 23, 2019.

338. On September 11, 2020, Department inspectors observed runoff from distiller's grain being stored by the **biochar** unit was discharging into a storm water conveyance west of the **biochar** unit. The SWPPP provided a silt fence was installed, but Department inspectors observed it had not been installed.

339. AltEn installed a silt fence around the **biochar** unit on September 16, 2020.

340. AltEn violated ISW Permit NER910000 by failing to minimize the exposure of the distiller's grain piles to runoff on or before September 11, 2020 and until September 16, 2020.

B. Requirement to Keep Exposed Areas Clean and Materials Orderly and Labeled.

341. ISW Permit NER910000(2.1.2.2) provides: "You must keep clean all exposed areas that are potential sources of pollutants, using such measures as sweeping at regular intervals, keeping materials orderly and labeled, and storing materials in appropriate containers."

342. On July 31, 2019, Department inspectors observed treated seed com was covering the ground east of the grain receiving/ unloading area and was making contact with condensate discharging from the top of the building. Department inspectors observed track out of distiller's grain on the haul road to a distiller's grain storage area. Department inspectors also observed tom and leaking bags of industrial starch and a leaking hypochlorite tote.

***38** 343. Spills of treated seed corn, tom and leaking bags of starch, track out, and a leaking hypochlorite tote were potential sources of pollutants.

344. AltEn cleaned up the spilled seed com and track out on July 31, 2019.

345. AltEn also moved the hypochlorite tote and put it into containment on July 31, 2019.

346. AltEn removed the tom and leaking bags of industrial starch on August 23, 2019.

347. AltEn violated ISW Permit NER910000 by failing to keep clean all exposed areas that are potential sources of pollutants by not sweeping or cleaning up the spilled treated seed com, the tom and leaking starch bags, the leaking tote, and track out of distiller's grain on or before July 31, 2019.

348. On September 11, 2020, Department inspectors observed unlabeled totes, fuel tanks, and multiple, unsecured hoses throughout the Facility.

349. On February 1, 2021, Department inspectors observed there were still unlabeled totes and multiple, unsecured hoses throughout the Facility.

350. Unsecured hoses and unlabeled totes are potential sources of pollutants.

351. Upon information and belief, AltEn has still not labeled the totes or secured the multiple hoses.

352. AltEn violated ISW Permit NER910000 by failing to keep materials orderly and labeled from September 11, 2020 to present.

C. **Requirement to Avoid Releases of Pollutants**.

353. ISW Permit NER910000(2.1.2.3) provides: "You must regularly inspect, test, maintain, and repair all industrial equipment and systems to avoid situations that may result in leaks, spills, and other releases of pollutants into storm water discharged to receiving waters."

354. On July 31, 2019, Department inspectors observed condensate was discharging from the top of the building and encountering treated seed com before discharging to a drainage area. There was also a discharge from the cooling tower's main piping system, which flowed until joining other discharges to the south of the Facility. These discharges appeared to have been ongoing.

355. The top of the building and the cooling tower are industrial equipment and systems under ISW Permit NER910000.

356. The condensate discharging over treated seed com and discharges from the cooling tower are pollutants that mixed with storm water runoff.

357. AltEn did not complete repairs to the cooling tower until August 23, 2019.

358. AltEn violated ISW Permit NER910000 by failing to regularly inspect, maintain, or repair the discharges from the top of the building and the cooling tower that resulted in releases of pollutants into storm water discharges on or before July 31, 2019 and until August 23, 2019.

D. Requirement to Minimize Pollutants in Discharges.

359. ISW Permit NER910000(2.1.2.6) provides: "You must divert, contain, or otherwise reduce storm water runoff, to minimize pollutants in your discharges."

360. On July 31, 2019, Department inspectors observed controls were not implemented in the areas where distiller's grain was piled north of the hoop buildings. There was no berm constructed along the haul road by the west lagoon where distiller's grain is stored north and east of the hoop buildings and there was no visibly constructed berm to prevent runoff from flowing to the southeast.

***39** 361. Distiller's grain contaminated with pesticides is a pollutant.

362. AltEn stated berms were repaired or put into place on July 31, 2019.

363. On February 1, 2021, Department inspectors observed controls were not implemented in the area where distiller's grain was piled on the east edge of the Facility. There were no berms or other controls to contain runoff from the distiller's grain, which is near a waterway that drains AltEn's property.

364. Installing berms in these areas would contain or reduce storm water runoff and reduce runoff from the distiller's grain contaminated with pesticides.

365. AltEn failed to divert, contain, or reduce storm water runoff from the areas where distiller's grain contaminated with pesticides was piled.

366. AltEn violated ISW Permit NER910000 by failing to minimize pollutants into its discharges by implementing controls where distiller's grain is piled from on or before July 31, 2019 to present.

367. On September 11,2020, Department inspectors observed two liquid spills in areas that could discharge through a storm water conveyance. One spill was teal-colored and the other spill was of wastewater. These spills were not being contained or being cleaned up.

368. These two liquid spills were pollutants.

369. AltEn cleaned up these spills by September 12, 2020.

370. AltEn violated ISW Permit NER910000 by failing to minimize pollutants into its discharges because it did not contain or immediately clean up the spills right as required by ISW Permit NER910000.

371. On September 11, 2020, Department inspectors observed no BMPs were installed to control distiller's grain runoff in the staging area and no silt fence was installed around the **biochar** unit although the SWPPP represented that one had been installed.

372. Distiller's grain contaminated with pesticides is a pollutant.

373. AltEn finally installed as silt fence on September 16, 2020.

374. Upon information and belief, AltEn has not installed any BMPs to control distiller's grain runoff in the staging area.

375. AltEn violated ISW Permit NER910000 by failing to minimize pollutants into its discharges because it has not implemented any BMPs to control distiller's grain runoff from on or before September 11, 2020 to present and failed to install silt fence required by its SWPPP on or before September 11, 2020 and until September 16, 2020.

E. Unauthorized Non-Storm Water Discharges.

376. ISW Permit NER910000 (1.1.4.1) provides: "Stormwater discharges that are mixed with non-stormwater, other than those non-stormwater discharges listed in Part 1.1.3, are not eligible for coverage under this permit." ISW Permit NER910000(2.1.2.6) provides: "You must eliminate non-stormwater discharges not authorized by an NPDES permit."

377. On July 31, 2019, Department inspectors observed spilled industrial starch was mixing with storm water and being discharged to a drainage area.

***40** 378. ISW Permit NER910000 prohibits storm water discharges mixed with industrial starch residue.

379. AltEn removed the tom and leaking bags and installed a silt fence to contain runoff on August 23, 2019.

380. AltEn violated ISW Permit NER910000 by failing to eliminate this non-storm water discharge on or before July 31, 2019 and until August 23, 2019.

381. On February 18, 2020, Department inspectors observed runoff was discharging from where distiller's grain was stored and there was evidence that a berm had been overtopped by a discharge.

382. ISW Permit NER910000 prohibits storm water discharges mixed with distillers grain residue, which contains pesticides.

383. AltEn repaired and constructed a berm on February 20, 2020 to address the discharges.

384. AltEn violated ISW Permit NER910000 by failing to eliminate this non-storm water discharge on or before February 18, 2020 and until February 20, 2020.

385. On September 11, 2020, Department inspectors observed distiller's grain residue was mixing with storm water and discharging into storm water conveyances in separate areas.

386. On February 1, 2021, Department inspectors observed controls were not implemented in the areas where distiller's gran was piled on the east edge of the Facility. There were no berms or other controls to contain runoff from the distiller's grain, which is near a waterway that drains AltEn's property.

387. ISW Permit NER910000 prohibits storm water discharges mixed with distiller's grain residue, which contains pesticides.

388. Upon information and belief, AltEn has not implemented BMPs or installed controls to prevent distiller's grain runoff from mixing with storm water and discharging into a storm water conveyance since February 2020.

389. AltEn violated ISW Permit NER910000 by failing to eliminate these non-storm water discharges from on or before September 11, 2020 to present.

F. Maintenance and Repair of Control Measures.

390. ISW Permit NER910000(2.1.2.3) provides:
You must regularly inspect, test, maintain, and repair all industrial equipment and systems to avoid situations that may result in leaks, spills, and other releases of pollutants in stormwater discharged to receiving waters. You must maintain all control measures that are used to achieve the effluent limits required by this permit in effective operating condition. Nonstructural control measures must also be diligently maintained (e.g., spill response supplies available, personnel appropriately trained). If you find that your control measures need to be replaced or repaired, you must make the necessary repairs or modifications as expeditiously as practicable.

391. On July 3, 2018, Department inspectors observed the berm installed to control runoff from the distiller's grain piles by the **biochar** area had breached and runoff was discharging onto a neighboring property. AltEn had no BMPs or secondary controls in place to stop or prevent runoff or discharges caused by a breach of the berm.

***41** 392. The berm installed by the **biochar** area was a control measure.

393. AltEn reestablished the berm on July 3, 2018.

394. AltEn violated ISW Permit NER910000 by failing to maintain the breached berm and failed to make the repairs as expeditiously as practicable on or before July 3, 2018.

G. Sampling of Authorized Discharges.

395. ISW Permit NER910000(6.1.2) provides: "If discharges authorized by this permit commingle with discharges not authorized under this permit, any required sampling of the authorized discharges must be performed at a point before they mix with other waste streams, to the extent practicable."

396. On July 31, 2019, Department inspectors discovered AltEn was sampling from a location over a mile away rather than a point that would capture a representative sample of authorized discharges prior to commingling with unauthorized discharges.

397. AltEn's SWPPP still has not been updated to correct the sampling location so that representative samples are captured.

398. AltEn violated ISW Permit NER910000 by failing to sample from a point before authorized discharges mix with other waste streams from July 31, 2019 to present.

H. Benchmark Monitoring.

399. ISW Permit NER910000(8.C.3) provides the benchmark monitoring concentration for COD is 120 mg/L for quarterly benchmark monitoring.

400. On July 31, 2019, Department inspectors collected a sample of a brown greenish liquid next to the cooling tower, as well as a sample of water from the current outfall 001 for benchmark monitoring to determine concentrations of COD.

401. The benchmark monitoring results for the brown greenish liquid showed a COD of 468 mg/L, which far exceeds the quarterly benchmark value of 120 mg/L.

402. AltEn violated ISW Permit NER910000 by exceeding the benchmark monitoring value for quarterly benchmark monitoring for COD.

I. Requirement to Document Areas and Describe Pollutants.

403. ISW Permit NER910000(5.1.3) requires AltEn to:

[D]ocument areas at [its] facility where industrial materials or activities are exposed to stormwater and from which allowable non-stormwater discharges are released.... For each area identified, the description must include ... [[a] list of the pollutant(s) or pollutant constituents ... associated with each identified activity. The pollutant list must include all significant materials that have been handled, treated, stored, or disposed, and that have been exposed to stormwater in the 3 years prior to the date you prepare or amend your SWPPP.

404. On July 31, 2019, Department inspectors observed track out of distiller's grain and pooling of water where the distiller's grain was piled with no containment.

405. Distiller's grain is an industrial material and a pollutant because it contains pesticides. Distiller's grain is exposed to storm water because it is stored in piles without adequate containment and is tracked out to other areas.

***42** 406. AltEn's SWPPP did not address pesticides from the use of treated seed com present in the distiller's grain as a pollutant.

407. The September 13, 2019 NOV required AltEn to address pesticides in the distiller's grain as pollutants in the SWPPP.

408. The May 1, 2020 NOV again required AltEn to update its SWPPP to address pesticides in the distiller's grain as pollutant.

409. AltEn did not update its SWPPP to account for pesticides in the distiller's grain until August 31, 2020.

410. AltEn violated ISW Permit NER910000 by failing to update its SWPPP from at least July 31, 2019 and until August 31, 2020.

J. SWPPP Availability Requirement.

411. ISW Permit NER910000(5) required AltEn to prepare a SWPPP.

412. ISW Permit NER910000(5.3) provides: "You must retain a copy of the current SWPPP required by this permit at the facility, and it must be immediately available to EPA; [the Department]; and the operator of an MS4 receiving discharges from the site."

413. On July 3, 2018, Department inspectors requested the SWPPP while conducting an investigation. AltEn did not make the SWPPP immediately available when requested by the Department.

414. AltEn violated ISW Permit NER910000 by failing to make its SWPPP immediately available on July 3, 2018.

415. AltEn violated Neb. Rev. Stat. § 81-1508.02(1)(b) by failing to comply with the following terms and conditions of ISW Permit NER910000:
a. Failing to regularly inspect, maintain, or repair or, alternatively, expeditiously repair the breached berm that allowed distiller's grain runoff to discharge onto neighboring property on or before July 3, 2018;

b. Failing to minimize exposure of industrial starch to runoff on or before July 31, 2019 until August 23, 2018;

c. Failing to minimize exposure of distiller's grain to runoff on or before September 11, 2020 until September 16, 2020;

d. Failing to keep clean exposed areas with spilled treated seed com, track out, and leaking tots, which are a potential sources of pollutants on or before July 31, 2019;

e. Failing to label totes and fuel tanks and secure hoses from September 11, 2020 to present;

f. Failing to regularly inspect, maintain, or repair the cooling tower to avoid releases of pollutants into storm water conveyances on or before July 31, 2019 until August 23, 2019;

g. Failing to minimize pollutants into discharges from the distiller's grain piles from on or before July 31,2019 to present;

h. Failing to minimize pollutants into discharges from two liquid spills on September 11, 2020;

i. Failing to minimize pollutants due to the lack of BMPs in the distiller's grain storage area and no silt fence from on or before September 11, 2020 to present;

j. Failing to eliminate non-storm water discharges of industrial starch on or before July 31, 2019 until August 23, 2019;

k. Failing to eliminate non-storm water discharges of distiller's grain runoff on or before February 18, 2020 until February 20, 2020;

***43** l. Failing to eliminate non-storm water discharges of distiller's grain runoff from on or before September 11, 2020 to present;

m. Failing to sample a point before authorized discharges mix with other waste streams on or before July 31, 2019;

n. Exceeding the benchmark monitoring for COD on July 31, 2019; and

o. Failing to update the SWPPP to address pesticides in the distiller's grain as a pollutant on or before July 31, 2020 until August 31, 2020; and

p. Failing to provide the SWPPP when requested by the Department on July 3,2018;

416. Pursuant to Neb. Rev. Stat. § 81-1508.02(2), AltEn is subject to a civil penalty of not more than $10,000 per day for each of these violations.

417. Pursuant to Neb. Rev. Stat. § 81-1508, the foregoing cause of action presents an imminent and substantial endangerment to the health of humans or animals or to the environment and/or AltEn violated and/or threatens to violate NEPA. This Court should issue an injunction immediately restraining AltEn from allowing runoff from distiller's grain contaminated with pesticides from mixing with storm water discharges by ordering AltEn to install, maintain, and repair storm water control measures onsite, as well as secondary containment and order such other actions as may be necessary.

NINTH CAUSE OF ACTION

FAILURE TO COMPLY WITH CONSTRUCTION STORM WATER PERMIT CONDITIONS IN VIOLATION OF NEB. REV. STAT. § 81-1508.02(l)(b).

418. Plaintiff hereby realleges and incorporates by reference the allegations contained in Paragraphs 1-172 as though fully set forth herein.

419. Under NEPA, it is "unlawful for any person ... [t]o violate ... any permit or license condition or limitation." Neb. Rev. Stat. § 81-1508.02(1)(b); *see also* 119 Neb. Admin. Code § 14-001.01 ("The permittee must comply with all conditions of the permit.").

420. AltEn was issued CSW Permit NER160000 on May 30, 2018 for construction of the west lagoon.

421. AltEn notified the Department of termination of its authorization under CSW Permit NER 160000 on October 5, 2018. Construction of the west lagoon was completed.

A. SWPPP Availability and Posting Requirements.

422. CSW Permit NER160000(III)(A) required AltEn to prepare a SWPPP.

423. CSW Permit NER160000(III)(L) provided: "The SWPPP must be made available upon request to federal, state, and local agencies, from the date of commencement of construction activities to the date of final stabilization." In addition, "[a] sign or other notice must be posted conspicuously near the entrance of the construction site" that includes a copy of the Notice of Intent submitted to the Department and a copy of the SWPPP or information detailing how to obtain access to the SWPPP.

424. On July 3, 2018, Department inspectors observed there was no posting of the Notice of Intent or SWPPP at AltEn. AltEn also could not provide the SWPPP when requested by Department inspectors.

***44** 425. AltEn did not provide the SWPPP to the Department until July 24, 2018.

426. AltEn failed to post any sign or notice of the Notice of Intent or SWPPP as required by CSW Permit NER160000.

427. AltEn violated CSW Permit NER 160000 by failing to make its SWPPP available from July 3, 2018 to July 24, 2018 and not having the Notice of Intent or SWPPP posted at the site before July 3, 2018 until October 5, 2018 when the permit was terminated.

B. Failure to Comply with Storm Water Effluent Limitation Guidelines.

428. CSW Permit NER160000(III)(E) requires AltEn to comply with construction storm water effluent limitation guidelines, which require all construction point sources to achieve erosion and sediment controls, including:
a. Minimize the disturbance of steep slopes; and

b. Minimize sediment discharges from the site.

429. On July 3, 2018, Department inspectors observed AltEn was not minimizing sediment discharges from track out or the lagoon construction site or minimizing the disturbance of steep slopes at the construction site.

430. AltEn failed to comply with the effluent limitation guidelines to minimize sediment discharges and disturbance of steep slopes as required by CSW Permit NER160000.

431. AltEn violated CSW Permit NER 160000 by failing to minimize sediment discharges from the site or disturbance of steep slopes before July 3, 2018 and until October 5, 2018 when the permit was terminated.

C. Failure to Maintain control BMPs.

432. CSW Permit NER160000(III)(F) requires AltEn to maintain control BMPs. Control BMPs include: "[m]inimize the disturbance of steep slopes to prevent erosion and implement controls as needed for disturbed slopes" and temporary construction control BMPs, which "must be properly selected, installed, and maintained in accordance with relevant manufacturer specifications, good engineering practices, and applicable federal, state, and local requirements."

433. On July 3, 2018, Department inspectors observed AltEn had not implemented any control BMPs for disturbed slopes and had not installed any temporary control measures for the construction site.

434. AltEn failed to maintain control BMPs as required by CSW Permit NER 160000.

435. AltEn violated CSW Permit NER160000 by failing to implement control BMPs for disturbed slopes and by failing to install temporary control measures before and after July 3, 2018.

436. The July 23, 2018 NOV required AltEn to correct these violations.

437. AltEn violated Neb. Rev. Stat. § 81-1508.02(1)(b) by failing to comply with the following terms and conditions of CSW Permit NER160000:
a. Provide the SWPPP when requested by the Department from July 3, 2018 to July 24, 2018;

b. Post a sign or notice of the Notice of Intent and SWPPP (or access to the SWPPP) on or before July 3, 2018 and until October 5, 2018;

c. Minimize sediment discharges from the construction site on or before July 3, 2018 and until October 5, 2018;

***45** d. Implement controls for disturbed slopes on or before July 3, 2018 and until October 5, 2018; and

e. Install temporary construction controls for the construction site on or before July 3, 2018 and until October 5, 2018.

438. Pursuant to Neb. Rev. Stat. § 81-1508.02(2), AltEn is subject to a civil penalty of not more than $10,000 per day for each of these violations.

TENTH CAUSE OF ACTION

FAILURE TO CONDUCT A PERFORMANCE TEST FOR THE DIGESTER FLARE IN VIOLATION OF NEB. REV. STAT. § 81-1506(4)(b) AND AIR PERMITS

439. Plaintiff hereby realleges and incorporates by reference the allegations contained in Paragraphs 1-172 as though fully set forth herein.

440. Under NEPA, it is "unlawful to ... [v]iolate any term or condition of an air pollution permit or any emission limit set in the permit." Neb. Rev. Stat. § 81-1506(4)(b).

441. AltEn's air permit CP 13-010(II)(D) required it to conduct performance tests "within sixty (60) days after first reaching the maximum capacity, but not more than 180 days after the start-up of operations of each unit, unless otherwise specified by the [Department]."

442. AltEn started up operations on or before January 9, 2015.

443. AltEn's air permit CP 14-066 (III)(E) required performance testing of the digester flare by July 8, 2015.

444. AltEn failed to complete a performance test of the digester flare by July 8, 2015, which is 180 days after Facility start up.

445. AltEn violated Neb. Rev. Stat. § 81-1506(4)(b) by failing to conduct a performance test of the digester flare by July 8, 2015 and still has not conducted a performance test.

446. Pursuant to Neb. Rev. Stat. § 81-1508.02(2), AltEn is subject to a civil penalty of not more than $10,000 per day for this violation.

447. Pursuant to Neb. Rev. Stat. § 81-1508, the foregoing cause of action presents an imminent and substantial endangerment to the health of humans or animals or to the environment and/or AltEn violated and/or threatens to violate NEPA. This Court should issue an injunction ordering AltEn to comply with its air permits.

ELEVENTH CAUSE OF ACTION

FAILURE TO INSTALL AND OPERATE CEMS UNITS FOR THE ANAEROBIC DIGESTION SYSTEM IN VIOLATION OF NEB. REV. STAT. § 81-1506(4)(b) AND AIR PERMIT

448. Plaintiff hereby realleges and incorporates by reference the allegations contained in Paragraphs 1-172 as though fully set forth herein.

449. Under NEPA, it is "unlawful to ... [v]iolate any term or condition of an air pollution permit or any emission limit set in the permit." Neb. Rev. Stat. § 81-1506(4)(b).

A. Failure to Install TRS CEMS Unit.

450. AltEn's air permit CP14-066(III)(E)(3)(f) was issued October 9, 2015 and required AltEn to install and operate a TRS CEMS for its anaerobic digestion and steam generation system that complies with certain requirements unless written approval is obtained from the Department.

***46** 451. To date, AltEn has failed to install and operate a TRS CEMS, as required by CP 14-066.

452. AltEn violated Neb. Rev. Stat. § 81 -1506(4)(b) by failing to monitor and operate a TRS CEMS from October 9, 2015 to present.

B. Failure to Install a Methane CEMS Unit.

453. AltEn's air permit CP14-066(III)(E)(3)(j) was issued October 9, 2015 and required AltEn to install and operate a continuous methane monitor (methane CEMS) for its anaerobic digestion and steam generation that complies with certain requirements unless written approval is obtained from the Department.

454. To date, AltEn has failed to install and operate a methane CEMS, as required by CP 14-066.

455. AltEn violated Neb. Rev. Stat. § 81-1506(4)(b) by failing to monitor and operate a methane CEMS from October 9, 2015 to present.

456. AltEn violated Neb. Rev. Stat. § 81-1506(4)(b) by failing to install the TRS CEMS and the methane CEMS required by its air permit:
a. Failing to install the TRS CEMS from October 9, 2015 to present; and

b. Failing to install the methane CEMS from October 9, 2015 to present.

457. Pursuant to Neb. Rev. Stat. § 81-1508.02(2), AltEn is subject to a civil penalty of not more than $10,000 per day for each of these violations.

458. Pursuant to Neb. Rev. Stat. § 81-1508, the foregoing cause of action presents an imminent and substantial endangerment to the health of humans or animals or to the environment and/or AltEn violated and/or threatens to violate NEPA. This Court should issue an injunction order AltEn to comply with CP 14-066.

TWELFTH CAUSE OF ACTION

FAILURE TO PAVE ALL PRODUCTION-RELATED TRUCK TRAFFIC AREAS AND RECORD BMPS USED ONSITE IN VIOLATION OF NEB. REV. STAT. § 81-1506(4)(b) AND AIR PERMITS

459. Plaintiff hereby realleges and incorporates by reference the allegations contained in Paragraphs 1-172 as though fully set forth herein.

460. Under NEPA, it is "unlawful to ... [v]iolate any term or condition of an air pollution permit or any emission limit set in the permit." Neb. Rev. Stat. § 81-1506(4)(b).

461. AltEn's air permit CP 13-010(III)(F)(1) provides: "All on-site haul roads with production-related truck traffic shall be paved." CP13-010(III)(F)(5) also required AltEn to keep records documenting the use of BMPs on haul roads.

462. AltEn's air permit OP16S2-001 also required all on-site haul roads to be paved.

463. On July 19, 2018, Department inspectors observed production-related haul roads were not paved and AltEn did not have records documenting the use of BMPs on haul roads.

464. AltEn certified it was keeping records documenting the use of BMPs on haul roads on September 14, 2018.

465. AltEn violated Neb. Rev. Stat. § 81-1506(4)(b) by failing to document the use of BMPs until September 14, 2018, as required by its air permit, and by failing to pave all production-related haul roads, as required by its air permit, from at least July 19, 2018 to present.

***47** 466. Pursuant to Neb. Rev. Stat. § 81-1508.02(2), AltEn is subject to a civil penalty of not more than $10,000 per day for this violation.

467. Pursuant to Neb. Rev. Stat. § 81-1508, the foregoing cause of action presents an imminent and substantial endangerment to the health of humans or animals or to the environment and/or AltEn violated and/or threatens to violate NEPA. This Court should issue an injunction ordering AltEn to comply with its air permits.

THIRTEENTH CAUSE OF ACTION

FAILURE TO COMPLY WITH PERMIT CONDITIONS FOR THE FERMENTATION AND DISTILLATION SCRUBBER IN VIOLATION OF NEB. REV. STAT. § 81-1506(4)(b) AND AIR PERMIT

468. Plaintiff hereby realleges and incorporates by reference the allegations contained in Paragraphs 1-172 as though fully set forth herein.

469. Under NEPA, it is "unlawful to ... [v]iolate any term or condition of an air pollution permit or any emission limit set in the permit." Neb. Rev. Stat. § 81-1506(4)(b).

A. Failure to Operate and Maintain the Scrubber.

470. AltEn's air permit CP13-010(II)(C) provides: "All permitted emission units, control equipment, and monitoring equipment shall be properly installed, operated, and maintained."

471. AltEn's fermentation and distillation scrubber falls within the definition of "permitted emissions units, control equipment, and monitoring equipment" under CPI3-010.

472. On July 19, 2018, Department inspectors observed the fermentation and distillation scrubber was not being properly operated and maintained because the scrubber stack was emitting water vapor. When properly operated and maintained, the scrubber stack should not be emitting water vapor as observed.

473. AltEn completed repairs on or about July 20, 2018.

474. AltEn violated Neb. Rev. Stat. § 81-1506(4)(b) by failing to properly operate and maintain the fermentation and distillation scrubber.

B. Failure to Provide the Manual for the Scrubber.

475. AltEn's air permit CP13-010(II)(B)(5) provides:

Records of all measurements, results, inspections, and observations as required to ensure compliance with all applicable requirements shall be maintained on-site as follows ... Operation and Maintenance manuals, or equivalent documentations, detailing proper operation and maintenance of all permitted emission units, required control equipment, and required monitoring equipment shall be keep for the life of the equipment.

476. On July 19, 2018, Department inspectors requested AltEn to provide the operation and maintenance manual for the fermentation and distillation scrubber. AltEn did not have the operation and maintenance manual to provide to the Department.

477. AltEn certified it was now keeping the operation and maintenance manual for the fermentation and distillation scrubber as of September 14, 2018.

478. AltEn violated Neb. Rev. Stat. § 81-1506(4)(b) by failing to provide the operation and maintenance manual for the fermentation and distillation scrubber from at least July 19, 2018 until September 14, 2018.

C. Failure to Provide Daily Observation Records for the Scrubber.

***48** 479. AltEn's air permit CP13-010(III)(B)(3)(b) provides:

Operation and maintenance of the fermentation and distillation scrubber ... shall be in accordance with the following requirements until the issuance of an operating permit to the source ... Observations at least once each day during daylight hours of scrubber operation shall be conducted to determine whether there are leaks, noise, or other indications that corrective action is necessary. If corrective action is necessary, it shall occur immediately.

480. CP13-010(III)(B)(5)(e) requires AltEn to keep records of observations of scrubber operation documenting “date and time of routine observations with a description, including operating parameters, atypical parameters observed, and any corrective actions taken, for each day the scrubber is in operation.”D'

481. On July 19,2018, Department inspectors requested AltEn to provide daily observation records for the fermentation and distillation scrubber since Facility startup on January 9, 2015. AltEn did not have any daily observation records for the fermentation and distillation scrubber.

482. AltEn certified it was now keeping daily observation records for the fermentation and distillation scrubber as of September 14, 2018.

483. AltEn violated Neb. Rev. Stat. § 81-1506(4)(b) by failing to provide daily observation records for the fermentation and distillation scrubber from January 9, 2015 to September 14, 2018.

D. Failure to Provide Records for the Scrubber and Ethanol Loadout System.

484. AltEn's air permit CP13-010(III)(B) provides specific conditions for operation of the fermentation and distillation scrubber, including that "[e]ach corrective action taken shall be documented upon occurrence, including the date, time, observations, and description of corrective action" and "[r]ecords documenting when routine maintenance and preventive actions were performed with a description of the maintenance and/or preventive action performed."

485. AltEn's air permit CP13-010(III)(B) provides specific conditions for operation of the ethanol loadout system, including keeping "[rjecords documenting when routine maintenance and preventive actions were performed on the vapor recovery system and flare with a description of the maintenance and/or preventive action performed."

486. On July 19, 2018, Department inspectors requested AltEn to provide corrective action and/or maintenance records for both the fermentation and distillation scrubber and the ethanol loadout system since Facility startup on January 9, 2015. AltEn did not have any corrective action and/or maintenance records for either the fernentation and distillation scrubber or the ethanol loadout system.

487. AltEn certified it was now keeping corrective action and/or maintenance records for both the fermentation and distillation scrubber and the ethanol loadout system as of September 14, 2018.

***49** 488. AltEn violated Neb. Rev. Stat. § 81-1506(4)(b) by failing to keep any corrective action and/or maintenance records for either the fermentation and distillation scrubber or the ethanol loadout system from January 9, 2015 to September 14, 2018.

489. AltEn violated Neb. Rev. Stat. § 81-1506(4)(b) by failing to comply with the permit conditions for the fermentation and distillation scrubber and the ethanol loadout system:
a. Failing to properly operate and maintain the fermentation and distillation scrubber from on or before July 19, 2018 to July 20, 2018;

b. Failing to keep the operation and maintenance manual for the fermentation and distillation scrubber from on or before July 19, 2018 until September 14, 2018;

c. Failing to provide daily observation records for the fermentation and distillation scrubber from January 9, 2015 until September 14, 2018;

d. Failing to document and maintain records for the fermentation and distillation scrubber from January 9, 2015 until September 14, 2018; and

e. Failing to document and maintain records for the ethanol loadout system from January 9, 2015 until September 14, 2018.

490. Pursuant to Neb. Rev. Stat. § 81-1508.02(2), AltEn is subject to a civil penalty of not more than $10,000 per day for each of these violations.

FOURTEENTH CAUSE OF ACTION

FAILURE TO SUBMIT RELEVANT FACTS IN THE PERMIT APPLICATION IN VIOLATION OF NEB. REV. STAT. § 81-1506(4)(b) AND AIR PERMIT

491. Plaintiff hereby realleges and incorporates by reference the allegations contained in Paragraphs 1-172 as though fully set forth herein.

492. Under NEPA, it is "unlawful to ... [v]iolate any term or condition of an air pollution permit or any emission limit set in the permit." Neb. Rev. Stat. § 81-1506(4)(b).

493. AltEn's air permit CP 13-010(I)(D) provides:
Any owner or operator who failed to submit any relevant facts or who submitted incorrect information in a permit application shall, upon becoming aware of such failure or incorrect submittal, promptly submit such supplementary facts or corrected information.... In addition, any modification which may result in an adverse change to the air quality impacts predicted by atmospheric dispersion modeling ... shall have prior approval from the [Department].

494. 129 Neb. Admin. Code § 17-006 also requires any applicant to submit ""supplementary facts or corrected information."

495. On July 19, 2018, Department inspectors observed treated seed com, beer, pop, and industrial starch at the Facility. AltEn representatives stated AltEn uses discarded treated seed com as a feed stock and uses beer and pop in the ethanol process.

496. AltEn's application for modification of its construction permit, received by the Department on February 14, 2013, did not state treated seed com, beer, industrial starch, or pop would be used as feedstock.

497. AltEn did not supplement or correct this information until on or about September 19, 2018.

***50** 498. AltEn violated Neb. Rev. Stat. § 81-1506(4)(b) by failing to submit relevant facts or by failing to promptly submit supplementary facts or corrected information regarding its feedstock for the ethanol process from at least 2017 and until September 19, 2018.

499. Pursuant to Neb. Rev. Stat. § 81-1508.02(2), AltEn is subject to a civil penalty of not more than $10,000 per day for this violation.

FIFTEENTH CAUSE OF ACTION

FAILURE TO NOTIFY THE DEPARTMENT OF OPERATIONAL CHANGES THAT MAY CAUSE PREVIOUS TESTING NOT TO REPRESENT CURRENT OPERATING CONDITIONS OR EMISSIONS IN VIOLATION OF NEB. REV. STAT. § 81-1506(4)(b) AND AIR PERMIT

500. Plaintiff hereby realleges and incorporates by reference the allegations contained in Paragraphs 1-172 as though fully set forth herein.

501. Under NEPA, it is "unlawful to ... [v]iolate any term or condition of an air pollution permit or any emission limit set in the permit." Neb. Rev. Stat. § 81-1506(4)(b).

502. AltEn's air permit CP13-010(II)(A) provides: "When the source makes physical or operational changes to an emissions unit or associated control equipment that may cause the previous testing to not represent current operation conditions or emissions, the owner/operator shall submit notification of the change. Such notification shall be postmarked within 15 days after the change."

503. On July 19, 2018, Department inspectors observed treated seed com, beer, pop, and industrial starch at the Facility and were told AltEn uses discarded treated seed com as a feed stock and uses beer and pop in the ethanol process.

504. By changing up its feedstock, AltEn made operational changes that may have caused previous testing not to represent current operation conditions or emissions, as set forth in CP13-010. AltEn was required to notify the Department of the changes within 15 days.

505. The Department did not receive notification within 15 days of AltEn making changes in its operations using different materials as its feedstock, as required by CP13-010.

506. AltEn violated Neb. Rev. Stat. § 81-1506(4)(b) by failing to notify the Department within 15 days that it had been begun using discarded treated seed com, not field com, and beer and pop as feedstock for its ethanol manufacturing process.

507. Pursuant to Neb. Rev. Stat. § 81-1508.02(2), AltEn is subject to a civil penalty of not more than $10,000 per day for each time AltEn changed its feedstock and did not notify the Department.

SIXTEENTH CAUSE OF ACTION

ALLOWING AN OPEN FIRE WITHOUT THE DIRECTOR'S WRITTEN PERMISSION IN VIOLATION OF NEB. REV. STAT. § 81-1506(4)(b) AND AIR PERMIT

508. Plaintiff hereby realleges and incorporates by reference the allegations contained in Paragraphs 1 -172 as though fully set forth herein.

509. Under NEPA, it is "unlawful to ... [vjiolate any term or condition of an air pollution permit or any emission limit set in the permit." Neb. Rev. Stat. § 81-1506(4)(b).

***51** 510. AltEn's air permit CP13-010(I)(H) prohibits open fires except pursuant to 129 Neb. Admin. Code § 30-002.

511. On July 19, 2018, Department inspectors observed a smoldering pile of **biochar** on the ground at AltEn. An AltEn representative stated three super sacks of **biochar** had caught fire previously.

512. On August 1, 2018, Department inspectors observed **biochar** was smoldering again.

513. The smoldering piles of **biochar** were open fires at the Facility.

514. The Director had not given written permission for the open fires.

515. AltEn violated Neb. Rev. Stat. § 81-1506(4)(b) by allowing open fires without meeting an exception under 129 Neb. Admin. Code § 30-002.

516. Pursuant to Neb. Rev. Stat. § 81-1508.02(2), AltEn is subject to a civil penalty of not more than $ 10,000 per day for this violation.

SEVENTEENTH CAUSE OF ACTION

FAILURE TO KEEP OR PROVIDE ACCESS TO RECORDS REQUIRED BY THE AIR PERMITS IN VIOLATION OF NEB. REV. STAT. § 81-1506(4)(b) AND AIR PERMITS

517. Plaintiff hereby realleges and incorporates by reference the allegations contained in Paragraphs 1-172 as though fully set forth herein.

518. Under NEPA, it is "unlawful to ... [v]iolate any term or condition of an air pollution permit or any emission limit set in the permit." Neb. Rev. Stat. § 81-1506(4)(b).

A. Failure to Keep Records of Equipment Failures.

519. AltEn's air permit CP 13-010(III)(A) provides: "Inspection and maintenance records for each fabric dust collector, to show compliance with Condition III.(A)(3)(b), shall include the following ... [r]ecords documenting equipment failures, malfunctions, or other variations, including time of occurrence, remedial action taken, and when corrections were made."

520. On July 19, 2018, Department inspectors discovered the air pump for one of the baghouses had been fixed and requested AltEn to produce all records of equipment failures, malfunctions, and other variations since Facility startup on January 9, 2015. AltEn did not have these records or records showing the air pump was fixed.

521. AltEn certified these records were being kept, as of September 14, 2018.

522. AltEn violated Neb. Rev. Stat. § 81-1506(4)(b) by not keeping records of equipment failures, malfunctions, and other variations from Facility startup on January 9, 2015 until September 14, 2018.

B. Failure to Keep Records Showing a Flare Present.

523. AltEn's air permit CP 14-066(III)(E)(5) provides: "Records of flame presence and biogas flow to demonstrate compliance with Condition III. (E)(3)(c)." Condition (III)(E)(3(c) provides:

[The digester flare] shall be operated with a flame present whenever biogas is flowing to the unit. A monitoring system, including a data recorder capable of continuously monitoring and recording the presence of a flame and biogas flow to [the digester flare], shall be installed to ensure that biogas flow to the flare cannot occur without the presence of a flame.

***52** 524. On July 19, 2018, Department inspectors requested AltEn to provide records showing a flame present at the digester flare since Facility start up on January 9, 2015.

525. AltEn did not have records showing the presence of flame because no monitoring system was installed.

526. AltEn violated Neb. Rev. Stat. § 81-1506(4)(b) by not keeping records showing the presence of a flame at the digester flare from Facility startup on January 9, 2015 to present.

C. Failure to Maintain and Keep a Site Survey Documenting As-Built Stack Heights.

527. AltEn's air permit CP13-010(II)(F) requires: "A site survey, or similar documentation containing the as-built stack dimensions, shall be maintained on-site and kept for the life of the source."

528. On July 19, 2018, Department inspectors requested the site survey documenting the as-built stack heights. AltEn did not provide the site survey required to be maintained on site and kept for the life of the source.

529. AltEn certified it was now maintaining the site survey onsite, as of September 14, 2018.

530. On October 2, 2018, Department inspectors again requested the site survey. The site survey failed to include the stack heights for the boiler and the digester flare, as required by CP13-010.

531. AltEn failed to maintain and keep a site survey with the as-built stack dimensions onsite, as required by CP13-010.

532. AltEn violated Neb. Rev. Stat. § 81 -1506(4)(b) by failing to maintain and keep a site survey containing the as-built stack heights from at least July 19, 2018 to October 2, 2018.

D. Failure to Keep the Drift Loss Design Specifications Onsite.

533. AltEn's air permit CP13-010(III)(H) provides: "Manufacturer's drift loss design specifications shall be kept on site."

534. On July 19, 2018, Department inspectors requested AltEn to provide the drift loss design specifications. AltEn did not have the drift loss design specifications onsite.

535. AltEn certified it was now keeping these records on site, as of September 14, 2018.

536. AltEn violated Neb. Rev. Stat. § 81-1506(4)(b) by not keeping the drift loss design specifications onsite from Facility startup on January 9, 2015 to September 14, 2018.

E. Failure to Provide Access to Records to Ensure Compliance.

537. AltEn's air permit CP13-010(I)(F)(2) provides: "The owner or operator shall allow the [Department], EPA or an authorized representative, upon presentation of credentials to ... [h]ave access to and copy, at reasonable times, any records, for the purpose of ensuring compliance with the permit or applicable requirements."

538. CP 13-010(II)(B)(1) also provides:
Records of all measurements, results, inspections, and observations as required to ensure compliance with all applicable requirements shall be maintained on-site as follows ... [a]ll calculations and records required throughout this permit shall be completed no later than the fifteenth (15th) day of each calendar month and shall include all information through the previous calendar month, unless otherwise specified in this permit.

***53** 539. On July 19, 2018, Department inspectors requested AltEn to produce the records of emission calculations since Facility startup on January 9, 2015.

540. AltEn did not produce these records when requested so the Department did not have access to these records.

541. AltEn violated Neb. Rev. Stat. § 81-1506(4)(b) by not providing the Department with access to the records of emissions calculations on July 19, 2018.

542. AltEn violated Neb. Rev. Stat. § 81-1506(4)(b) by failing to comply with the recordkeeping requirements of its air permit:
a. Failing to keep records of equipment failures from January 9, 2015 until September 14, 2018;

b. Failing to keep records showing a flame present at the digester flare from January 9, 2015 to present;

c. Failing to maintain and keep a site survey onsite from at least July 19, 2018 until October 2, 2018;

d. Failing to keep the drift loss design specifications onsite from January 9, 2015 until September 14, 2018; and

e. Failing to provide access to the emissions calculations from July 19, 2018 until September 14, 2018;

543. Pursuant to Neb. Rev. Stat. § 81-1508.02(2), AltEn is subject to a civil penalty of not more than $10,000 per day for each of these violations.

544. Pursuant to Neb. Rev. Stat. § 81-1508, the foregoing cause of action presents an imminent and substantial endangerment to the health of humans or animals or to the environment and/or AltEn violated and/or threatens to violate NEPA. This Court should issue an injunction ordering AltEn to comply with its air permits.

EIGHTEENTH CAUSE OF ACTION

FAILURE TO SUBMIT A REPORT THAT DESCRIBES AND CERTIFIES THE CONTROL EQUIPMENT MEETS SPECIFICATIONS IN VIOLATION OF NEB. REV. STAT. § 81-1508.02(l)(e) AND 129 NEB. ADMIN. CODE § 18-001

545. Plaintiff hereby realleges and incorporates by reference the allegations contained in Paragraphs 1-172 as though fully set forth herein.

546. Under NEPA, it is "unlawful for any person ... [t]o violate any other provision of or fail to perform any other duty imposed by such acts, rules, or regulations." Neb. Rev. Stat. § 81-1508.02(1)(e).

547. 129 Neb. Admin. Code § 18-001 adopts by reference and incorporates the "Standards of Performance for Stationary Sources" published at 40 C.F.R. Part 60, effective July 1, 2013, including standards for volatile organic liquid storage vessels. 40 C.F.R. § 60.115b provides:

The owner or operator of each storage vessel ... shall keep records and furnish reports as required by paragraphs (a), (b), and (c) of this section depending upon the control equipment installed to meet the requirements of § 60.112b. The owner or operator shall keep copies of all reports and records required by this section, except for the record required by (c)(1), for at least 2 years. The record required by (c)(1) will be kept for the life of the control equipment.

(a) After installing control equipment in accordance with § 60.112b(a)(1) (fixed roof and internal floating roof), the owner or operator shall meet the following requirements.

***54** (1) Furnish the Administrator with a report that describes the control equipment and certifies that the control equipment meets the specifications of § 60.112b(a)(1) and § 60.113b(a)(1). This report shall be an attachment to the notification required by § 60.7(a)(3).

548. The notification of the actual date of initial startup required by 40 C.F.R. § 60.7(a)(3) had to be postmarked within 15 days after such date.

549. AltEn was required to provide the report with the notification of actual date of initial startup.

550. The Department received AltEn's notification of actual date of initial startup on January 16, 2015, but it did not contain the report.

551. The Department did not receive the report required by 40 C.F.R. § 60.115b(a)(1) from AltEn until September 14, 2018.

552. AltEn violated 129 Neb. Admin. Code § 18-001 by not providing a report describing and certifying its control equipment from January 16, 2015 until September 14, 2018.

553. AltEn violated Neb. Rev. Stat. § 81-1508.02(1)(e) by failing to comply with the rules and regulations of the Department.

554. Pursuant to Neb. Rev. Stat. § 81-1508.02(2), AltEn is subject to a civil penalty of not more than $10,000 per day for this violation.

REQUEST FOR RELIEF

WHEREFORE, Plaintiff requests this Court to enter judgment on this Complaint in its favor and grant the following relief:

Waste Violations

A. Declare AltEn violated the Nebraska Environmental Protection Act and/or Title 132 of the Nebraska Administrative Code by:
1. Disposing solid waste at a location other than a permitted solid waste management facility (Cause of Action #1); and/or

2. Operating a solid waste management facility without a permit (Cause of Action #2);

3. Causing pollution to water and land of the state or placing or causing to be placed wastes in a location where the wastes will likely cause pollution to waters and land of the state (Cause of Action #3);

B. Enter the statutory maximum civil penalty against AltEn, as provided under Neb. Rev. Stat. § 81-1508.02(2), for the solid waste violations in Causes of Action #1, #2, and #3;

C. Issue a permanent injunction ordering AltEn to remove all distiller's grain solid waste from its property and dispose of the distiller's grain solid waste at a permitted solid waste management facility, for the solid waste violations in Causes of Action #1, #2, and #3;

Water Violations

D. Declare AltEn violated the Nebraska Environmental Protection Act, Title 119 of the Nebraska Administrative *Code-NPDES* Regulations, Title 123 of the Nebraska Administrative *Code-Department Regulations*, and/or NPDES Permit NE0137634, CSW Permit NER16000, and/or ISW Permit NER910000 by:
1. Causing pollution to water and land of the state or placing or causing to be placed wastes in a location where the wastes will likely cause pollution to waters and land of the state (Cause of Action #3);

***55** 2. Discharging a pollutant into waters of the state without a permit (Cause of Action #4);

3. Failing to comply with NPDES Permit NE0137634 (Cause of Action #5);

4. Failing to comply with an Order of the Director (Cause of Action #6);

5. Failure to comply with operation and maintenance requirements (Cause of Action #7);

6. Failure to comply with ISW Permit NER910000 (Cause of Action #8);

7. Failure to comply with CSW Permit NER160000 (Cause of Action #9);

E. Enter the statutory maximum civil penalty against AltEn, as provided under Neb. Rev. Stat. § 81-1508.02(2), for the water violations in Causes of Action #3 through #9;

F. Issue a permanent injunction ordering AltEn to:
1. Prohibit AltEn from operating the lagoon system in such a manner as to cause pollution by prohibiting land application or disposal of lagoon wastewater until approval from the Department; and order secondary containment around the lagoon system, for Cause of Action #3;

2. Complete items (B), (D), and (G) of the Consent Order, for Cause of Action #6;

3. Repair the floating liners and any other liner damage in the west and northeast lagoon, for Cause of Action #7, upon approval by the Department;

4. Implement BMPs and install storm water controls to prevent discharges of distiller's grain runoff into storm water conveyances, for Cause of Action #8;

Air Violations

G. Declare AltEn violated the Nebraska Environmental Protection Act, Title 129 of the Nebraska Administrative Code, *Nebraska Air Quality Regulations* and/or CP13-010, CP 14-066, and/or OP 16S2-001 by:
1. Failure to conduct a performance test for the digester flare (Cause of Action #10);

2. Failure to install and operate the TRS CEMS unit and/or methane CEMS Unit for the anaerobic digestion system (Cause of Action #11);

3. Failure to pave all production-related truck traffic haul roads (Cause of Action #12);

4. Failure to comply with permit conditions for the fermentation and distillation scrubber (Cause of Action #13);

5. Failure to submit relevant facts in the permit application (Cause of Action #14);

6. Failure to notify the Department of operational changes that may cause previous testing not to represent current operating conditions or emissions (Cause of Action #15);

7. Allowing an open fire without the Director's written permission (Cause of Action #16);

8. Failure to keep or provide access to records required by the air permit (Cause of Action #17);

9. Failure to submit report (Cause of Action #18);

H. Enter the statutory maximum civil penalty against AltEn, as provided under Neb. Rev. Stat. § 81-1508.02(2), for the air violations in Causes of Action #10 through #18;

I. Issue a permanent injunction ordering AltEn to pave all haul roads with production-related truck traffic, for Cause of Action #12;

J. Issue a permanent injunction ordering AltEn to comply with the conditions of its air permits, for Causes of Action #10 through #12, and #17;

***56** K. Tax all court costs herein to AltEn; and

L. Grant Plaintiff such additional and further relief as this Court deems just and proper.

DATED this 1st day of March 2021.

Douglas J. Peterson, #18146
Attorney General

Footnotes

1 In 2019, the Nebraska Department of Environmental Quality became the Nebraska Department of Environment and Energy. For the sake of simplicity, ""Department" will be used throughout.

2 A glossary of acronyms used in this Complaint is hereto attached to this Complaint as **Attachment A**.

3 In 2020, the Department began issuing LNC instead of NOVs. Although these documents have different names, an LNC still notifies the regulated party of violations and requests correction of violations.

2021 WL 1536693 (Neb.Dept.Env.Control)

End of Document

Exhibit 5

United States Department of Agriculture

Farm and Foreign Agricultural Services

Risk Management Agency

Springfield Regional Office

3500 Wabash Avenue
Springfield, IL 62711-8287

217-241-6600

July 16, 2015

TO: All Approved Insurance Providers Writing in the States of Illinois, Indiana, Michigan and Ohio

FROM: Brian D. Frieden /s/ ***Brian Frieden***
Director, Springfield Regional Office

SUBJECT: Salvage Buyers List

In response to inquiries received in the Springfield RO, an updated list of salvage grain buyers is being provided. This list is not a recommendation or endorsement of these specific buyers and is not all inclusive, but rather should act as a guide in finding a market for damaged/salvage grain.

AltEn, LLC
5225 Renner Rd.
Shawnee, KS 66217
(913) 3962-9999
POC: Bryce Meeker
Email: bmeeker@mrgkc.com

Callan Salvage & Appraisal
Eads (Memphis), TN
(800) 238-2632
POC: Ron Callan
www.callansalvage.com

Gladstone Grain Co., Inc. (corn & soybean buyer only)
Gladstone, IL 61437
(309) 627-2374

Jim Newsom Trucking, Inc.
PO Box 450
Glen Allan, MS 38744
(662) 839-4613

Lackawanna Products
8545 Main St.
Clarence, NY 14031
(716) 633-1940
gperry@lpctrade.com
POC: Gregg Perry

Maks Bak
Wichita, KS and Ellis, KS (800) 749-4690

MGM Marketing
12732 S. Pflumm Road
Olathe, KS 66062
(800)214-7788 or (913)451-0023
FAX: (913)345-8087
MOBILE: (319)360-4311
mbear@teammgm.com
www.mgmbusinesspartners.com
POC: Mike Bear

Michael Poettker
4601 Old US Hwy. 50
Aviston, IL 62216
(618) 228-7486 or (618) 795-4791
FAX: (618) 228-5015
m1maverick@charter.net

Michigan Agriculture Commodities, Inc.
(13 locations across Michigan)
(800)878-8900
www.michag.com

Northern Ag Service, Inc.
7400 W 130th St, Ste 380
Overland Park, Kansas 66213
800-205-5751
www.northernagservice.com
(30 locations in different states including Indiana)

Pruess Elevator, Inc.
717 Union Ave.
Lowden, IA 52255
(800) 828-6642
POC: Todd

Ron Holevoet
15630 Old State Rd.
Carlyle, IL 62231
(618) 594-4789 or (618) 316-3054
holevoet@att.net

Rupiper Grain and Salvage
Carroll, IA 51401
(712) 830-2502
POC: Kevin

West Side Salvage, Inc.
7251 32nd
Atkins, IA 52206
(800) 747-0104
POC: Ken

Zumbach Feed Yards
POC: Myron or Dave
2078 330th St.
Coggon, IA 52218
319-480-1673 or 563-926-2190

According to the Risk Management Agency *Loss Adjustment Manual (LAM) Standards Handbook*, Part 3, Section 5, Paragraph 232J, ZMV Production, "Every reasonable effort should be made by the insured and AIP to find a market for the production before it is declared ZMB. It is essential that AIPs communicate with the RMA RO to ensure AIPS are aware of available markets for damaged production….."

United States Department of Agriculture

Farm Production and Conservation

Risk Management Agency

St. Paul Regional Office

30 E. 7th St.
Suite 1890
St. Paul, Minnesota 55101

Telephone:
(651) 290-3304

Fax:
(651) 290-4139

April 5, 2019

TO: All Approved Insurance Providers Writing in the States of Iowa, Minnesota, or Wisconsin

FROM: Duane Voy, Director, St. Paul RO

Subject: Damaged Grain Markets

BACKGROUND

In accordance with Paragraph 1102 (H) of The Loss Adjustment Manual Standards Handbook (FCIC-25010), the St. Paul Regional Office is providing the following list of buyers of damaged grain that service Iowa, Minnesota, or Wisconsin. Grain that has been determined to be adulterated cannot be used for feed or food. FDA's guidelines are set out in their "Guidance for Industry: Evaluating the Safety of Flood-Affected Food Crops for Human Consumption." The full guidance can be found at: www.fda.gov/food/guidanceregulation/guidancedocumentsregulatoryinformation/ucm287808.htm

ACTION

Approved Insurance Providers (AIP) have requested a list of potential damaged production markers for damaged grain. Below is a list of damaged grain buyers. This list is not complete and is provided as a guide to assist the AIP in locating damaged production markets.

Northern Ag. Service
Stilwell, KS
800-205-5751
salvage@norag-us.com

Pruess Elevator Inc.
717 Union Ave.
Lowden, IA 52255
800-828-6642
563-828-6642

Gregerson Grain Salvage Inc.
Damaged/Off Grade
Waubay, SD
605-947-4888
800-456-3305

Schwieger Grain Inc
Damaged Grain
Fairmont, MN
507-238-2483

Kendall Upchurch
16084 US Hwy 65
Zearing, IA 50278
641-487-7476

Zumbach Feed Yards
2078 330th St
Coggon, IA 52218
319-480-1673 – Cell
563-926-2190 – Phone

Rupiper Grain & Salvage
Carroll, Iowa 51401
712-658-2502 – Office
712-830-6100 – (Kevin)
712-830-4809 – (KelLee)
rupipergrainandsalvage.com

Murray Enterprises Inc
Damaged Grain
Hopkinton, IA
800-284-5686

Kleinburger c/o Tom Gilley
Damaged Dry Beans
701-280-0061

S.W. Vac Inc
Willmar, MN
800-366-8665

Dean Grain
Nevada, IA
417-394-3155 – Home
417-850-7968 – Cell
800-658-2314

Grabanski Grail LLC
Grafton, ND
701-360-0088
701-352-0613

West Side Salvage, Inc.
Cedar Rapids, IA
800-747-0104

AltEn, LLC
5225 Renner Rd
Shawnee, KS 66217
913-3962-9999
POC: Bryce Meeker
bmeeker@mrgkc.com

Gregory Perry
Lackawanna Products Corp.
8545 Main Street Clarence NY
14031
716-633-1940
gperry@pctrade.com

Midwest Livestock Mktg.
29751 US HWY 71
Redwood Falls, MN 56283
866-623-1121
507-430-5880
507-430-4482
tim@midwestlivestock.net
terry@midwestlivestock.net

AltEn LLC.
Craig Gubbels
1344 County Road 10
Mead, NE. 68041
402-624-2000 – Office
AltEnReceiving@mrgkc.com

Randy Sieren
Fremont, IA
641-777-9039 – Phone

Frontier Trading Co.
Ada, OH
888-421-9400

Additional information concerning Mycotoxin and other grain fungal diseases may be found at: www.ams.usda.gov/services/fgis/mycotoxins.

Please contact the St Paul Regional Office at 651-290-3304 to request updates or get added to this list.

Exhibit 6

in Search

Home My Network Jobs Messaging

Bryce Meeker

President, Northeastern Biochar Solutions, LLC

Director of Business Development & Project Finance

Alter Energy Group

Jan 2011 - Nov 2013 · 2 yrs 11 mos

Kiev, Ukraine

Alter Energy Group AG (AEG) is a Swiss-based renewable energy investment company focusing on Eastern Europe and North America.

Exhibit 7

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Environmental Permits, Region 5
1115 State Route 86, PO Box 296, Ray Brook, NY 12977-0296
P: (518) 897-1234 | F: (518) 897-1394
www.dec.ny.gov

By email only

December 28, 2022

Raymond Apy, CEO
Saratoga Biochar Solutions, LLC
26F Congress Street #346
Saratoga Springs, NY 12866

RE: **Notice of Incomplete Application**
Saratoga Biochar Solutions, LLC
DEC Application # 5-4144-00187/00001 (ASF and SW)
Moreau (T), Saratoga (Co.)

Dear Mr. Apy:

In accordance with DEC's Record of Compliance Enforcement Policy DEE-16 and DEC's solid waste regulations, 6 NYCRR § 360.16(e), DEC requests that you complete the enclosed Record of Compliance forms in support of your pending Air State Facility (ASF) and Solid Waste Facility (SW) permit applications:

1. Record of Compliance - Permit Application Supplement
2. Record of Compliance Supplemental Information Form

If you have any questions, please feel free to contact me by email Erin.Burns@dec.ny.gov or phone (518) 897-1236.

Sincerely,

Erin L. Burns

Erin L. Burns
Regional Permit Administrator

Encls.
ec: Kevin Wood – DEC Solid Waste
Katelyn White – DEC Solid Waste
Paul Sierzenga – DEC Air
Yasmini Patel – DEC Air
Aaron Love – DEC OGC
Bryce Meeker – Northeastern Biochar

Exhibit 8

Date: March 21, 2023

To: New York State Department of Environmental Conservation

From: Bryce Meeker, President
Northeastern Biochar Solutions, LLC
Saratoga Biochar Solutions, LLC
26F Congress Street #346,
Saratoga Springs, NY 12866

To whom it may concern,

I consulted Earth, Energy, and Environment, LLC, the parent company of AltEn, LLC, from November 2013 to May 2019 on financial modeling for prospective business opportunities. I was paid by both entities over the course of my tenure as an independent contractor third-party consultant. I received 1099 income from 2013 to 2019 from one or both companies at various times.

At no point in time was I an employee, and I did not manage any employee, of either company. I never received any employment benefits from either company. At no point in time did I receive or hold any ownership, stock, or decision-making authority in either company.

Sincerely,

Bryce L. Meeker
President
Northeastern Biochar Solutions, LLC
Saratoga Biochar Solutions, LLC

Exhibit 9

From:	Charles Dumas
To:	Love, Aaron A (DEC)
Cc:	rapy@northeasternbiochar.com; Seth Finkell; Robert Lippman; Bryce Meeker (bmeeker@northeasternbiochar.com)
Subject:	RE: DEC Application # 5-4144-00187/00001: Saratoga Biochar Solutions: Moreau
Date:	Tuesday, March 21, 2023 4:01:22 PM
Attachments:	Bryce Meeker_AltEn Statement_21Mar2023.pdf

ATTENTION: This email came from an external source. Do not open attachments or click on links from unknown senders or unexpected emails.

Hi Aaron,

Further to our March 8 conversation, as you requested, attached is a statement from Bryce Meeker with a summary of his activity for AltEn. Please let me know if you need anything further in this regard.

Charles

Charles B. Dumas, Esq.

Lemery Greisler LLC
677 Broadway, 8th Floor
Albany, NY 12207
Email: cdumas@lemerygreisler.com
Office Direct: 518.930.4143
Office Recep: 518.433.8800 X332
Fax: 518.930.4143
Cell: 518.424.5297

From: Charles Dumas
Sent: Wednesday, March 8, 2023 12:32 PM
To: Love, Aaron A (DEC) <Aaron.Love@dec.ny.gov>
Cc: Raymond Apy <rapy@northeasternbiochar.com>; Seth Finkell <SFinkell@lemerygreisler.com>