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The Big Apple's Tiny Problem: A Legal Analysis of the Microplastic Problem in the N.Y./N.J. Harbor

Sean Dixon, Zachary Lees, and Andrea Leshak*

INTRODUCTION

A prominent threat to the N.Y./N.J. Harbor is microplastic pollution. It has been estimated that at least eighty percent of plastic pollution is land-based from littering and stormwater runoff.¹ At an alarming rate, we are contaminating our waterways, ecosystems, and most likely ourselves. Consumers rely on prevalent throwaway products such as plastic bags, bottles, straws, utensils, and Styrofoam to-go boxes just for short-term use.² These plastic products often enter local waterways through littering, stormwater runoff, and improper waste management.³ Sewer systems are like horizontal smokestacks for these plastics, discharging trash into our waterways every time it

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1. Matthew Cole et al., *Microplastics as Contaminants in the Marine Environment: A Review*, 62 MARINE POLLUTION BULL. 2588, 2590 (2011).

2. N.Y./N.J. BAYKEEPER, N.Y.-N.J. HARBOR ESTUARY PLASTIC COLLECTION REP. 4 (2016), <http://nynjbaykeeper.org/wp-content/uploads/2016/02/NYNJBaykeeper-Plastics-Report-February-2016-1.pdf>.

3. *Id.*

rains.

Once plastic is in a local waterway, it can never biodegrade.⁴ Instead, water currents and sunlight act like paper shredders, transforming larger plastics into microplastic (plastic about the size of a grain of rice and smaller).⁵ Many wastewater treatment plants are unable to capture the tiny floating plastics, and they escape into our waterways.⁶ Contaminants such as pesticides and flame retardants already present in the water are able to be absorbed by the plastic.⁷ Thus, when plankton, fish, or birds mistake microplastic for food, they also ingest contaminants adhered to the plastic.⁸ “Microplastic contamination has been found in finfish and shellfish tissues, indicating that microplastics can enter aquatic and likely human food webs.”⁹ By 2025, our world’s oceans are expected to contain one metric ton of plastic for every three metric tons of fish, and by 2050, more plastics than fish by weight.¹⁰ To reverse these startling predictions, environmental advocates have sounded the alarm, encouraging the public to avoid single-use, throwaway plastics and switch over to sustainable and renewable alternatives.

The N.Y./N.J. Harbor is a complex ecosystem in the midst of the New York City metropolitan center that includes over 1,000 miles of New York and New Jersey coastlines.¹¹ Home to 20 million people and diverse species of wildlife, including 300 species of birds, the N.Y./N.J. Harbor is especially vulnerable to microplastic pollution and its potential impacts.¹² Research is just now beginning to uncover the impacts of microplastics entering the human food web generally, the effects of microplastics on the wildlife of the N.Y./N.J. Harbor, and the interaction between plastic and persistent contaminants of concern. As such, exploring novel legal and regulatory mechanisms to control microplastic pollution is a topic of particular importance for the N.Y./N.J. Harbor.

Here, our goal is to describe the sources of microplastic

4. *See id.*

5. *See* Cole et al., *supra* note 1, at 2589–90.

6. *Id.* at 2590.

7. N.Y./N.J. BAYKEEPER, *supra* note 2, at 5.

8. *See id.*

9. *Id.*

10. *Id.* at 17.

11. *Id.* at 2–3.

12. *Id.* at 2.

pollution; whether, and to what extent, air and water pollution control laws allow for regulating such pollution; and what local N.Y./N.J. Harbor programs and policies (ranging from stormwater management to consumer behavior laws) address microplastics. It is important to note, at the outset, that the field of microplastic science, law, and policy is changing rapidly. With each new microbead ban, synthetic microfiber research initiative, and microplastic pollution control petition to the U.S. Environmental Protection Agency (EPA), the nation's air and waters will move one step closer toward an innovative solution to this unique and globally-ubiquitous pollution crisis.

I. SOURCES, IMPACTS, AND MITIGATION MECHANISMS FOR
MICROPLASTIC POLLUTION

A. *Sources of Microplastics in the N.Y./N.J. Harbor*

The use of throwaway plastics and plastic polymers has become ubiquitous. With the increased use of plastics, there has been a corresponding increase in the amount of plastics that accumulate in the marine environment. It is estimated that up to ten percent of plastic debris ends up in the marine environment.¹³ Of particular concern is the proliferation of "microplastics," or tiny plastic fragments, fibers, and granules, often defined as having diameters of less than five millimeters.¹⁴

Research by the environmental advocacy group N.Y./N.J. Baykeeper estimates that at least 165 million plastic particles are within N.Y./N.J. Harbor waters at any given time.¹⁵ A significant number of pre-production pellets of plastic, also known as nurdles, are present in harbor waters.¹⁶ Polystyrene foam and blue spherical beads suspected to derive from personal care products are also abundant in the N.Y./N.J. Harbor.¹⁷ Based on a sampling of plastic particles floating in the harbor, approximately eighty-

13. Richard C. Thompson, *Plastic Debris in the Marine Environment: Consequences and Solutions*, in MARINE NATURE CONSERVATION IN EUR. 2006 107, 108 (Jochen C. Krause et al., eds., 2007), https://www.bfn.de/fileadmin/MDB/documents/themen/meeresundkuestenschutz/downloads/Fachtagungen/Marine-Nature-Conservation-2006/Proceedings-Marine_Nature_Conservation_in_Europe_2006.pdf.

14. Cole et al., *supra* note 1, at 2589.

15. N.Y./N.J. BAYKEEPER, *supra* note 2, at 13.

16. *Id.*

17. *Id.*

five percent were microplastics, and the most abundant material was polystyrene.¹⁸

Microplastics are categorized into two types—primary microplastics and secondary microplastics. Primary microplastics are plastics that are manufactured to be of a microscopic size and are typically used in facial cleansers and cosmetics or in air-blasting media.¹⁹ Secondary microplastics are tiny plastic fragments that are formed by biological degradation, photodegradation, chemical deposition, and physical breakdown of larger pieces of plastics.²⁰

Both primary and secondary microplastics are abundant in the N.Y./N.J. Harbor, though secondary microplastics have been found in higher concentrations than primary microplastics,²¹ and make up a majority of total microplastics found in the marine environment.²² Unlike primary microplastics, the sources of secondary microplastics are more varied, and can include cigarettes, plastic bags, and tires.²³ Often, the degradation and breakdown of these larger plastics occurs along the shore and on beaches, before the plastics enter waterways.²⁴

Microfibers, or fibrous microplastics, are another type of microplastic that are abundantly found in the marine environment.²⁵ Often released from clothing during washing in domestic washing machines, microfibers are typically even smaller in size than microbeads and secondary microplastics.²⁶

The variety and diversity of microplastics in the marine

18. *Id.*

19. Cole et al., *supra* note 1, at 2589.

20. Shirin Estahbanati & N.L. Fahrenfeld, *Influence of Wastewater Treatment Plant Discharges on Microplastic Concentrations in Surface Water*, 162 CHEMOSPHERE 277, 283 (2016), <http://www.sciencedirect.com/science/article/pii/S004565351630981X>.

21. See N.Y./N.J. BAYKEEPER, *supra* note 2, at 13.

22. See Estahbanati & Fahrenfeld, *supra* note 20, at 283.

23. *Id.*

24. Anthony L. Andrady, *Microplastics in the Marine Environment*, 62 MARINE POLLUTION BULL. 1596, 1601 (2011), http://ac.els-cdn.com/S0025326X11003055/1-s2.0-S0025326X11003055-main.pdf?_tid=0895871a-c090-11e6-abc700000aab0f26&acdnat=1481563733_4c285442dcad8df2ec3a5ca435d74637.

25. Stephanie L. Wright et al., *The Physical Impacts of Microplastics on Marine Organisms: A Review*, 178 ENVTL. POLLUTION 483, 483 (2013), <http://www.sciencedirect.com/science/article/pii/S0269749113001140>.

26. See Cole et al., *supra* note 1, at 2594 (“Plastic fibres found in the environment can be as small as 1 µm in diameter, and 15 µm in length.”).

environment presents a significant challenge, as multiple strategies will need to be implemented in order to address the various sources. In the following paragraphs, we provide additional information on how microplastics end up in the marine environment, the public health issues presented by microplastics, and the remedies available to address microplastic pollution.

1. Wastewater Treatment Plants

Wastewater treatment plants are a known source of microplastics. For example, primary microplastics, typically from cosmetic products and microfibers, travel through wastewater systems and end up being discharged into receiving waterbodies because the microplastics are too small to be captured by wastewater treatment processes.²⁷ In New York, twenty-five wastewater treatment plants were confirmed to have discharged microbeads into waterbodies across the state, including the Hudson River, Long Island Sound, and the Atlantic Ocean.²⁸ In addition, research has observed increased concentrations of microplastics downstream from wastewater treatment plants.²⁹ The Raritan River, which has more than ten wastewater treatment plants that discharge into it, has been identified as a likely source of microplastics in the N.Y./N.J. Harbor.³⁰

Although existing wastewater treatment plants are not

27. See *id.* at 2590; Lisa S. Fendall & Mary A. Sewell, *Contributing to Marine Pollution by Washing your Face: Microplastics in Facial Cleansers*, 58 MARINE POLLUTION BULL. 1225, 1225 (2009), <http://www.sciencedirect.com/science/article/pii/S0025326X09001799>; Mark A. Browne et al., *Microplastic—An Emerging Contaminant of Potential Concern?*, 3 INTEGRATED ENVTL. ASSESSMENT & MGMT. 559, 560 (2007), http://www.adventurescience.org/uploads/7/3/9/8/7398741/browne_et_al_2007_integr_envl_assess_and_manag.pdf.

28. N.Y. ST. OFF. ATT'Y GEN., DISCHARGING MICROBEADS TO OUR WATERS: AN EXAMINATION OF WASTEWATER TREATMENT PLANTS IN NEW YORK 6, 8 (2015), http://www.ag.ny.gov/pdfs/2015_Microbeads_Report_FINAL.pdf [hereinafter N.Y. ATT'Y GEN. STUDY].

29. See Estahbanati & Fahrenfeld, *supra* note 20, at 283; Amanda McCormick et al., *Microplastic is an Abundant and Distinct Microbial Habitat in an Urban River*, 48 ENVTL. SCI. & TECH. 11863, 11865 (2014), <http://pubs.acs.org/doi/pdf/10.1021/es503610r>.

30. Estahbanati & Fahrenfeld, *supra* note 20, at 281 (“The presence of microplastics at the furthest downstream sampling location indicates that the Raritan River is likely a source of microplastics in the receiving estuary.”).

designed to remove microplastics,³¹ some wastewater treatment plants with advanced filters may be effective at capturing microplastics.³² At six wastewater treatment plants in New York, where microbeads were not detected in discharge samples, the facilities utilized advanced treatment units including membrane microfiltration, continuous backwash upflow dual sand microfiltration, and rapid sand filters.³³ Higher concentrations of primary microplastics downstream from wastewater treatment plants, as compared to a background level of primary microplastics, indicates that wastewater treatment plants are a source of primary microplastics, but not the only source.³⁴

2. Combined Sewer Overflows and Nonpoint Sources

Combined sewer overflow (CSO) drainage systems allow untreated wastewater to discharge directly into local waterways during rain events.³⁵ Each year, New York City discharges approximately 25 to 30 billion gallons of combined sewage and wastewater into the N.Y./N.J. Harbor.³⁶

New York City operates approximately 426 CSO outfalls that discharge wastewater combined with stormwater into N.Y./N.J. Harbor.³⁷ In New Jersey, untreated wastewater and stormwater

31. Rachel Doughty & Marcus Eriksen, *The Case for a Ban on Microplastics in Personal Care Products*, 27 TUL. ENVTL. L.J. 277, 280 (2014) (citing Marcus Eriksen et al., *Microplastic Pollution in the Surface Waters of the Laurentian Great Lakes*, 77 MARINE POLLUTION BULL. 177, 180 (2013), <http://www.sciencedirect.com/science/article/pii/S0025326X13006097>).

32. See N.Y. ATT'Y GEN. STUDY, *supra* note 28, at 6.

33. *Id.*

34. Estahbanati & Fahrenfeld, *supra* note 20, at 283 (“The results of this study indicated that microplastic concentration in select size categories, particularly primary microplastics, increased downstream of several [wastewater treatment program] outfalls. Additionally, the presence of microplastics at the background location showed that [wastewater treatment programs] are not the only source of microplastic contamination in the river.”).

35. CARTER STRICKLAND, JR. ET AL., N.Y. CITY DEP'T OF ENVTL. PROTECTION, N.Y.C. GREEN INFRASTRUCTURE PLAN: A SUSTAINABLE STRATEGY FOR CLEAN WATERWAYS 15 (2010), http://www.nyc.gov/html/dep/pdf/green_infrastructure/NYCGreenInfrastructurePlan_LowRes.pdf.

36. *Id.* at 8; *Be a Clean Water Steward: Your Guide to Understanding the City's Water Quality Improvement Plans & How to Advocate for Fishable, Swimmable Waterways*, STORMWATER INFRASTRUCTURE MATTERS 4 (2016), swimmablenyc.info/wp-content/uploads/2016/03/workbook-3.8.16-2-4.pdf [hereinafter *Be a Clean Water Steward*].

37. Consent Order at para. 5, *In re* Violations of Art. 17 of Env'tl.

is discharged into the N.Y./N.J. Harbor through 212 CSO outfalls on the Arthur Kill, Elizabeth River, Hackensack River, Hudson River, Kill Van Kull, Newark Bay, Passaic River, and Raritan River.³⁸ N.Y./N.J. Baykeeper's research, which documented large amounts of microplastics in the N.Y./N.J. Harbor in close proximity to CSO outfalls, suggests that CSO outfalls are a likely contributor of microplastics to the marine environment.³⁹

In addition to being discharged through CSO outfalls, microplastics can enter the marine environment through runoff that contains microbeads from cosmetic products, microplastics used in the ship-breaking industry, and industrial microbeads in sandblasting materials.⁴⁰ Research on the presence of microplastics in the marine environment has found that there are higher concentrations of microplastics during runoff events, suggesting that runoff is another source of microplastics.⁴¹ Additionally, pre-production plastics can be accidentally released and enter waterways through runoff due to improper transport, packing, and processing of plastics.⁴²

Sewage sludge, a product of wastewater treatment plants, represents a source of microplastics in the terrestrial environment; it is disposed of in landfills, incinerated, or used to fertilize land.⁴³ When sewage sludge is disposed of in landfills or used to fertilize land, microplastics in the sludge can be mobilized

Conservation L. and Pt. 750, *et seq.*, of Title 6 of Official Compilation of Codes, Rules, and Regulations of N.Y., No. CO2-20110512-25 (N.Y. Envtl. Conserv. 2012), http://www.dec.ny.gov/docs/water_pdf/csomod2012.pdf.

38. See *CSO Basics: Where Are Combined Sewer Overflow Outfalls in N.J.?*, N.J. DEPT OF ENVTL. PROTECTION: DIVISION OF WATER QUALITY, <http://www.nj.gov/dep/dwq/cso.htm> (last visited Dec. 13, 2016).

39. N.Y./N.J. BAYKEEPER, *supra* note 2, at 7, 13.

40. Andrady, *supra* note 24, at 1600.

41. See Austin K. Baldwin et al., *Plastic Debris in 29 Great Lakes Tributaries: Relations to Watershed Attributes and Hydrology*, 50 ENVTL. SCI. & TECH. 10377, 10381 (2016), <http://pubs.acs.org/doi/pdf/10.1021/acs.est.6b02917>.

42. Charles James Moore, *Synthetic Polymers in the Marine Environment: A Rapidly Increasing, Long-Term Threat*, 108 ENVTL. RES. 131, 137 (2008), <http://www.sciencedirect.com/science/article/pii/S001393510800159X>.

43. Karen Duis & Anja Coors, *Microplastics in the Aquatic and Terrestrial Environment: Sources (with a Specific Focus on Personal Care Products), Fate and Effects*, ENVTL. SCI. EUR., Dec. 2016, at 1, 6–7, <http://link.springer.com/article/10.1186/s12302-015-0069-y> (follow "Download PDF" hyperlink).

and distributed by airborne transport and then reenter the terrestrial environment through airborne deposition.⁴⁴ Microplastics in sewage sludge are also at risk of entering the aquatic environment through surface runoff.⁴⁵

3. *Wastewater from Washing Machines*

Research indicates that fibrous microplastics, also known as microfibers, are the most abundant microplastic in the marine environment.⁴⁶ A significant, if not primary, source of microfibers in the marine environment is wastewater from domestic washing machines.⁴⁷ The microfibers that are released from garments during washing end up being discharged into the marine environment through wastewater because wastewater treatment plants are not designed to remove the tiny microfibers.⁴⁸ Experiments that sampled wastewater from washing machines demonstrate that a single garment can produce more than 1,900 fibers per wash.⁴⁹ Another study that examined the amount of microfibers released from polyester, polyester-cotton blend, and acrylic fabrics in domestic washing machines found that an average wash load could release over 700,000 fibers.⁵⁰ These studies suggest that microfibers are being discharged through wastewater into waterways in alarmingly high numbers.

B. *Health and Ecosystem Impacts of Microplastics*

The health and ecosystem impacts of microplastics have increasingly become the subject of scientific research. While the full impacts of microplastics in the marine environment are not

44. *Id.* at 6–7; Matthias C. Rillig, *Microplastic in Terrestrial Ecosystems and the Soil?*, 46 ENVTL. SCI. & TECH. 6453, 6453 (2012), <http://pubs.acs.org/doi/pdf/10.1021/es302011r>.

45. *See* Duis & Coors, *supra* note 43, at 6–7 (noting that sewer overflow can occur during heavy rainfall events and can reach environment).

46. Wright et al., *supra* note 25, at 483.

47. Mark Anthony Browne et al., *Accumulation of Microplastic on Shorelines Worldwide [sic]: Sources and Sinks*, 45 ENVTL SCI. & TECH. 9175, 9177 (2011), <http://pubs.acs.org/doi/pdf/10.1021/es201811s>.

48. Imogen E. Napper & Richard C. Thompson, *Release of Synthetic Microplastic Plastic Fibres from Domestic Washing Machines: Effects of Fabric Type and Washing Conditions*, 112 MARINE POLLUTION BULL. 39, 43–44 (2016), <http://www.sciencedirect.com/science/article/pii/S0025326X1630639>.

49. *See* Browne et al., *supra* note 47, at 9177.

50. *See* Napper & Thompson, *supra* note 48, at 43.

yet known, recent studies, briefly summarized *infra*, suggest that microplastics present a number of negative impacts on the marine environment and potentially on human health.

Microplastics can be ingested by a large range of aquatic species, including low trophic suspension, filter and deposit feeders, detritivores, and planktivores.⁵¹ The risks to aquatic species that result from consumption of microplastics include starvation, reduced food consumption due to satiation, and intestinal blockage.⁵² Alteration of feeding behavior and reduced energy allocation due to consumption of microplastics can also cause reduced reproductive output and fitness in marine species.⁵³ At least one study that examined effects of oysters exposed to microplastics found that the oysters experienced altered rates of energy uptake and allocation, reproduction, and offspring performance.⁵⁴ Another study, which analyzed the effects of microplastic pollution on a species of lobster, found that the species experienced reduced nutrient availability which could lead to a reduced population stability and viability of local fisheries.⁵⁵ Such results suggest that ingestion of microplastics can have lasting impacts on species and potentially ecosystem health.

In addition to the physical impacts that can result from the ingestion of microplastics, microplastics can also cause toxicity in organisms due to leaching contaminants from plastic additives.⁵⁶ Microplastics can also become contaminated from hydrophobic persistent organic pollutants (POPs) in the marine environment, which presents the potential for bioaccumulation and biomagnification of POPs in marine organisms that consume

51. Wright et al., *supra* note 25, at 484; see also Chelsea M. Rochman et al., *Ingested Plastic Transfers Hazardous Chemicals to Fish and Induces Hepatic Stress*, SCI. REP., 2013, at 1, <http://www.nature.com/articles/srep03263>.

52. Fendall & Sewell, *supra* note 27, at 1228.

53. See Tamara S. Galloway & Ceri N. Lewis, *Marine Microplastics Spell Big Problems for Future Generations*, 113 PROC. NAT'L ACAD. SCI. 2331, 2331 (2016), <http://www.pnas.org/content/113/9/2331.full.pdf>.

54. See Rossana Sussarellu et al., *Oyster Reproduction Is Affected by Exposure to Polystyrene Microplastics*, 113 PROC. NAT'L ACAD. SCI. 2430, 2432 (2016), <http://www.pnas.org/content/113/9/2430.full.pdf>.

55. Natalie A.C. Welden & Phillip R. Cowie, *Long-Term Microplastic Retention Causes Reduced Body Condition in the Langoustine, Nephrops Norvegicus*, 218 ENVTL. POLLUTION 895, 899 (2016), <http://www.sciencedirect.com/science/article/pii/S0269749116307278>.

56. Wright et al., *supra* note 25, at 484.

microplastics.⁵⁷ While microplastics can serve as a conduit for POPs, they also have the potential to increase the environmental persistence of such pollutants.⁵⁸

Recent studies have determined that microplastics are present in seafood intended for human consumption. Microplastics have been found in commercially-grown mussels and oysters purchased from grocery stores,⁵⁹ as well as in sixty-seven percent of all species sampled from fish markets in California.⁶⁰ These results are particularly concerning because of the potential negative impacts of microplastics on human health.⁶¹ Microplastics may cause physical harm to humans when microplastics are ingested via seafood like sardines, mussels, and oysters, as microplastics “ha[ve] been shown to cause physical damage leading to cellular necrosis, inflammation and lacerations of tissues in the gastrointestinal tract.”⁶² Furthermore, human consumption of seafood containing microplastics “has the potential to increase the burden of hazardous chemicals in humans.”⁶³

While further research is necessary to determine the full extent of the harms posed by microplastic pollution, it is clear from recent studies that microplastics are negatively impacting aquatic species and are making their way into seafood intended for human consumption.

C. Remedies and Mitigation Measures for Microplastic Pollution

The widespread use of plastics as well as the presence of microplastics already in the marine environment present significant challenges to remedying the problem of microplastic pollution. Scientists in the field have recommended a dual approach informed by the best available science that combines

57. *Id.*

58. Juliana A. Ivar do Sul & Monica F. Costa, *The Present and Future of Microplastic Pollution in the Marine Environment*, 185 ENVTL. POLLUTION 352, 353 (2014), <http://www.sciencedirect.com/science/article/pii/S0269749113005642>.

59. Lisbeth Van Cauwenberghe & Colin R. Janssen, *Microplastics in Bivalves Cultured for Human Consumption*, 193 ENVTL. POLLUTION 65, 66 (2014), <http://www.sciencedirect.com/science/article/pii/S0269749114002425>.

60. Chelsea M. Rochman et al., *Anthropogenic debris in seafood: Plastic debris and fibers from textiles in fish and bivalves sold for human consumption*, SCI. REP., 2015, at 1, <http://www.nature.com/articles/srep14340>.

61. *Id.* at 2.

62. *Id.*

63. *Id.*

source reduction and cleanup of microplastics already in the marine environment.⁶⁴

1. Source Reduction

Source reduction of microplastics can be achieved through multiple strategies including removing microbeads from cosmetic products, improving waste management infrastructure, reducing the likelihood of larger plastics entering the marine environment, and preventing microfibers from clothing from entering wastewater.

The first strategy, removing microbeads from cosmetic products, is expected to be implemented in the near future as a result of the Microbead Free Waters Act of 2015.⁶⁵ That legislation, signed into law on December 28, 2015, bans the manufacturing of cosmetic products containing plastic microbeads by January 1, 2018, and the sale of such products by 2019.⁶⁶ While the Act represents a significant accomplishment, it will only address a fraction of the microplastic pollution problem; it does not address secondary microplastics, microfibers, or other primary microplastics used in the ship-breaking industry and sandblasting materials.

A second source-reduction strategy focuses on improving waste and wastewater management infrastructure. Waste management can be improved through various ways, including the use of state-of-the-art technology at wastewater treatment plants and the implementation of well-designed structural controls to capture plastic debris before it enters waterways.

As discussed above, several wastewater treatment plants in New York that used advanced treatment units, including “membrane microfiltration, continuous backwash upflow dual

64. See Chelsea M. Rochman, *Strategies for Reducing Ocean Plastic Debris Should Be Diverse and Guided by Science*, ENVTL RES. LETTERS, Apr. 2016, at 1, 2, <http://iopscience.iop.org/article/10.1088/1748-9326/11/4/041001/pdf>; see also Peter Sherman & Erik van Sebille, *Modeling Marine Surface Microplastic Transport to Assess Optimal Removal Locations*, ENVTL RES. LETTERS, Jan. 2016, at 1, <http://iopscience.iop.org/article/10.1088/1748-9326/11/1/014006/pdf> (noting one proposed method, *The Ocean Cleanup*, removes surface plastic via floating collection devices that utilize ocean current).

65. Microbead Free Waters Act of 2015, Pub. L. No. 114-114, 129 Stat. 3129 (2015) (codified as amended at 21 U.S.C. § 331(ddd) (2012)).

66. *Id.* § 2(a)–(b).

sand microfiltration, and rapid sand filters,” did not have microbeads detected in their discharged effluent.⁶⁷ Additional research suggests that buoyant microplastics may be removed during the grease separating step of wastewater treatment, while high-density microplastics can be captured in sand trap processes.⁶⁸ While state-of-the-art technology for wastewater treatment plants provides a potential solution to microplastics, upgrades to existing wastewater treatment plants may be costly and time-consuming, and additional research into the effectiveness of wastewater treatment plant microplastic removal should be pursued.

Structural controls to capture plastic debris before it enters waterways present another strategy to reduce microplastics. In California, which has implemented Total Maximum Daily Loads (TMDLs) requiring the reduction of trash input to urban waterways, devices “are being installed at urban catch basins, storm drains and pumping stations, and debris booms are being placed across rivers draining urban areas.”⁶⁹

Reducing plastic waste by curbing the habit of single-use plastics can also reduce secondary microplastics. As discussed in more detail below, local and state governments have begun to institute fees and bans of plastic bags, polystyrene, and plastic bottles as a way to curb the use of single-use plastics.⁷⁰

Addressing microfibers through domestic washing machines is another strategy to reduce microplastics. Researchers believe that filters for washing machines are a promising prospect for reducing the discharge of microfibers, but that more research is necessary to determine their effectiveness.⁷¹ The Rozalia Project

67. N.Y. ATT’Y GEN. STUDY, *supra* note 28, at 6.

68. See Duis & Coors, *supra* note 45, at 6.

69. Moore, *supra* note 42, at 136.

70. See *State Plastic and Paper Bag Legislation*, NAT’L CONF. ST. LEGISLATURES, <http://www.ncsl.org/research/environment-and-natural-resources/plastic-bag-legislation.aspx> (last visited Dec. 15, 2016) (addressing state governments); *Polystyrene Ordinances*, SURFRIDER FOUNDATION, <http://www.surfrider.org/pages/polystyrene-ordinances> (last visited Oct. 10, 2016) (addressing local governments); *What Cities are Banning Plastic Bags, Bottles*, EFFICIENTGOV, <http://efficientgov.com/blog/2014/10/16/cities-banning-plastic-bags-bottles/> (last visited Dec. 15, 2016) (addressing local governments).

71. See Mark A. Browne, *Sources and Pathways of Microplastics to Habitats*, in MARINE ANTHROPOGENIC LITTER 229, 238, 241 (Melanie Bergmann et al. eds., 2015).

has developed a consumer solution to removing microfibers from domestic washing machines, wherein a cyclical “microfiber catcher” is placed in washing machines and extracts microfibers from the wash, thereby preventing microfibers from flowing out with the washing effluent.⁷² Other proposed approaches may also serve as solutions to microplastics, such as the use of “inorganic-organic hybrid silica gels” that “have the ability to remove stressors such as microplastics from wastewater;”⁷³ and the scientific development of biodegradable polymers that would allow a switch in manufacturing from non-biodegradable plastics to fully biodegradable materials.⁷⁴ The effectiveness and cost-benefit ratio of such approaches should be further analyzed.

2. Removal and Cleanup of Microplastics

While most scientists agree that source reduction strategies are the most effective way to reduce microplastic pollution, some have also made the case for large-scale cleanup efforts to remove plastic already in the ocean.⁷⁵ Modeling suggests that ocean cleanup efforts are most effective at reducing microplastics when the cleanup efforts are concentrated closer to shore, rather than inside the plastic accumulation zones in the centers of gyres.⁷⁶ Passive removal of plastics concentrated in the Great Pacific Garbage Patch, though less effective than removal of plastics near shore, is still characterized by some as a viable approach.⁷⁷

Given the pervasiveness of microplastic pollution and its sources, it is likely that multiple approaches are needed to adequately address the problem. In the sections that follow, we analyze the existing legal framework and recommend specific

72. See *A Human-scale Solution to the Biggest Plastic Pollution Problem Facing our Ocean: Synthetic Microfibers*, ROZALIA PROJECT, <http://rozaliaproject.org/stop-microfiber-pollution/> (last visited Dec. 15, 2016).

73. Adrian Frank Herbort & Katrin Schuhen, *A Concept for the Removal of Microplastics from the Marine Environment with Innovative Host-Guest Relationships*, 23 ENVTL. SCI. AND POLLUTION RES. INT’L, <http://link.springer.com/article/10.1007%2Fs11356-016-7216-x>.

74. Olga Goldberg, Note, *Biodegradable Plastics: A Stopgap Solution for the Intractable Marine Debris Problem*, 42 TEX. ENVTL. L.J. 307, 341 (2012).

75. Rochman et al., *supra* note 51, at 2.

76. Sherman & Sebille, *supra* note 64, at 1.

77. BOYAN SLAT ET AL., HOW THE OCEANS CAN CLEAN THEMSELVES: A FEASIBILITY STUDY 33 (2nd ed. 2014), https://www.theoceancleanup.com/fileadmin/mediaarchive/Documents/TOC_Feasibility_study_lowres_V2_0.pdf.

mechanisms to prevent microplastic pollution.

III. THE LAW OF MICROPLASTIC POLLUTION PREVENTION

Given that Congress has passed no laws specifically addressing microplastic pollution control (though there are laws aimed at regulating consumer behavior), we must look to the nation's two main pollution laws, the Clean Air Act and Clean Water Act. Microplastics in the air and water, under even the most conservative reading of these statutes, should be deemed pollutants in need of control. This section discusses this issue in detail. From there, we discuss, for both air and water pollution programs, how and to what extent these laws regulate, limit, and control microplastic pollution.

A. *The Clean Air Act and Massachusetts v. EPA*

1. *The Clean Air Act*

Under the Clean Air Act (CAA), microplastic pollution is much more difficult to fit into existing regulatory systems. Broadly, the CAA mandates the development of National Ambient Air Quality Standards (NAAQS) for specific pollutants.⁷⁸ NAAQS set air quality standards at a level necessary to protect the health of the most vulnerable members of the public. States are charged with implementing programs, with federal oversight, that have locally-tailored rules and requirements for air pollution sources within each state; these programs must ensure that the NAAQS are met and maintained.⁷⁹

One of the key purposes of the CAA, according to Congress, is “to protect and enhance the quality of the Nation’s air resources so as to promote the public health and welfare and the productive capacity of its population.”⁸⁰ An “air pollutant” is defined quite broadly, and includes:

[A]ny air pollution agent or combination of such agents, including any physical, chemical, biological, radioactive (including source material, special nuclear material, and byproduct material) substance or matter which is emitted

78. See 42 U.S.C.A. § 7409(a) (Westlaw through Pub. L. No. 114-316).

79. See *id.* § 7410(a) (Westlaw).

80. *Id.* § 7401(b)(1) (Westlaw).

into or otherwise enters the ambient air.⁸¹

Clearly, the CAA is broadly written. For microplastics, however, it has not been as widely implemented. Using the authority endowed by Congress, the EPA has promulgated standards for just six pollutants: particulate matter (PM), sulfur dioxide (SO₂), nitrogen dioxide (NO₂), carbon monoxide (CO), ozone, and lead.⁸² Thus, while microplastics could be read into the statutory definition of an “air pollutant,” none of the NAAQS yet developed apply to microplastics, and none of the CAA’s requirements that stem from the NAAQS apply.⁸³

Section 202 of the CAA, however, provides that the EPA “from time to time revise” NAAQS.⁸⁴ As discussed *infra*, this avenue (creation of a NAAQS for a pollutant like microplastics) could be one way for the federal government to control this emerging pollution problem.

For some classes of pollutants, hazardous air pollutants (HAPs), Congress provides more space for microplastics to be covered under the CAA. Under the CAA, Congress established a list of these hazardous pollutants to kick-start the EPA’s work toward reaching the maximum degree of pollution reduction achievable.⁸⁵ This list was designed to be augmented, either by the EPA’s own action or upon successful petition from the public.⁸⁶ New HAPs, Congress stated, could be added if they:

[P]resent, or may present, through inhalation or other routes of exposure, a threat of adverse human health effects (including, but not limited to, substances which are known to be, or may reasonably be anticipated to be, carcinogenic, mutagenic, teratogenic, neurotoxic, which cause reproductive dysfunction, or which are acutely or chronically toxic) or adverse environmental effects

81. *Id.* § 7602(g) (Westlaw).

82. 40 C.F.R. §§ 50.4–50.18 (2015).

83. Indeed, microplastics appear to fall within the class of emerging causes of concern that Congress designed the CAA to address: “[T]he growth in the amount and complexity of air pollution brought about by urbanization, industrial development, and the increasing use of motor vehicles, has resulted in mounting dangers to the public health and welfare.” 42 U.S.C.A. § 7401(a)(2) (Westlaw through Pub. L. No. 114-316).

84. *Id.* § 7521(a)(1) (Westlaw).

85. *See id.* § 7412(b), (d)(2) (Westlaw).

86. *Id.* § 7412(b)(3) (Westlaw).

whether through ambient concentrations, bioaccumulation, deposition, or otherwise.⁸⁷

With a broad field of potential HAPs, Congress's test for whether a HAP needs to be regulated was quite simple:

The Administrator *shall add* a substance to the list upon a showing by the petitioner or on the Administrator's own determination that the substance is an air pollutant and that emissions, ambient concentrations, bioaccumulation or deposition of the substance are known to cause or may reasonably be anticipated to cause adverse effects to human health or adverse environmental effects.⁸⁸

Thus, with sufficient evidence presented by a petitioner, adverse microplastic impacts to human health or the environment, by inhalation, through bioaccumulation, or other cause would trigger regulation under the CAA.⁸⁹ A petition making a sufficient showing of the hazards of microplastics in the air would seem to be a second avenue for controlling this emerging air pollution problem.

2. Massachusetts v. EPA

Turning back to whether NAAQS could be developed for microplastics, a key consideration must be the 2007 U.S. Supreme Court decision *Massachusetts v. EPA* and its progeny.⁹⁰ In *Massachusetts v. EPA*, the Supreme Court opened the door for EPA regulation of carbon dioxide as a criteria pollutant; whether microplastics are the "next" such pollutant has not yet been tested in court.

Even a very basic reading of the facts of *Massachusetts v. EPA* showcases the similarities between the pollution under consideration almost ten years ago and the pollution we are grappling with today. In *Massachusetts v. EPA*, greenhouse gas pollution (specifically carbon dioxide) was ubiquitous worldwide, the CAA-regulated facilities were only the source of a fraction of total global emissions, and EPA regulation of the pollutant—even

87. *Id.* § 7412(b)(2) (Westlaw).

88. *Id.* § 7412(b)(3)(B) (Westlaw) (emphasis added).

89. Costs can be considered when setting control technologies or emissions standards for HAPs, once they are listed. *See id.*, § 7412(f)(2)(A) (Westlaw).

90. 549 U.S. 497 (2007).

at a national level—was not likely the silver bullet needed to end the effect of this pollution: global climate change. Because microplastics are found across the planet, EPA regulation of microplastics—in the air or water—is only part of the solution. Similarly, carbon dioxide and microplastics—if controlled as air pollutants—could both lead to extensive regulatory control over a wide spectrum of sources. Each of these issues is discussed in greater detail by the Court.

As perhaps would be the case today if the EPA were pressed to regulate airborne microplastics, the EPA, in 2007, did not “believe that any realistic possibility exist[ed] that [regulation of greenhouse gases] would mitigate global climate change and remedy [petitioners’] injuries.”⁹¹ Regulating the sources of airborne microplastic pollution (such as laundry or industrial facilities) may not solve the problem; microfibers come from buildings, clothes, roads—anything made with synthetic materials. This argument, however, did not persuade the Court in *Massachusetts v. EPA*. It noted that while the first steps toward controlling sources of pollution may be small, they were not—by definition—too small for regulation:

[The EPA’s] argument rests on the erroneous assumption that a small incremental step, because it is incremental, can never be attacked in a federal judicial forum. Yet accepting that premise would doom most challenges to regulatory action. Agencies, like legislatures, do not generally resolve massive problems in one fell regulatory swoop. They instead whittle away at them over time, refining their preferred approach as circumstances change and as they develop a more nuanced understanding of how best to proceed.⁹²

Perhaps most importantly, the Court warned that while a “first step might be tentative,” the CAA’s mandate—that the EPA regulate and control air pollutants that pose risks to the environment or human health—still applied.⁹³ Thus, as the regulation of “motor-vehicle emissions will not by itself reverse global warming,”⁹⁴ regulating microplastics from air sources may

91. *Id.* at 523.

92. *Id.* at 524 (internal citations omitted).

93. *Id.*

94. *Id.* at 525.

not by itself remove these pollutants from our air shed. Nonetheless, as the Court noted, “it by no means follows that we lack jurisdiction to decide whether the EPA has a duty to take steps to slow or reduce it.”⁹⁵

In a similar vein, the Court rejected the EPA’s argument that regulation of air pollutants like carbon dioxide was too big an initiative and was never envisioned by Congress when drafting the CAA.⁹⁶ “In essence, EPA concluded that climate change was so important that unless Congress spoke with exacting specificity, it could not have meant the Agency to address it.”⁹⁷ The EPA also argued that “EPA regulation of motor-vehicle emissions [w]as a piecemeal approach to climate change,” and stated that such regulation “would conflict with the President’s comprehensive approach to [the problem].”⁹⁸ With microplastics, these same conditions apply; there are many diverse sources of air pollutants coming from most—if not all—corners of the economy, and most states and many agencies in the federal government are beginning to develop comprehensive action plans to reduce plastic pollution. In *Massachusetts v. EPA*, however, these lines of reasoning did not persuade the Court:

While the statute does condition the exercise of EPA’s authority on its formation of a “judgment,” that judgment must relate to whether an air pollutant “cause[s], or contribute[s] to, air pollution which may reasonably be anticipated to endanger public health or welfare.” Put another way, the use of the word “judgment” is not a roving license to ignore the statutory text. It is but a direction to exercise discretion within defined statutory limits.⁹⁹

As the Court concluded, “[t]he statutory question is whether sufficient information exists to make an endangerment

95. *Id.*

96. *Id.* at 512.

97. *Id.*

98. *Id.* at 497 (internal citations omitted). The Court noted that this comprehensive approach to climate change “involve[d] additional support for technological innovation, the creation of nonregulatory programs to encourage voluntary private-sector reductions in greenhouse gas emissions, and further research on climate change.” *Id.*

99. *Id.* at 532–33 (citing 42 U.S.C. § 7521(a)(1) (1990)).

finding.”¹⁰⁰

For microplastics, the same conclusion should apply; namely, that any requests to treat microplastics as air pollutants should turn solely on whether they meet the CAA definitions (discussed above) of air pollutant or HAP. Were someone to petition for microplastics (here, as air pollution) to be regulated as air pollutants, this statutory-definition analysis would likely track that of *Massachusetts v. EPA*. As noted above, and cited by the Court as its basis in law:

In relevant part, § 202(a)(1) provides that EPA “shall by regulation prescribe . . . standards applicable to the emission of any air pollutant from any class or classes of new motor vehicles or new motor vehicle engines, which in [the Administrator’s] judgment cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health or welfare.”¹⁰¹

The statute is unambiguous; any air pollution agent—physical or chemical—that is emitted “or otherwise enters the ambient air” can be a pollutant.¹⁰² Microplastics certainly fall within this definition. As with greenhouse gases in *Massachusetts v. EPA*, the only outstanding question is how the EPA would regulate emissions or incentivize “the development and application of the requisite technology, giving appropriate consideration to the cost of compliance.”¹⁰³

If a petition for rulemaking to the EPA asking the agency to treat microplastics as an air pollutant, this hurdle—determining how to regulate emissions—may be more complex than the regulation of greenhouse gasses, but would nonetheless need to be tackled by the EPA. Regulatory complexities should not disqualify microplastics from regulation. As stated by the Court in *Massachusetts v. EPA*, Congress understood that “without regulatory flexibility, changing circumstances and scientific developments would soon render the Clean Air Act obsolete . . . [and that the] broad language of § 202(a)(1) reflects an intentional effort to confer the flexibility necessary to forestall such

100. *Id.* at 534.

101. *Id.* at 528 (citing 42 U.S.C. § 7521(a)(1) (1990)).

102. *Id.* at 529 (citing 42 U.S.C. § 7602(g) (1990)).

103. *Id.* at 531 (citing 42 U.S.C. § 7521(a)(2) (1990)).

obsolescence.”¹⁰⁴

B. *Clean Air Meets Clean Water in Gulf Restoration Network v. McCarthy*

As discussed in more detail below, one of the other key ways to regulate microplastic pollution is through the Clean Water Act (CWA). In the wake of *Massachusetts v. EPA*, courts around the nation have been applying, as we do here, the analysis by the Court to other questions surrounding emerging pollutants. In a recent water-pollution case from the Fifth Circuit U.S. Court of Appeals, *Gulf Restoration Network v. McCarthy*, the court applied *Massachusetts v. EPA* to the issue of microplastic pollution control.

In *Gulf*, the court reviewed the EPA’s decision to deny a petition to create new water quality standards to control nitrogen and phosphorous pollution in the Mississippi River Basin and the Northern Gulf of Mexico.¹⁰⁵ The EPA’s denial of the petition turned on the agency’s decision to defer action to the states:

While the agency agreed that nitrogen and phosphorous pollution “is a significant water quality problem,” it did “not believe that the comprehensive use of federal rulemaking authority is the most effective or practical means of addressing these concerns at this time.” Instead, the EPA said that, because its “long-standing policy, consistent with the CWA, has been that states should develop and adopt standards in the first instance,” and in light of the fact that the states had been “quite active” in addressing water pollution issues, it was appropriate to let the states take the primary role in issuing new standards.¹⁰⁶

The *Gulf* court disagreed with this characterization of the EPA’s responsibilities. Citing the Supreme Court’s holding in *Massachusetts v. EPA*, the *Gulf* court held that under the CWA, as with the CAA, the EPA’s reasons for making—or declining to make—any new water quality determinations must be rooted in

104. *Id.* at 532.

105. *Gulf Restoration Network v. McCarthy*, 783 F.3d 227, 231 (5th Cir. 2015).

106. *Id.*

the statute.¹⁰⁷ It held that, under the CWA, the EPA “is obligated to issue new water quality standards” where the agency finds that “a revised or new standard is necessary” to meet the CWA’s goals.¹⁰⁸

As in *Massachusetts v. EPA*, the test for whether the EPA should consider regulating a pollutant was, by the *Gulf* court, based directly on the statute:

The EPA is required to publish new water quality standards . . . [where any are needed] to protect the public health or welfare, enhance the quality of water and serve the purposes of this chapter. Such standards shall be established taking into consideration their use and value for public water supplies, propagation of fish and wildlife, recreational purposes, and agricultural, industrial, and other purposes, and also taking into consideration their use and value for navigation.¹⁰⁹

The *Gulf* court specifically notes the similarities between water and air pollutant analyses, stating that:

[T]he CAA section at issue in *Massachusetts [v. EPA]* and the CWA provision at issue [in *Gulf*] have the same structure: (1) a mandatory clause requiring the EPA Administrator to issue regulations on a certain topic, (2) if she makes a specific threshold determination, using her bounded discretion, (3) that a substantive standard has been satisfied.¹¹⁰

107. *See id.* at 240 (“Informed by this precedent, we conclude that the EPA’s reasons for declining to make a necessity determination must be rooted in the words of section 1313(c)(4)(B). And because the agency can only justify its decision not to make a necessity determination based on factors identified in the language of the statute, we look to those words to decide whether the statute is sufficiently specific to allow judicial review.”).

108. *Id.* at 229–30.

109. *Id.* at 240 (citing 33 U.S.C. § 1313(c)(2)(A) (2000)).

110. *Id.* at 242. In the *Gulf* court’s background discussion of the mechanics involved in developing a new nutrient water quality standard, the court’s analysis is pertinent to our microplastics pollution problem, and analogous to the greenhouse gas analysis in *Massachusetts v. EPA*. *See id.* The *Gulf* court noted that controlling nutrient pollution from the Mississippi River would require action across a number of states and sectors, and would likely be a highly complex, unique undertaking. *Id.* at 235–36. Moreover, like microplastics and greenhouse gases, nutrient pollution controls in the river basin would likely “grant rights, impose obligations, or produce other

Thus, if the EPA is petitioned to treat microplastics as a new water pollutant or petitioned to create water quality standards for microplastics, under the *Gulf* holding based on *Massachusetts v. EPA*, the EPA must provide “an adequate explanation, grounded in the statute” in deciding whether or not to regulate microplastics.¹¹¹

It is vital to note, here, that these findings did not erode the well-established discretionary latitude given to agencies by the *Gulf* court. The court in *Gulf* cited a number of “other courts who have applied *Massachusetts v. EPA* to similarly structured statutes and concluded that the agency is not required to make a predicate threshold finding,” but has the discretion to do so if and where it decides there is a need.¹¹² The court stressed that the discretion afforded to the EPA in its review of rulemaking petitions (such as what could be submitted calling for microplastics water quality standards) is “at the high end of the range of deference, and such review is extremely limited and highly deferential.”¹¹³

In *Massachusetts v. EPA*, the Court, in *dicta*, concluded that the EPA had already acknowledged the need to regulate greenhouse gasses and had already admitted to the need to classify carbon dioxide as an air pollutant.¹¹⁴ Contrast that to the case at hand, where the *Gulf* court specifically left the door open for the EPA to decide, on remand, whether new water quality standards were needed—remanding the “case to the district court to decide in the first instance whether the EPA’s explanation for why it declined to make a necessity determination was legally sufficient.”¹¹⁵ The instructions given, which would no doubt apply if the EPA was presented with a microplastic petition for rulemaking, directed the lower court “to decide whether the EPA ha[d] provide[d] some reasonable explanation as to why it cannot or will not exercise its discretion.”¹¹⁶ Clearly, “in light of this highly deferential standard of review, the agency’s burden is

significant effects on private interests.” *Id.* at 236 (citing *Am. Hosp. Ass’n v. Bowen*, 834 F.2d 1037, 1045 (D.C. Cir. 1987) (internal citations omitted)).

111. *Id.* at 243.

112. *Id.* at 243 n.86.

113. *Id.* (internal quotations omitted).

114. *Massachusetts v. EPA*, 549 U.S. 497, 500 (2007).

115. *Gulf*, 783 F.3d at 243.

116. *Id.* at 244.

slight.”¹¹⁷

In the administrative process leading to the controversy decided by the *Gulf* court, the agency had decided it did not need to create new water quality standards because of its “long-standing policy” to “let the states take the primary role in issuing new standards,” especially where they have been “quite active.”¹¹⁸ For microplastic pollution, states have indeed been active (not yet “quite active”) in regulating microplastics such as microbeads, and curtailing discharges of macro-plastic pollution that can lead to microplastic pollution. The *Gulf* court, though, invalidated this “long-standing” agency policy, dictating that, as in *Massachusetts v. EPA*, the statute trumps any informal agency policies.¹¹⁹ Thus, a petition asking the EPA to set new water quality standards for microplastics will likely be met with the same analysis and conclusions as in the *Gulf* decision, and will turn on whether the agency decides regulating microplastic pollution fits within the CWA.

B. *Water Pollution Control*

According to the EPA, approximately ninety percent of the plastics in the pelagic marine environment are microplastics.¹²⁰ As noted in the discussion of microplastic sources above, microbeads and microfibers, found in personal care products and synthetic fabrics, are “pervasive in some water bodies,” as they generally are not “removed as part of the wastewater treatment [process]” and therefore are discharged directly into receiving waters largely unchanged.¹²¹ Once in waterways, microplastics can lead to toxic bioaccumulation, be ingested by aquatic organisms, and persist in sediment for unknown lengths of time.

The CWA was enacted in 1972 “to restore and maintain the chemical, physical and biological integrity of the Nation’s

117. *Id.* The court in *Gulf* points to the CWA’s ambiguity as the source of this wide deference, noting that the agency’s burden is light “particularly . . . when the statute is as broadly written as section 1313(c)(4)(B).” *Id.*

118. *Id.* at 231.

119. *See Massachusetts v. EPA*, 549 U.S. at 497; *see also Gulf*, 783 F.3d at 234.

120. *See Trash-Free Waters: Toxicological Threats of Plastic*, EPA, <https://www.epa.gov/trash-free-waters/toxicological-threats-plastic> (last visited Mar. 1, 2017).

121. *Id.*

waters.”¹²² In order to meet this goal, the CWA prohibits discharging pollutants into waters of the United States except as authorized by the statute, unless a polluter has a permit for any such discharge.¹²³ Permits are required for all discharges, including stormwater discharges,¹²⁴ except for a select few exceptions. Generally, these are for discharges from vessels, discharges that are regulated by dredge and fill permits, discharges from private homes into sanitary sewers, and non-point-source agricultural pollution, among others.¹²⁵ Importantly, while discharges from private homes are exempted from permit coverage requirements, the wastewater treatment facilities to which sanitary sewer lines run are not exempt from needing CWA permits.¹²⁶

Permit coverage is meaningless without a frame of reference. In the case of the CWA, the law demands that states adopt water quality standards for every state-wide waterway.¹²⁷ These standards must include a designated use for each waterway (e.g., swimming, commercial ship traffic, or drinking water), the water quality criteria sufficient to protect these uses, and measures to ensure waterways do not regress over time (called anti-degradation).¹²⁸ The EPA is tasked with approving state water quality standards and ensuring that permitted point sources do not cause or contribute to water quality impairments. In short, the CWA required states and the EPA to set water quality goals and uses the point source permitting process as the tool to achieve those goals. At the moment, there are no microplastic-specific water quality standards in the United States.

1. Defining “Pollutant”

Having established how to govern point source discharges, Congress then defined what pollutants would be regulated as part of the water permitting system. The CWA definition of “pollutant” includes, in relevant part, “solid waste . . . sewage, garbage,

122. 33 U.S.C.A. § 1251(a) (Westlaw through Pub. L. No. 114-316).

123. *Id.* § 1311(a) (Westlaw).

124. *Id.* § 1342(p) (Westlaw).

125. *See* 40 C.F.R. § 122.3 (2013), *invalidated by* Catskill Mountains Chapter of Trout Unlimited, Inc. v. U.S. E.P.A., 8 F. Supp. 3d 500 (S.D.N.Y. 2014).

126. *Id.* § 122.3(c).

127. 33 U.S.C.A. § 1313 (Westlaw through Pub. L. No. 114-316).

128. 40 C.F.R. § 131.6 (2016).

sewage sludge . . . and industrial, municipal, and agricultural waste discharged into water.”¹²⁹ Microplastics clearly fit within this broad category—they are discharged into water, they are waste products from some industries and most municipalities, they are certainly solid waste, and they are found in sewage and sewage sludge. The CWA also specifically defines “floatable material” as meaning “any foreign matter that may float or remain suspended in the water column,” including plastic.¹³⁰

Given these two broad definitions, microplastics clearly fit within the statutory definitions of pollutant and “floatable material.” One case particularly useful in this analysis was decided by the Fifth Circuit in 1996.¹³¹ In *Sierra Club, Lone Star Chapter v. Cedar Point Oil Co.*, the court was faced with similar circumstances as our microplastics’ problem.¹³² In *Cedar Point*, a citizen sued over discharge of an “alleged pollutant without a permit even where EPA ha[d] failed to issue a permit or promulgate an effluent limitation to cover the discharge.”¹³³ The EPA had not only failed to issue permits or effluent limitations for the substance in question (a type of oil and gas extraction wastewater), but it had not even ever made a determination that the substance was a “pollutant.”¹³⁴ On the issue of whether the

129. 33 U.S.C.A. § 1362(6) (Westlaw through Pub. L. No. 114-316).

130. *Id.* § 1362(22) (Westlaw). Note that microplastics are not chemically different (necessarily) than “plastic.” Microplastics are simply a physical-size-based subset of the world of plastic wastes.

131. See *Sierra Club, Lone Star Chapter v. Cedar Point Oil Co.*, 73 F.3d 546, 566 (5th Cir. 1996).

132. *Id.*

133. *Id.*

134. *Id.* Note the court’s claim of jurisdiction in this case:

We find that this logic compels a holding that a court may determine in a citizen suit whether a discharged substance is a pollutant, notwithstanding the fact that EPA has failed to issue a permit or to promulgate an effluent limitation that regulates the discharge. *Cedar Point* does not direct us to any statutory authority to the contrary. First, we note that neither the statute nor the legislative history expressly grants EPA the exclusive authority to decide that a substance falls within the statutory definition of pollutant or divests the courts of the same. The D.C. Circuit has interpreted the legislative history of the CWA to mean that Congress has invested EPA with [at least some power] to define the term pollutant[.] While we agree with this assessment, we find no support for the logical leap that this delegation of power necessarily deprives the federal courts of similar authority where EPA has not spoken. It is true that Congress intended EPA to apply the definition of pollutant

CWA definition of “pollutant” was broad or narrow, the court in *Cedar Point* based its decision in part on a 1986 review of the CWA’s legislative history:

Despite the absence of an indisputable catch-all (e.g., “any other waste whatever”), there is little doubt that the recitation of categories in the definition of “pollutant” is designed to be suggestive not exclusive. In the 1972 amendments, Congress meant to carry on the tradition of the Refuse Act, and that tradition was to construe the word “refuse” as condemning each and every variation of damage-inducing wastes that changing technologies could invent. This interpretation is endorsed by *United States v. Hamel*, [551 F.2d 107 (6th Cir. 1977),] which condemns a discharge of gasoline as within a generic understanding of “pollutant,” rather than stretch the less inclusive “biological materials” to cover organically-based petroleum compounds. That the definition of “pollutant” is meant to leave out very little is confirmed by the statutory definition of “pollution,” which means nothing less than the “man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water.” [33 U.S.C. § 1362(19).]¹³⁵

The court concluded that “while the listing of a specific substance in the definition of pollutant may be significant, the fact that a substance is not specifically included does not remove it from the coverage of the statute.”¹³⁶ Here, especially given the CWA inclusion of “plastics” within the definition of floatable material, microplastics would likely be found by the EPA and courts to fit within the definition of “pollutant” even though not specifically listed.

to particular substances and to regulate those substances through effluent standards and permits. Nevertheless, as explained in our discussion regarding stating a claim, Congress also made it unlawful for a person to discharge a pollutant without a permit even where EPA has not applied the definition to the substance being discharged. In such a case, the courts must apply the definition.

Id. at 566–67 (internal citations omitted).

135. *Id.* at 565–66 (quoting 2 WILLIAM H. RODGERS, JR., ENVIRONMENTAL LAW: AIR AND WATER 144 (1986)).

136. *Id.* at 566.

2. *Setting and Applying Water Quality Standards*

Assuming they can be called “pollutants,” microplastics are not yet specifically regulated under the CWA in any water quality standards or effluent limitations. In a 2012 petition to the EPA asking for the agency to develop plastic pollution water quality standards, the Center for Biological Diversity summarized the problem using the plain language of the statute:

Under section 304(a)(1) of the Clean Water Act, the EPA is required to develop and publish water quality criteria accurately reflecting the latest scientific knowledge:

(A) on the kind and extent of all identifiable effects on health and welfare including, but not limited to, plankton, fish, shellfish, wildlife, plant life, shorelines, beaches, esthetics, and recreation which may be expected from the presence of pollutants in any body of water, including ground water;

(B) on the concentration and dispersal of pollutants, or their byproducts, through biological, physical, and chemical processes; and

(C) on the effects of pollutants on biological community diversity, productivity, and stability, including information on the factors affecting rates of eutrophication and rates of organic and inorganic sedimentation for varying types of receiving waters.¹³⁷

These criteria must be issued to the states and be made available to the public. *To date, the EPA has not issued water quality criteria for plastic pollution.*

While the CWA generally leaves the establishment of water quality standards (such as a new microplastics standard) to the states, the EPA may also take direct action. First, if a state’s proposed standard is not consistent with the CWA, the EPA may develop better standards.¹³⁸ Second, the EPA may take unilateral action if it determines that “a revised or new standard is

137. CTR. FOR BIOLOGICAL DIVERSITY, PETITION FOR WATER QUALITY CRITERIA FOR PLASTIC POLLUTION UNDER THE CLEAN WATER ACT, 33 U.S.C. § 1314, at 25 (2012), https://www.biologicaldiversity.org/campaigns/ocean_plastics/pdfs/Petition_Plastic_WQC_08-22-2012.pdf [hereinafter WATER QUALITY CRITERIA].

138. 33 U.S.C.A § 1313(c)(4)(A) (Westlaw through Pub. L. No. 114-316).

necessary.”¹³⁹

In short, it is the job of the EPA, whether it is asked to set water quality standards for new pollutants like microplastics or to improve upon deficient state programs, to “ensure that [water quality standards] are sufficient ‘to protect the public health or welfare, enhance the quality of water and serve the purposes of [the CWA].”¹⁴⁰ The EPA defined its goal to serve the purpose of the CWA to mean that:

[W]ater quality standards should, wherever attainable, provide water quality for the protection and propagation of fish, shellfish and wildlife and for recreation in and on the water and take into consideration their use and value of public water supplies, propagation of fish, shellfish, and wildlife, recreation in and on the water, and agricultural, industrial, and other purposes including navigation.¹⁴¹

In the years since the Center’s plastic pollution petition, which was functionally denied by the EPA (though the agency promised to launch programs, research studies, and policy analyses just short of actual CWA regulation), despite a growing dataset detailing the presence, effects, risks, and sources of microplastics and plastics in general, there are no plastic pollution water quality standards that address the unique problem of microplastic water pollution.

If the Center’s petition was filed again today, in the wake of the *Gulf* decision, courts might push the EPA for more of a finely tuned rationale for declining to regulate this pollutant. While the agency has deference to decide whether to create a new water quality standard, it must base that decision on the statute; the EPA could not leave unanswered the question posed by the Center in 2012 when they asked the EPA to determine if plastics in waterways pose the types of risks Congress sought to remedy with water pollution control.¹⁴²

139. *Id.* § 1313(c)(4)(B) (Westlaw). This is the “necessity determination” section that gave rise to the *Gulf* case, where a citizen’s group petitioned the EPA to use this authority to set new standards for nutrient pollution in the Gulf of Mexico and the Mississippi River.

140. *Gulf Restoration Network v. McCarthy*, 783 F.3d 227, 230–31 (5th Cir. 2015).

141. 40 C.F.R. § 131.2 (2015).

142. In 1975, in a seminal environmental law case centered on the public

Indeed, there is a long history of flexibility and precaution in water pollution control. In *United States v. Frezzo Bros., Inc.*, the Third Circuit specifically concluded that:

Without this flexibility, numerous industries not yet considered as serious threats to the environment may escape administrative, civil, or criminal sanctions merely because the EPA has not established effluent limitations . . . [and thus] dangerous pollutants could be continually injected into the water solely because the administrative process has not yet had the opportunity to fix specific effluent limitations.¹⁴³

As discussed in a 2014 law journal article calling for a ban on microbeads in personal care products, there are two general circumstances where water quality standards exist that could cover microplastic pollution, but do not.¹⁴⁴ First, the article's authors cite to trash and turbidity standards in California and Maryland.¹⁴⁵ Microplastics clearly fit within the definition of trash, and contribute to turbidity, but these two state standards were built to remedy different problems:

California's water quality criteria are found in basin plans . . . [which] prohibit[] floating material, including solids, . . . in concentrations that cause nuisance or adversely affect beneficial uses and discharge of [r]ubbish, refuse, . . . or other solid wastes into surface

and ecosystem health impacts of asbestos fibers (similar in risk profile to microfibers), the Eighth Circuit was faced with a disagreement over the scope of these risks. The court decided, in part, that clean water protections dictate that pollutants be removed:

On this record it cannot be forecast that the rates of cancer will increase from drinking Lake Superior water or breathing Silver Bay air. The best that can be said is that the existence of this asbestos contaminant in air and water gives rise to a *reasonable medical concern for the public health*. The public's exposure to asbestos fibers in air and water creates some health risk. Such a contaminant should be removed.

Reserve Mining Co. v. EPA, 514 F.2d 492, 520 (8th Cir. 1975) (emphasis added).

143. *United States v. Frezzo Bros.*, 602 F.2d 1123, 1128 (3rd Cir. 1979), *cert. denied*, 444 U.S. 1074 (1980).

144. Rachel Doughty & Marcus Eriksen, *The Case for a Ban on Microplastics in Personal Care Products*, 27 TUL. ENVTL. L.J. 277 (2014).

145. *Id.* at 282.

waters and of floating materials from any activity in quantities sufficient to cause deleterious bottom deposits, turbidity or discoloration in surface waters; [and] Maryland's criteria also includes a prohibition of any floating material in amounts sufficient to . . . [c]reate a nuisance.¹⁴⁶

According to the authors, neither state has applied these tests (nuisance, adverse impacts, or deterioration of sediment quality) to microplastics.¹⁴⁷ Second, the authors note that microplastics, as discussed above, fit within the statutory definition of "floating material" and therefore may be covered by CWA floatable material action plans and programs.¹⁴⁸ These programs, especially the EPA's Trash Free Waters initiatives in the N.Y./N.J. Harbor,¹⁴⁹ tend, however, to focus on visible garbage, large plastic pieces, and trash collectable by booms, screens, or other capture devices too coarse to have any impact on microfibers, microbeads, or other microplastics.

3. *Clean Water Conclusions*

In conclusion, given the case law and the language of the statute, under the CWA, microplastics are "pollutants." Based on a dearth of state or federal regulatory language examining in detail whether and to what extent microplastics might be included in water quality standards that already exist for pollutants like garbage and floatables, we cannot consider these programs to provide coverage for microplastic pollution control. As noted above, these programs, in practice, focus more on macro-plastic pollution (e.g., bags, bottles, fishing gear, and floatable, plastic sewage solids); they do not provide solutions to, nor were they written to address, microplastic pollution.

We are left, then, with a gap in regulatory coverage that should be closed by the EPA or states, but which can also be

146. *Id.* (citing CAL. REG'L WATER QUALITY CONTROL BD., S.F. BAY BASIN (REGION 2) WATER QUALITY CONTROL PLAN, ch. 3, at 3-5, tbl. 4-1 (2013); Md. Dep't of the Env't & D.C. Dep't of the Env't Natural Res. Control Bd., *Total Maximum Daily Loads of Trash for the Anacostia River Watershed*, MD. DEP'T OF THE ENV'T 10 (Aug. 2010)) (internal quotations omitted).

147. *Id.* at 282-83.

148. *Id.* at 282.

149. See *Trash-Free Waters*, U.S. ENVTL. PROTECTION AGENCY, <https://www.epa.gov/trash-free-waters> (last visited Mar. 1, 2017).

potentially closed with citizen lawsuits against discharge sources of microplastic pollution, such as wastewater treatment facilities. Such citizen actions could be taken whether or not effluent standards exist for classes of pollutants like microbeads or microfibers.

IV. N.Y./N.J. HARBOR STRATEGIES FOR MICROPLASTIC POLLUTION PREVENTION

While there are no specific national CWA or CAA programs in place—either standards or emission and discharge limitations—applicable to microplastics, states have also failed to incorporate microplastic pollution control into local programs and policies such as stormwater management. Consumer behavior and floatables control programs, though, are beginning to explore the issue, especially within the N.Y./N.J. Harbor. This section discusses some of these local initiatives.

A. *Sewage and Stormwater Treatment and Control*

In most of the country, sewage (toilet flush) and grey water (sink or washing machine) is conveyed through a sanitary sewer system to a wastewater treatment plant for treatment and discharge. Wastewater treatment plants are known sources of primary microplastics, and are seen by some as the last stop for removal of microplastics (and many other emerging contaminants such as pharmaceuticals and other chemicals) before they are discharged into the marine environment.¹⁵⁰ In most cities, stormwater and urban runoff from rain events are conveyed through a separate drainage system directly into waterways without treatment. These municipal separate storm sewer systems are sources of primary and secondary microplastics as well as larger plastic debris that will breakdown into microplastics in the environment.

Furthermore, several communities in New York City and North Jersey have combined stormwater and sewer systems. During dry weather, the system conveys effluent to a treatment plant for treatment and discharge. However, routine rain events can increase the flow to the wastewater treatment plant and

150. Cole et al., *supra* note 1, at 2590; see Fendall & Sewell, *supra* note 27, at 1225.

overwhelm the system's capacity, resulting in CSOs.¹⁵¹ CSO events release raw sewage and debris into coastal waters, and may be a potential source of both primary microplastics as well as plastic debris that will eventually degrade into secondary microplastics.¹⁵²

1. *Publically-Owned Treatment Works*

Publically-owned treatment works (POTWs) receive, primarily, domestic sewage from residential and commercial customers.¹⁵³ Sources of microplastics in POTW effluent “include microbeads used in personal care products, pre-production pellets used as precursors to manufacture plastic products, [and] fibers derived from clothes and fabrics made with synthetic materials (e.g., polyester and acrylic).”¹⁵⁴

CWA requirements for wastewater treatment plants were initially focused on “conventional pollutants” such as pH, total suspended solids, and fecal coliforms, and required all municipal POTWs to treat water at the secondary level (e.g., the process that removes solids and biosolids) by 1977.¹⁵⁵ Primary treatment utilizes settling tanks where sediments and organic materials settle out of the wastewater. Secondary treatment is known as the “activated sludge process” and uses aeration to stimulate “the growth of oxygen-using bacteria and other tiny organisms that are naturally present in the sewage. These beneficial microorganisms

151. See *Combined Sewer Outflows*, N.Y.C. DEP'T OF ENVTL. PROTECTION, http://www.nyc.gov/html/dep/html/stormwater/combined_sewer_overflow.shtml (last visited Mar. 6, 2017); see also *FAQs—Individual Combined Sewer Outflows (CSO) Permits*, N.J. DEP'T OF ENVTL. PROTECTION, <http://www.nj.gov/dep/dwq/pdf/cso-faqs-12-21.pdf> (last visited Mar. 6, 2017).

152. See *Combined Sewer Outflows*, N.Y.C. DEP'T OF ENVTL. PROTECTION, http://www.nyc.gov/html/dep/html/stormwater/combined_sewer_overflow.shtml (last visited Mar. 6, 2017).

153. C.F.R. § 403.3(o) defines a POTW as “a treatment works as defined by section 212 of the [Clean Water] Act” that is owned by a state or municipality (as defined by section 502(4) of the CWA). 40 C.F.R. § 403.3 (2005).

154. Rebecca Sutton, et al., *Microplastic contamination in the San Francisco Bay, California, USA*, 109 MARINE POLLUTION BULL. 230, 230 (2016).

155. 33 U.S.C.A. § 1311(b) (Westlaw through Pub. L. No. 114-316); Clean Water Act of 1977, Pub. L. No. 95-217, § 304(a)(4), 91 Stat. 1566, 1587 (1977); 33 C.F.R. § 401.16 (2015); see *New York City's Wastewater Treatment System*, N.Y.C. DEP'T OF ENVTL. PROTECTION, <http://www.nyc.gov/html/dep/html/wastewater/wssystem-process.shtml>.

consume most of the remaining organic materials . . . and this produces heavier particles that will settle out later in the treatment process.”¹⁵⁶ According to the New York City Department of Environmental Protection, “[p]rimary and secondary treatments remove about [eighty-five to ninety-five percent] of pollutants from the wastewater before the treated wastewater is disinfected and discharged into local waterways.”¹⁵⁷

Secondary treatment requirements addressed the majority of the conventional pollutant impacts on waterways and by 1977 the EPA began focusing on effluent limitations on toxic pollutant discharges and nonconventional pollutants such as ammonia and chlorine.¹⁵⁸ However, no requirement has been promulgated by the EPA, nor at the state level in New York or New Jersey, for a “tertiary treatment” requirement. Neither has a microplastic effluent recommendation or limitation been developed by the EPA or states. The many regulatory hurdles, lack of certainty, and tremendous costs associated with treating for pharmaceuticals and primary care products have also hampered any regulatory efforts to regulate microplastics at the POTW level.¹⁵⁹ In fact, to our knowledge, POTWs in the N.Y./N.J. Harbor have not yet begun to implement routine monitoring of microplastic levels in influent and effluent—the first step in any regulatory process.

While tertiary treatment technologies have been implemented at some POTWs in New York and New Jersey, these investments are tied to attaining more stringent water quality limits, or maintaining current water quality effluent standards on a smaller facility footprint (i.e., plant treatment capacity increase without physical footprint increase) than any effluent limit or technology based limitation. In 2012, as noted above, the Center for Biological Diversity petitioned the EPA to establish national water quality criteria pursuant to § 304(a)(1) of the CWA, requiring states to “either adopt the national recommended water

156. *New York City’s Wastewater Treatment System*, N.Y.C. DEP’T OF ENVTL. PROTECTION, <http://www.nyc.gov/html/dep/html/wastewater/wwsystem-process.shtml>.

157. *Id.*

158. See Clean Water Act of 1977, Pub. L. No. 95-217, § 307, 91 Stat. 1566, 1589 (1977); 33 C.F.R. § 401.15 (2015).

159. Gabriel Eckstein, *Drugs on Tap: Managing Pharmaceuticals in Our Nation’s Waters*, 23 N.Y.U. ENVTL. L.J. 37, 37, 51 (2015).

quality criteria as part of their water quality standards or provide a science-based explanation for alternate criteria.”¹⁶⁰ The EPA responded to the petition, pledging to “take steps to cut plastic pollution in oceans, improve monitoring and conduct a scientific review of the human-health effects of eating fish that have ingested plastics and other pollution.”¹⁶¹

A recent study of microplastics discharged from treatment plants found that it was not at all clear what effect advanced treatment processes such as tertiary treatment had on microplastic amounts in effluent.¹⁶² In essence, current wastewater treatment technologies are not designed to remove microplastics and other contaminants from wastewater before it is discharged.¹⁶³ Rather, microplastic removal is an incidental occurrence—they may be removed in secondary treatment during the skimming and settling processes, or captured through advanced filtration or other treatment, however, their small size, buoyancy, and lack of reactivity limits removal.¹⁶⁴ As Gabriel Eckstein wrote about potential pharmaceutical effluent limits for POTWs, “[t]reating for these substances after they enter the sewage or wastewater system or the environment is costly and out of the financial reach of most municipalities and wastewater and drinking water treatment operators.”¹⁶⁵ This statement would also seem to apply to microplastics.

2. *Municipal Separate Storm Sewer Systems*

In 1990, the EPA issued “Phase I” regulations for discharges of stormwater from industrial facilities, large development projects, and large cities with separate storm sewer systems (large MS4s), and in 1999, issued “Phase II” permit rules to cover smaller cities (small MS4s) and other industrial sources.¹⁶⁶ Stormwater regulations are carried out under the National Pollutant Discharge Elimination System (NPDES), authorized in

160. WATER QUALITY CRITERIA, *supra* note 137, at 26.

161. *Ocean Plastics Pollution: A Global Tragedy For Our Oceans And Sea Life*, CTR. FOR BIOLOGICAL DIVERSITY, http://www.biologicaldiversity.org/campaigns/ocean_plastics/ (last visited Mar. 16, 2017).

162. *See* Doughty & Eriksen, *supra* note 144, at 280.

163. *Id.*

164. Sutton, et al., *supra* note 154, at 130.

165. Eckstein, *supra* note 159, at 40.

166. *See* CLAUDIA COPELAND, CONG. RESEARCH SERV., 97–290, STORMWATER PERMITS: STATUS OF EPA’S REGULATORY PROGRAM (2012).

§ 402 of the CWA.¹⁶⁷ Under the CWA, it is illegal to discharge pollutants from point sources (e.g., industrial plant pipes, sewage treatment plants, or storm sewers) into the nation's waters without an NPDES permit.¹⁶⁸ The EPA manages the NPDES stormwater program in Idaho, Massachusetts, New Hampshire, and New Mexico, the District of Columbia, and most U.S. territories; it has delegated regulatory authority to the remaining forty-six states, including New York and New Jersey, and the U.S. Virgin Islands.¹⁶⁹

Stormwater permits issued to municipalities with separate storm sewer systems require cities to develop, implement, and enforce a stormwater management program that contains key elements such as public education, eliminating illicit connections to storm sewers, good housekeeping of municipal operations, and control of erosion and sedimentation from construction sites.

New Jersey Stormwater Permitting Rules, first promulgated in 2004, and again in 2009 and 2016, require large public complexes and MS4s to develop and implement a Stormwater Pollution Prevention Plan requiring municipal stormwater management planning, public education programs, as well as requirements to address the improper disposal of waste, solids and floatable controls, and maintenance yard operations.¹⁷⁰ The New Jersey Department of Environmental Protection recently released and is currently finalizing the 2016 preliminary draft versions of stormwater permits for both large and small MS4s.¹⁷¹ The 2016 permits contain some improvements over the original; however, there remain no measurable permit terms, no requirement for monitoring discharges, and no true linkage between permit terms and impaired waterways.

In 1994, stormwater related requirements were implemented by the New York City Department of Environmental Protection (New York City DEP).¹⁷² Until August 2015, those requirements were incorporated into the State Pollution Discharge Elimination

167. 33 U.S.C.A. § 402 (Westlaw through Pub. L. No. 114-316).

168. *Id.*

169. COPELAND, *supra* note 166.

170. N.J. ADMIN CODE § 7:8.

171. *Id.*

172. NYC Municipal Separate Storm Sewer System: 2016 Progress Report, N.Y.C. DEP'T OF ENVTL. PROTECTION (2016), http://www.nyc.gov/html/dep/pdf/water_sewer/ms4-progress-report.pdf.

System (SPDES) permits for the city's fourteen individual wastewater treatment plants.¹⁷³ On August 1, 2015, the New York State Department of Environmental Conservation (New York DEC) issued the first ever MS4 permit to New York City, of which approximately thirty-five to forty percent is served by a separate storm sewer system. The MS4 permit requires that New York City adopt specific practices that will "control the various sources of pollutants and their means of entry into the MS4, reducing pollution system-wide to the maximum extent practicable with the goal of attainment of water quality standards."¹⁷⁴

The permit requires New York City to develop a Stormwater Management Plan that addresses public education and participation, illicit discharges, construction sites, post construction management practices as well as municipal best practices. The permit also requires New York City to target and control "floatable and settleable trash and debris" by identifying the best available control technologies that can be implemented within New York City.¹⁷⁵ However, no mention is specifically made to plastic pollution or emerging contaminants like microplastics. Pollutants are defined by the permit terms to include:

[D]redged spoil, filter backwash, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand and industrial, municipal, and agricultural waste discharged into water; which may cause or might reasonably be expected to cause pollution of the waters of the State in contravention of the standards or guidance values adopted as provided in 6 New York Code of Rules and Regulations ('NYCRR') Part 750-1.2a.¹⁷⁶

173. *Id.*

174. *Fact Sheet for New York State Department of Environmental Conservation SPDES Permit for Stormwater Discharges from Municipal Separate Storm Sewer Systems of New York City*, N.Y.C. DEP'T OF ENVTL. PROTECTION (2015), http://www.dec.ny.gov/docs/water_pdf/nycms4factsheet.pdf.

175. *Id.*

176. STATE POLLUTANT DISCHARGE ELIMINATION SYSTEM (SPDES) DISCHARGE PERMIT, N.Y. ST. DEP'T OF ENVTL. CONSERVATION 46 (2015)

New York City's Stormwater Management Plan (SWP) is currently being developed, with a target date of submittal to the New York DEC of August 1, 2018. As microplastics are not currently included in New York's water quality standards, it is unlikely the SWP for New York City will include specific control measures designed to abate microplastic pollution.

For larger plastic pieces, both New York City and New Jersey MS4 permits require litter and debris abatement actions. New York City's MS4, in particular, holds promise for addressing the flow of plastic debris into the harbor by requiring an interim floatables and debris management strategy while developing a goal to determine loading rates of floatables and trash and debris from MS4s to waterbodies. This research may eventually be used to support the pursuit of a trash TMDL, or provision in the MS4 permit to require measurable reductions in trash discharge. Using NPDES permits to address point sources of trash can significantly reduce the amount of trash reaching waterways, and cities such as Los Angeles, San Francisco, and Honolulu are utilizing these tools in varying capacities.¹⁷⁷ It is also likely that New York City will incorporate catch basin inspection and clean out, street sweeping, and improper disposal of waste measures in the final SWP. These measures will reduce the amount of plastic debris that is conveyed into waterways during rain events. In turn, reductions in microplastics (at the least, those generated by degradation of larger plastic pieces) should follow.

The New York City MS4 Permit contains a mandate for the identification of "MS4 Priority Waterbodies" which would trigger additional or customized nonstructural best management practices as well as identification of pilot green infrastructure project opportunities.¹⁷⁸ In New Jersey, New Jersey Administrative Code § 7:14 includes "additional measures" that would require the New Jersey Department of Environmental Protection (New Jersey DEP) in an MS4 permit to address a water quality impairment.¹⁷⁹ However, there was never a requirement

http://www.nyc.gov/html/dep/pdf/water_sewer/spdes-ms4-permit.pdf.
[hereinafter SPDES DISCHARGE PERMIT].

177. *Trash-Free Waters: The Clean Water Act and Trash-Free Waters*, U.S. ENVTL. PROTECTION AGENCY, <https://www.epa.gov/trash-free-waters/clean-water-act-and-trash-free-waters> (last visited Mar. 6, 2017).

178. SPDES DISCHARGE PERMIT, *supra* note 176, at 8.

179. N.J. ADMIN. CODE 7:14A-25.6(e) (Westlaw through 2016).

to actually identify and implement additional measures in New Jersey and New Jersey DEP has, to our knowledge, failed to utilize this regulatory tool at all. Yet, the New York City “MS4 Priority Waterbody” and New Jersey DEP “additional measures” regulatory tools hold the potential to be utilized to address microplastic contamination in receiving waterways.

Retrofitting stormwater inlets is required in New Jersey as the MS4 permits seek to phase out outdated inlet designs that allow trash and debris to be swept into the system. More ambitious retrofitting projects, including filtration systems designed into the structure or inserted in catch basins and even outfall pipes have also been explored, and implemented in private development projects and pilot projects,¹⁸⁰ but are not currently required. Filtration systems and filter inserts may provide a potential microplastic reduction benefit; however, the cost of maintenance and replacement is high, and may make these options unpalatable to municipalities. Furthermore, it has become increasingly clear that low impact development and green infrastructure implementation are both cheaper and more effective than standard “grey infrastructure” for the reduction and treatment of stormwater.¹⁸¹ While green infrastructure practices may not directly capture microplastics, the reduction in total stormwater volume entering waterways would also reduce the total volume of stormwater conveyed microplastics, plastics and debris that enter the harbor every time it rains.

Unfortunately, New Jersey’s MS4 program has continued to be criticized due to ineffective implementation and limited green infrastructure requirements among other issues, and New York City’s proposed MS4 program has faced similar criticisms.¹⁸²

180. Austin Meyermann, *Super Size My Stormwater Treatment System, Please!*, BAYSAVER TECH. (Oct. 13, 2006), http://www.baysaver.com/news_events/published_articles/oct_2006.html.

181. Glen Scherer, *Low Impact Development (LID) As a Solution to the CSO Problem In the NY-NJ Harbor Estuary (A Policy Briefing Paper)*, N.Y./N.J. BAYKEEPER 5, http://nynjbaykeeper.org/wp-content/uploads/2013/05/CSO-LID-FINALTEXT-11-7-07_andy.pdf (last visited Mar. 17, 2017); Janet Clements & Alexis St. Juliana, *The Green Edge: How Commercial Property Investment in Green Infrastructure Creates Value*, NAT’L RESOURCES DEF. COUNCIL (Dec. 2013), <https://www.nrdc.org/sites/default/files/commercial-value-green-infrastructure-report.pdf>.

182. See letter from Helen Henderson, et al., Manager, Atlantic Coast Programs, to Bob Martin, Commissioner, New Jersey Department of Environmental Protection (Feb. 4, 2014) (on file at

3. Combined Sewer Systems and Combined Sewer Overflows

Combined sewers convey sewage to a treatment plant, just as separate sewers do. However, they also carry stormwater during wet weather events. When the combined volume of sewage and stormwater flow is too high for the treatment plant to handle, the system is designed to discharge directly into nearby water bodies without treatment. Approximately sixty percent of New York City is serviced by a combined sewer system.¹⁸³ In New York City, CSO outfalls in the five boroughs discharge 25 to 30 billion gallons of CSO every year.¹⁸⁴ In New Jersey, twenty-one communities discharge 7 billion gallons of CSO every year through outfalls.¹⁸⁵ The majority of these outfalls are located in the northern New Jersey area, and contribute pollution to the N.Y./N.J. Harbor.¹⁸⁶

Due to the enormous costs of replacing sewer and stormwater infrastructure, CSO abatement has been a slow process.¹⁸⁷ In 2011, the New York DEC and New York City DEP identified numerous modifications to the existing 2005 CSO Consent Order, including integration of some green infrastructure into the plans

https://www.nrdc.org/sites/default/files/mediauploads/nj_ms4_permit_petition_2-4-14_with_exhibits.pdf); letter from Karen Argenti & Dart Westphal, Co-Chairs, Water Committee, Brooklyn Council for Environmental Quality, to Steve A. Watts, Regional Permit Administrator, Department of Environmental Conservation Region 2 (Apr. 10, 2015) (on file at http://www.dec.ny.gov/docs/water_pdf/nycms4draftcom.pdf).

183. *The State of the Sewers*, N.Y.C. DEP'T OF ENVTL. PROTECTION 2 (2013), <http://www.nyc.gov/html/dep/pdf/reports/state-of-the-sewers-2013.pdf>.

184. *Be a Clean Water Steward*, *supra* note 36, at 4; LTCP Frequently Asked Questions, N.Y. ST. DEP'T OF ENVTL. CONSERVATION (last visited Apr. 24, 2017) http://www.nyc.gov/html/dep/pdf/cso_long_term_control_plan/ltcp_faqs_handout.pdf.

185. *New Jersey Combined Sewer System Fact Sheet*, N.J. FUTURE 1 (2015), <http://www.njfuture.org/wp-content/uploads/2015/03/New-Jersey-Combined-Sewer-System-Fact-Sheet.pdf> (last visited Mar. 6, 2017) [hereinafter *NJ Sewer System Fact Sheet*]; *What is a Combined Sewer Overflow?*, N.J. DEP'T OF ENVTL. PROTECTION (last visited Apr. 24, 2017) <http://www.nj.gov/dep/dwq/cso-basics.htm>.

186. Daniel J. Van Abs, *Water Infrastructure in New Jersey's CSO Cities: Elevating the Importance of Upgrading New Jersey's Urban Water Systems*, N.J. FUTURE 40 (2014), http://www.njfuture.org/wp-content/uploads/2014/04/VanAbs_Urban-Water-Infrastructure-Report-Revised-Final-June-2014.pdf.

187. *See id.* at ix. ("While not all municipalities have estimated the costs of upgrading their existing infrastructure to ensure system viability, enough have to know that the total costs will be in the billions of dollars as well, for just these twenty-one municipalities.").

and fixed dates for submittal of the Long Term Control Plans.¹⁸⁸ Currently, New York City DEP is developing and submitting Long Term Control Plans (LTCPs) to the New York DEC for approval.¹⁸⁹ The LTCPs are intended to reduce the frequency and amount of CSO events in eleven waterways within the N.Y./N.J. Harbor using a mix of green and grey infrastructure approaches to stormwater management.¹⁹⁰

In 1995, the New Jersey DEP implemented nine Minimum Control Measures for New Jersey CSO communities.¹⁹¹ These measures include “maximum use of the collection system storage,” solid and floatable debris reduction using trash racks and screens, and inspection and maintenance of the system.¹⁹² According to N.Y./N.J. Baykeeper monitoring, large amounts of solids and floatables are found and removed from the required screens and catches at the ends of CSO pipes.¹⁹³ These Minimum Control Measures have reduced the amount of plastic material entering waterways during CSO events, however, the goal for communities is to reduce or eliminate the frequency, amount, and damage caused by CSO events by utilizing green infrastructure and low impact development implementation, grey infrastructure projects, and innovative end of pipe measures such as screens, filters, and treatment.¹⁹⁴

To start this process, the New Jersey DEP issued twenty-five individual CSO permits to municipalities and utilities in 2015, which requires the development of LTCPs and implementation schedules for the reduction and elimination of CSO discharges.¹⁹⁵ Permittees will complete their plans by June 1, 2020, and submit

188. N.Y. ST. DEP'T OF ENVTL. CONSERVATION, ORDER ON CONSENT, DEC Case No. CO2-20110512-25, ¶¶ 14, 16 (2011).

189. *See id.* ¶ 26.

190. *See id.* ¶ 19.

191. *Nine Minimum Controls*, N.J. DEP'T OF ENVTL. PROTECTION, <http://www.nj.gov/dep/dwq/cso-nine.htm> (last updated Feb. 28, 2017).

192. *Id.*; *see also Combined Sewer Overflows: Guidance for Nine Minimum Controls*, U.S. ENVTL. PROTECTION AGENCY 1–7 (1995), <http://www.nj.gov/dep/dwq/pdf/1995-05-nmc-guidance-epa-832-b-95-003.pdf>.

193. *CSO Update—One Year in for New CSO Individual Permits*, N.Y./N.J. BAYKEEPER, <http://nynjbaykeeper.org/cso-update-one-year-in-for-new-cso-individual-permits/> (last visited Mar. 7, 2017).

194. *See Trash-Free Waters*, U.S. ENVTL. PROTECTION AGENCY, <https://www.epa.gov/trash-free-waters/clean-water-act-and-trash-free-waters> (last visited Mar. 16, 2017).

195. *NJ Sewer System Fact Sheet*, *supra* note 185, at 2.

to New Jersey DEP for approval.¹⁹⁶ Once approved, CSO communities must start to begin the process of implementation.¹⁹⁷

The approval and implementation of LTCPs for New York City and New Jersey communities is the start of a long expensive process. However, improved water quality, jobs, and implementation of beneficial green infrastructure in urban areas are just some of the benefits of this necessary work. LTCPs should reduce the overall frequency and volume of CSO events in the N.Y./N.J. Harbor. This should directly reduce the total volume of primary microplastics and fibers from CSO events, and direct these particles instead to POTWs where treatment processes can capture at minimum a portion of these contaminants. Furthermore, reductions in frequency and volume of CSO events would also reduce total floatables and debris entering the harbor, and eliminate source material for secondary microplastic weathering.

Once again, conventional grey infrastructure and end of pipe solutions may be proposed to address these issues and may be necessary if designing a system targeted at microplastic and debris reduction; however, for now, environmental organizations and communities have focused on green infrastructure and reduction in total volume of stormwater as both the best value and most environmentally beneficial strategy to addressing CSO discharges.

B. *Consumer Behavior*

It is clear that individual behaviors will need to change in order to address the growing plastic pollution problems. Currently, marine debris is generally addressed through: (1) educational programs focusing either on litter prevention or storm water pollution; (2) trash and debris collection and cleanup on streets, highways, and beaches and in waterways and storm drains; (3) bans and prohibitions on the use of certain materials such as polystyrene food containers or smoking at beaches; (4) local anti-litter enforcement; and (5) state regulation of storm water discharges. Yet, these efforts have thus far proven rather ineffective in addressing microplastic pollution.

The general scientific consensus on microplastics is that these

196. *See id.*

197. *See id.*

substances are harmful to human health and the environment.¹⁹⁸ Because of how ubiquitous the use of plastics are in everyday consumer products, the multitude of potential sources, and extent of contamination in the environment, the only viable regulatory pathway towards addressing these contaminants may be “pulling up the roots of the contaminants” by controlling microplastics and other CECs at their source—the manufacturer.¹⁹⁹ Manufacturers respond to regulations (traditional “command and control”) as well as to economic incentives and disincentives. These market forces can be brought to bear by fees, taxes, or incentives or by individual consumer choices.

In the United States, a successful example of using the market to affect individual behavior is the bottle bill or bottle deposit program. In the eleven states that now have a bottle bill, the average redemption rate is nearly double that of non-bottle bill states with a strong correlation between the deposit rate and the redemption rate.²⁰⁰ New York City has passed a five-cent single use plastic bag fee,²⁰¹ and successfully passed a ban on polystyrene containers, which was unfortunately struck down by New York’s Supreme Court.²⁰² In New Jersey, efforts to pass a plastic bag ban/fee have been ongoing since 2008; however, these efforts have stalled.²⁰³

Currently, there is no method for holding manufacturers of

198. See *Human Health Impacts of Microplastics and Nanoplastics*, N.J. DEPT OF ENVTL. PROTECTION 3 (2016), <http://www.state.nj.us/dep/sab/NJDEP-SAB-PHSC-final-2016.pdf>.

199. Ashleigh K. Acevedo, *Still Emerging, Not Yet Concerning: Cutting off Contaminants of Emerging Concern at Their Source*, THE LONE STAR CURRENT 1, 6 (July 2016), <http://www.lglawfirm.com/wp-content/uploads/2016/07/July-2016-Vol-21-No-3.pdf>.

200. See *Bottle Bills Promote Recycling and Reduce Waste*, BOTTLE BILL RESOURCE GUIDE, <http://www.bottlebill.org/about/benefits/waste.htm> (last visited Mar. 6, 2017).

201. J. David Goodman, *5¢ Fee on Plastic Bags Is Approved by New York City Council*, N.Y. TIMES (May 5, 2016), http://www.nytimes.com/2016/05/06/nyregion/new-york-city-council-backs-5-cent-fee-on-plasticbags.html?_r=0. The New York State Legislature subsequently passed, and Governor Cuomo signed, legislation that effectively killed New York City’s plastic bag fee. See Jesse McKinley, *Cuomo Blocks New York City Plastic Bag Law*, N.Y. TIMES (Feb. 14, 2017) https://www.nytimes.com/2017/02/14/nyregion/cuomo-blocks-new-york-city-plastic-bag-law.html?_r=0.

202. See *id.*

203. See Susan K. Livio, *That plastic bag is going to cost you, N.J. bill says*, NJ.COM (May 19, 2016, 6:53 PM), http://www.nj.com/healthfit/index.ssf/2016/05/using_that_plastic_bag_is_going_to_cost_you_nj_bil.html.

plastic materials liable for the harm caused by their products. Extended producer responsibility is a strategy designed to promote the integration of environmental costs associated with goods throughout their life cycles into the market price of the products.²⁰⁴ Many European nations have passed extended producer responsibility laws to increase reuse and recycling of plastics.²⁰⁵ The Resource Conservation and Recovery Act could also potentially function to require extended producer responsibility.²⁰⁶ However, currently, there is no requirement for plastic manufacturers to extend their responsibility for the products they produce.

C. *National Ocean Policy and Marine Debris Management*

The Mid-Atlantic Regional Planning Body (RPB) is a collaboration of federal, state, tribal, and Mid-Atlantic Fishery Management Council representatives authorized by executive order and the National Ocean Policy Implementation Plan.²⁰⁷ Recently, the RPB released a draft Mid-Atlantic Ocean Action Plan (OAP) for comment.²⁰⁸ The Mid-Atlantic OAP contains actions designed to achieve two main goals: “Promote Healthy Ocean Ecosystems” and “Foster Sustainable Ocean Uses.”²⁰⁹ Healthy Ocean Ecosystem Action 4 aspires to “develop a regionally appropriate strategy for marine debris reduction.”²¹⁰ The Mid-

204. *Extended Producer Responsibility: A Guidance Manual for Governments*, ORG. FOR ECON. COOPERATION AND DEV. 9 (2001), http://www.oecd-ilibrary.org/environment/extended-producerresponsibility_9789264189867-en.

205. See John H. Tibbetts, *Managing Marine Plastic Pollution: Policy Initiatives to Address Wayward Waste*, ENVTL. HEALTH PERSP. 92 (2015), <http://ehp.niehs.nih.gov/wp-content/uploads/123/4/ehp.123-A90.acco.pdf>.

206. *Summary of the Resource Conservation and Recovery Act*, U.S. ENVTL. PROTECTION AGENCY, <https://www.epa.gov/laws-regulations/summary-resource-conservation-and-recovery-act> (last visited Dec. 1, 2016).

207. *Mid-Atlantic Regional Planning Body*, BUREAU OF OCEAN ENERGY MGMT., <https://www.boem.gov/Mid-Atlantic-Regional-Planning-Body/> (last visited Mar. 7, 2016); see also *National Ocean Policy Implementation Plan*, NAT'L OCEAN COUNCIL 6 (Apr. 2013), https://obamawhitehouse.archives.gov/sites/default/files/national_ocean_policy_implementation_plan.pdf.

208. See *Draft Mid-Atlantic Regional Ocean Action Plan*, MID-ATLANTIC REGIONAL PLANNING BODY 9 (2016), <http://midatlanticocean.org/wp-content/uploads/2016/07/Draft-MidA-Regional-Ocean-Action-Plan.pdf> [hereinafter *Ocean Action Plan*].

209. *Id.* at 36, 43.

210. *Id.* at 40.

Atlantic OAP acknowledges the threat of marine debris and necessity for reduction actions and states that the “purpose of this action is to build on efforts of NOAA’s Marine Debris Program, EPA’s Trash Free Waters Program, and other existing programs and partnerships in the region to develop regionally appropriate and feasible marine debris reduction strategies.”²¹¹ However, there are several issues that hinder a National Ocean Policy led marine debris reduction strategy.

First, the actual binding effect of the National Ocean Policy and Mid-Atlantic RPB’s planning exercise is unclear. The term “policy” connotes a guidance role more than a binding requirement, and furthermore, the National Ocean Policy itself states it does not create any new regulations, jurisdiction, or authority.²¹² Rather, the National Ocean Policy is strictly meant to improve agency coordination and collaboration. While this function is certainly needed, the impact of these improved lines of communication is not yet known. The Mid-Atlantic RPB echoed this position in the draft Mid-Atlantic OAP, stating, “[t]he RPB Charter explains that the RPB ‘is not a regulatory authority and has no independent legal authority to regulate or otherwise direct Federal, State, Tribal entities, local governments, or the [Mid-Atlantic Fishery Management Council].’ The goal of the regional planning process is to guide and align Federal and State activities, consistent with their existing authorities.”²¹³

Second, land-based sources comprise eighty percent of marine debris in our marine environment.²¹⁴ The Mid-Atlantic OAP contains a geographic focus that begins at the shoreline and extends seaward to two-hundred nautical miles.²¹⁵ The Mid-Atlantic OAP does not extend to land-based sources, nor does it apply to estuaries, tidal rivers, or other inshore areas.²¹⁶ It is nearly impossible to address the marine debris issues in the Mid-Atlantic without addressing land-based activities, regulations, and

211. *Id.*

212. *See Ocean Action Plan, supra* note 208, at 2; Emily Migliaccio, *The National Ocean Policy: Can It Reduce Marine Pollution and Streamline Our Ocean Bureaucracy?*, 15 VERMONT J. OF ENVTL. L. 629, 647–48 (2014).

213. *Ocean Action Plan, supra* note 208, at 13.

214. Claire Le Guern, *When The Mermaids Cry: The Great Plastic Tide*, COASTAL CARE, <http://coastalcare.org/2009/11/plastic-pollution/?override=1> (last visited Mar. 16, 2017).

215. *See Ocean Action Plan, supra* note 211, at 22.

216. *Id.*

policies.

Finally, the Mid-Atlantic OAP does not identify a timeline or schedule for achieving this action, nor does it identify specific funding sources for developing and implementing this action. Clearly, as microplastics do not neatly fit within any existing initiatives of the National Ocean Policy, and because the sources of microplastics are outside the jurisdiction of the National Ocean Policy, this mechanism for reducing plastic pollution appears untenable in the N.Y./N.J. Harbor.

D. *Conclusions*

Because of the proximity of New York and New Jersey CSO and MS4 outfalls, achieving water quality goals in the harbor will require cooperation and coordination between states. Regionally focused research is critical in quantifying the extent of microplastics duration, and identifying shared resources for floatable and debris management and monitoring efforts. There are several models to look to, such as the toxics reduction work plan for the N.Y./N.J. Harbor that was initiated as a response to harbor dredging issues.²¹⁷ New York DEC and New Jersey DEP can utilize currently existing tools such as TMDLs and NPDES stormwater permits to address point sources of trash,²¹⁸ bag and bottle fees or bans, and education and outreach activities to influence consumer behavior.

The New York City DEP is tasked with developing and implementing the MS4 permit program for New York City, as well as the LTCPs for New York City CSO communities. New York DEC is tasked with oversight and monitoring responsibilities. The situation is a bit different in New Jersey, where the municipalities tasked with implementing MS4 requirements and CSO LTCPs are much smaller than New York City, and therefore have fewer resources to implement these programs. Therefore,

217. See *New York/New Jersey Harbor Contaminant Assessment and Reduction Project*, N.Y. ST. DEPT OF ENVTL. CONSERVATION, <http://www.dec.ny.gov/chemical/23839.html> (last visited Mar. 7, 2016); Joel A. Pecchioli, *The New Jersey Toxics Reduction Workplan for NY-NJ Harbor*, N.J. DEPT OF ENVTL. PROTECTION, <http://www.state.nj.us/dep/dsr/njtrwp/Nov05SeminarIntro.pdf> (last visited Mar. 16, 2017).

218. *The Clean Water Act and Trash-Free Waters*, U.S. ENVTL. PROTECTION AGENCY, <https://www.epa.gov/trash-free-waters/clean-water-act-and-trash-free-waters> (last updated Nov. 3, 2016).

the New Jersey DEP has a much larger role to play in facilitating MS4 implementation and compliance and implementation of LTCPs for CSO communities.

An aspirational goal exists for the EPA to eventually regulate microplastics pursuant to § 304(a)(1) of the CWA, requiring states to either adopt the national recommended water quality criteria as their part of their water quality standards.²¹⁹ However, the pace of criteria development is glacial, and in the meantime, federal programs such as the EPA's Trash-Free Waters and NOAA's marine debris program have dispersed grants and provided lines of communication to states and organizations working on these issues.

V. CONCLUSION

Greenhouse gases come from myriad sources and to remedy or mitigate the public health and environmental risks posed by climate change, controlling all of those sources is vital. Microplastic pollution, given the number of sources—industrial, residential, commercial, and from air, water, and waste streams—and the need to control all of these sources to limit the bioaccumulation, pollutant absorption, and public health risks presented by microbeads and microfibers, might be the next greenhouse gas regulatory challenge for the EPA.

This Article discussed some of the sources of this pollution and the ways in which N.Y./N.J. Harbor projects are beginning to grapple with microplastics in local action agendas. One key regulatory gap, though, remains: the lack of any nationally-applicable air or water quality standards for microplastics. In the short-term, consumer behavior laws, education, and other legal systems (such as solid waste management programs, drinking water protection, or international marine pollution control initiatives) may fill this gap with partial fixes. However, until the EPA does the work necessary to determine what amount of microplastic pollution is safe, if any (under either CAA or CWA standards), the environment will continue to be the reservoir for these emerging pollutants of concern.

219. See WATER QUALITY CRITERIA, *supra* note 137, at 25.