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Forever Chemicals in Modern Dinosaurs: Using CERCLA to Force Polluters to Pay for PFAS Contamination of Florida Alligators

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Disclaimer: Major Matthew Carey serves in the United States Air Force Judge Advocate General's Corps. This paper was submitted in partial satisfaction of the requirements for the degree of Master of Laws in Environmental Law at The George Washington University Law School. The views expressed in this paper are solely those of the author and do not reflect the official policy of the United States Air Force, Department of Defense, or United States Government.

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INTRODUCTION

Perfluoroalkyl Substances (PFAS), the family of chemical compounds known colloquially as forever chemicals, have long been prized for their chemical properties which allow them to create a “magic carpet” of turf at sports stadiums or weave impermeable fabric and cookware. However, the cresting wave of anecdotal and scientific evidence highlights the consequences of extended exposure to these chemicals.¹ The Philadelphia Inquirer recently reported that six former Phillies players have died of the same form of aggressive brain cancer after lengthy baseball careers on an AstroTurf field engineered with PFAS—a striking “coincidence” which highlights the mysteriousness and potential severity of the chemicals’ effects.² These chemicals don’t remain on the field or in the non-stick frying pan: they are in human blood, breast milk, dust, drinking water, and animals that survived the extinction of the dinosaurs — such as alligators.³ PFAS persist in the body for decades, becoming increasingly pernicious over time as they bioaccumulate.⁴ Perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS) are two members of this group which are known for bringing the world Teflon, rainproofing coats, and, according to some observers, poisoning most of the natural environment.⁵

Companies responsible for the manufacture of PFAS knew of their threat since the 1960s or 1970s.⁶ Mr. Robert Bilott, an Ohio corporate defense lawyer turned plaintiff’s class action attorney, first alerted the world to forever

1. Barbara Laker, *Field of Dread: Six former Phillies died from the same brain cancer. We tested the Vet’s turf and found dangerous chemicals*, PHILA. INQUIRER (Mar. 7, 2023), [<https://perma.cc/83F6-ZFE2>].

2. *Id.*

3. U.S. ENV’T PROT. AGENCY, MULTI-INDUSTRY PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) STUDY – 2021 PRELIMINARY REPORT (2021), 3-9 – 3-11.

4. *Id.* at 3-9.

5. United States Environmental Protection Agency, *PFAS Explained*, <https://www.epa.gov/pfas/pfas-explained> [<https://perma.cc/FT5D-9FKM>] (updated Oct. 25, 2023). There are thousands of PFAS substances found in various consumer and industrial products. The focus of this paper will be on PFOA and PFOS.

6. Johanna Adashek, *The Corrupt Past of PFAS and Corporate Greed*, THE GW POINT SOURCE (Jan. 30, 2023), [<https://perma.cc/U275-K9A5>]; *The Devil They Knew: PFAS Contamination and the Need for Corporate Accountability: Hearing Before the Subcommittee on Env’t*, 116th Cong. 2 (2019) (statement of Hon. Harley Rouda, Chairman, Subcommittee on Environment), [<https://perma.cc/SND5-WPE2>].

chemicals in 1998.⁷ In his class action suit, Mr. Bilott sued E.I. DuPont in West Virginia under common law tort theories of negligence and nuisance for recklessly discharging PFOA into landfills from which it then leached into streams.⁸ In subsequent discovery, Mr. Bilott unearthed that DuPont and 3M, both manufacturers of forever chemicals, were aware that exposure to PFAS constituted a serious health risk to animals and people.⁹

Beginning as early as 1962, internal DuPont studies on rats, beagles, monkeys, and even employees demonstrated that forever chemicals caused long-term health impacts, ranging from liver disease and cancer to death.¹⁰ DuPont was not alone; other companies, including 3M, were gathering alarming toxicological data on PFAS in the 1960s and 1970s.¹¹ Internal documentation shows DuPont recommended avoiding drinking water with PFOS levels as low as 0.6 parts per billion, but failed to act to contain the chemical spread.¹² In fact, levels as high as 1,000 parts per billion were found in a creek near one of DuPont's landfills.¹³ For decades, DuPont was not required to disclose that these chemicals were being discharged at all.¹⁴ An absence of government regulation allowed companies to minimize the presence of these chemicals as an acceptable business risk.¹⁵

Since Mr. Bilott's lawsuit began in 1998, these chemicals have grown infamous. Forever chemicals—including PFOA, PFOS, and similar compounds—are prevalent around the world and will persist in the environment for generations to come.¹⁶ This persistence, an intended consequence of the complex chemical bonds present in these chemical compounds, make them ideal for use in Teflon

7. See generally ROBERT BILOTT, *EXPOSURE: POISONED WATER, CORPORATE GREED, AND ONE LAWYER'S TWENTY YEAR BATTLE AGAINST DUPONT* (2019).

8. Mark P. Nevitt & Robert V. Percival, *Can Environmental Law Solve the "Forever Chemical" Problem?*, 57 WAKE FOREST L. REV., 251–252 (2022); Adashek, *supra* note 6.

9. Nevitt & Percival, *supra* note 8.

10. See generally Suzanne E. Fenton, et al., *Per- and Polyfluoroalkyl Substance Toxicity and Human Health Review: Current State of Knowledge and Strategies for Informing Future Research*, ENV'T TOXICOLOGY & CHEMISTRY 606 (2020); Adashek, *supra* note 6.

11. See Daniel Renfrew & Thomas W. Person, *The Social Life of the Forever Chemical*, ENV'T & SOC'Y: ADVANCES IN RESEARCH 146, 150–151 (2021).

12. See EXPOSURE, *supra* note 7. The EPA standard for arsenic in drinking water is currently 10 ppb, and prior to 2001 was as high as 50 ppb. See U.S. ENV'T PROT. AGENCY, *Chemical Contaminant Rules*, <https://www.epa.gov/dwreginfo/chemical-contaminant-rules> [<https://perma.cc/F3Y2-452Y>] (updated Nov. 7, 2023).

13. Rob Bilott, Esq., Fedder Lecture, University of Maryland Francis King School of Law, Nov. 18, 2022.

14. *Id.*

15. *Id.*

16. Throughout Southern Maine, dairy farmers are still dealing with livestock contaminated with forever chemicals at levels as high as 1,470 parts per trillion. The practice of spreading PFOS-infested sludge over dairy farms stopped in 2004, yet 15 years later the chemicals are still found in cow's milk. Susan Cosier, *America's Dairyland May Have a PFAS Problem*, NRDC (Oct. 11, 2019), <https://www.nrdc.org/stories/americas-dairyland-may-have-pfas-problem> [<https://perma.cc/63UM-DEKJ>].

but ensure their slow decay in the environment.¹⁷ PFAS are found in the blood of people and animals across the planet.¹⁸ Though the damage they inflict is long lasting, complex, far reaching, and often well-documented, the law does not protect animals or the environment from these chemicals. Those responsible for the spread of these pollutants must be held accountable for rehabilitating natural resources that have been forever contaminated by forever chemicals.¹⁹

While Mr. Bilott achieved victory on behalf of his clients through a large settlement with DuPont, the natural resources left behind, unrepresented by Bilott, remain contaminated.²⁰ Bilott represented the farmer who owned the cattle, but he could not represent the stream itself, or the wild animals who relied on that contaminated stream for drinking water.²¹ Subsequent lawsuits attempting to hold these large chemical companies responsible have proved no more fruitful than Bilott's initial settlement. In common law litigation, plaintiffs are held to impossibly high scientific standards for causation and damages, and those impacted by these chemical releases often are not financially equipped for lengthy, expensive litigation.²² These litigation hurdles are seldom overcome when pitted against a burgeoning, productive, and profitable chemical backed by multimillion-dollar corporations. The law must afford another solution—one that can stand up for the inherent rights of nature, her natural resources, and the public's right to enjoy them.

Presently, the EPA is poised to classify both PFOS and PFOA as hazardous substances under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA),²³ which will create a new avenue for lawsuits seeking to remove these chemicals from the environment.²⁴ The classification of these chemicals as hazardous will allow trustees (usually federal and state officials charged with protecting the nation's natural resources)

17. Mackenzie Moyer, "Forever Chemicals:" PFAS Contamination and Public Health, 125 PENN ST. L. REV. 565, 569 (2021); PFAS Explained, *supra* note 5.

18. U.S. ENV'T PROT. AGENCY, Our Current Understanding of the Human Health and Environmental Risks of PFAS, (2021), <https://www.epa.gov/pfas/our-current-understanding-human-health-and-environmental-risks-pfas> [<https://perma.cc/3KX2-MXKZ>]; U.S. ENV'T PROT. AGENCY, *supra* note 3 at 3–3.

19. See Carly Johnson, *How the Safe Drinking Water Act and The Comprehensive Environmental Response, Compensation, and Liability Act Fail Emerging Contaminants*, 42 MITCHELL HAMLINE L.J. PUB. POL'Y PRACT. 91 (arguing that most suits against PFAS polluters still focus on common law theories of negligence or nuisance).

20. See BILOTT, *supra* note 7.

21. Nevitt & Percival, *supra* note 8 (Mr. Bilott's primary client, Wilbur Tennant, a dairy farmer, suspected that his cows were dying off due to DuPont's discharges into streams).

22. Johnson, *supra* note 19, at 112.

23. Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. §§ 9601–9675.

24. Designation of Perfluorooctanoic Acid (PFOA) and Perfluorooctanesulfonic Acid (PFOS) as CERCLA Hazardous Substances, 87 Fed. Reg. 54,415 (Sept. 6, 2022) (to be codified at 40 C.F.R. § 302). The EPA is not, however, seeking to classify the entire PFAS family as hazardous.

to bring suit on behalf of those resources.²⁵ As this paper will explore in detail, these natural resource suits have the potential to be more impactful than the aforementioned private claims for punitive damages.²⁶

Natural Resource Damage (NRD) actions, codified in CERCLA and the Clean Water Act (CWA),²⁷ are designed to restore damaged and dying natural resources to their original and natural state.²⁸ Instead of relying on private parties to fund the suit, the federal government fronts the cost and then seeks recovery from the responsible parties.²⁹ CERCLA has become synonymous with the “polluter pays” principle, where the polluter covers the cost of restoring the environment they damaged.³⁰ While common law litigation, like the suit led by Mr. Bilott, is designed to restore people and punish polluters, CERCLA NRD actions are designed to restore nature to its rightful state.

With roots in the public trust doctrine, the provisions within CERCLA and the CWA allow for wide-reaching, holistic environmental remediation. This doctrine entrusts the sovereign to protect natural resources for use by the citizenry.³¹ NRD assessments were created to quickly remediate environmental damages and avoid the typically lengthy common law tort litigation process.³² Furthermore, the trustee need not prove causation and damages by any stringent legal standard, as theories of joint and several liability apply.³³

For example, after the infamous Exxon Valdez oil spill, trustees for the Prince William Sound, exercising NRD provisions found in the CWA and CERCLA, were awarded monetary damages to restore natural resources in the Sound.³⁴ Ongoing natural resources damage litigation related to forever chemicals is buoyed by state laws that act similarly to the NRD provisions of

25. 42 U.S.C. §9607(f)(1); see also Allan Kanner, *Tortious Interference with Public Trust*, 36 J. ENV'T L. & LITIG. 43, 49 (2021).

26. Bringing common law claims of nuisance or negligence is exceedingly difficult, as the plaintiff must prove breach of duty as well as causation and injury. This underscores the need for natural resource damage suits to fill the void the common law cannot. See Johnson, *supra* note 19, at 112.

27. Clean Water Act (CWA), 33 U.S.C. §§ 1251–1387.

28. Allan Kanner, *Natural Resource Restoration*, 28 TUL. ENV'T L.J. 355 (2015).

29. See *United States v Aceto*, 872 F.2d 1373, 1378 (8th Cir. 1969) (holding that strict, retroactive, joint and several liability for polluters creates a “polluter pays” statutory scheme).

30. See generally 42 U.S.C. § 9607(f)(2)(C).

31. Center for Biological Diversity, Inc. v. FPL Group, Inc., 83 Cal Rptr. 3d. 588, 596 (Cal Ct. App. 2008); Allan Kanner, *Environmental Gatekeepers: Natural Resource Trustee Assessments and Frivolous Daubert Challenges*, 49 ENV'T L. REP. 10420, 10421 (2019).

32. Itzhak E Kornfeld, *Of Dead Pelicans, Turtles, and Marshes: Natural Resources Damages in the Wake of the BP Deepwater Horizon Spill*, 38 B.C. ENV'T AFF. L. REV. 24 (2011), citing statement from Senator Mitchell, a proponent of NRD assessments, during congressional hearings in 1980); Sanne H. Knudsen, *Adversarial Science*, 100 IOWA L. REV. 1538 (2014) (observing that the threat of litigation causes parties to settle quickly to avoid growing liability).

33. Johnson, *supra* note 19, at 112–114.

34. See William H Rodgers, Jr. et al., *The Exxon Valdez Reopener: Natural Resources Damage Settlements and Roads Not Taken*, 22 ALASKA L. REV. 137–138 (2005).

CERCLA: for example, Minnesota recently settled an action under such state law provisions with 3M, a manufacturer of forever chemicals, for \$850 million.³⁵ Delaware won a similar suit for \$50 million after settling with DuPont and others.³⁶ In both victories, the funds were set aside primarily to restore drinking water resources to their pre-contaminant levels.³⁷ It's not likely these settlement amounts alone are sufficient to restore water resources to pristine conditions. In Delaware, DePont was subsequently required to increase their settlement 50 percent after DuPont settled a similar suit in Ohio.³⁸ Despite the success of these state programs, a comprehensive federal approach would better address this widespread problem by ensuring greater inter-state consistency and equity.

The EPA designation of PFOA and PFOS as hazardous will make possible the large-scale restoration of natural resources impacted by forever chemicals. However, the completion of CERCLA NRD assessments for ecosystems and animals will pose a challenge due to the nature of PFAS's impact. This impact is often only realized as hazardous after years of bioaccumulation or, in rare cases, when there are severely high concentrations at the onset.³⁹ As this paper will show, past NRD assessments typically apply to habitats victimized by a singular acute injury attributable to a defined responsible party. On the contrary, the release of PFAS comes from many different sources which are less immediately identifiable. This delay in identification allows PFAS to bioaccumulate in animals (especially apex predators), water, and municipal and publicly-owned utilities and landfills.⁴⁰ Without action under CERCLA and by Congress, those animals and the public will bear the cost of remediating PFAS.

First, this paper will describe what forever chemicals are and the damage these compounds inflict. This paper will then explore what a CERCLA NRD assessment is: a tool to protect the public from chemicals like PFAS. The goals of NRD assessments can be tied back to the Public Trust: a sovereign holding natural resources in public trust for the citizenry. After briefly discussing pending federal regulatory action, which would list PFOA and PFOS as hazardous and thus pull them under CERCLA's jurisdiction, this paper will propose two

35. Kegan Brown et al., *A Best Practice Framework: PFAS and Natural Resource Damages* (Draft), 2022 Natural Resources Symposium (2022), <https://static1.squarespace.com/static/55d62125e4b0e91cf1a2486b/t/642d78587321f2093585ed23/1680701529001/PFAS+AND+NATURAL+RESOURCE+DAMAGES+A+BEST+PRACTICE+FRAMEWORK+%28NOVEMBER+2022%29.pdf> [<https://perma.cc/47JV-YXCS>].

36. *Id.*

37. *Id.*

38. Jacob Owens, *Delaware gets \$25M after Ohio-DuPont PFAS settlement*, DELAWARE BUSINESS TIMES, (Nov. 30, 2023), <https://delawarebusinesstimes.com/news/dupont-ohio-pfas> [<https://perma.cc/Y6GJ-S7YQ>].

39. See generally Alana K. Greaves et al., *Brain Region Distribution and Patterns of Bioaccumulative Perfluoroalkyl Carboxylates and Sulfonates in East Greenland Polar Bears (Ursus Maritimus)*, 32 ENVIRON. TOXICOL. CHEM. 713, 713 (2013).

40. U.S. ENV'T PROT. AGENCY, *supra* note 18; U.S. ENV'T PROT. AGENCY, *supra* note 3.

potential solutions to the problems trustees face when asserting NRD claims. To illustrate these problems and their proposed solutions, this paper uses the Florida marine environment and one of the oldest and most treasured natural resources in the animal kingdom, the alligator, as a muse.

The first solution the paper proposes is that Congress amend CERCLA to exempt public or municipal wastewater treatment facilities and waste management facilities from litigation related to NRD assessments. Additionally, this paper proposes that Congress amend CERCLA to broaden the potentially responsible parties to include manufacturers of PFAS chemicals, as they so often fall outside CERCLA's four statutorily responsible parties. Finally, this paper will show the NRD process will bolster the science around PFAS, proving causation and not just correlation, so that all potentially responsible parties can be held responsible.

I. BACKGROUND – FOREVER CHEMICALS

In the mid 20th century, when the use of PFAS began in earnest, it was not regulated and so did not need to be treated or even reported when used or discharged into the environment.⁴¹ Forever Chemicals, including some compounds later marketed as Teflon, were critical to the Manhattan Project in World War II.⁴² Their unregulated status led to years of PFAS production without any understanding of how it impacted the environment.⁴³ Today, forever chemicals have expanded beyond the original PFOA and PFOS, and are now a broader group of highly stable manufactured fluorine compounds that are not naturally occurring and are known for their strong carbon-fluorine covalent bond, making them extremely durable.⁴⁴ The National Center for Computational Toxicology compiles a list of 5,000 chemicals whose structures are like that of PFAS, with approximately half of them believed to be present in the United States.⁴⁵

These chemicals transfer their inherent durability to products and industrial equipment of which they are a part.⁴⁶ This resilience translates to resistance to heat, water, and oil, making them an extremely valuable solution for waterproofing and cookware.⁴⁷ Their chemical endurance makes them attractive for industrial and military applications, as PFAS allow the end product to withstand heat, acids, bases, and oxidants.⁴⁸ However, that same characteristic ensures that

41. *Id.* at 149.

42. Renfrew & Person, *supra* note 11, at 148.

43. *Id.*

44. Moyer, *supra* note 17; see generally Linda G. T. Gaines, *Historical and Current Usage of Per- and Polyfluoroalkyl Substances (PFAS): A Literature Review*, 66 AM. J. INDUS. MED. 353, 353–54 (2022).

45. U.S. ENV'T PROT. AGENCY, *supra* note 3.

46. Gaines, *supra* note 44.

47. Moyer, *supra* note 17.

48. *Id.* at 4.

they persist in the natural environment.⁴⁹ Outside of manufacturing waste, PFOS and PFOA also enter the environment through the disposal of consumer items, such as plastics.⁵⁰ PFAS ultimately make their way into groundwater, drinking water, rainwater, soil, ice, air, plants, animals, and humans.⁵¹

PFOS and PFOA manufacturers, namely DuPont and 3M, have known about the adverse and toxic effects of PFOS and PFOA for years.⁵² In the 1950s, a study conducted by 3M indicated that PFOS accumulate in blood.⁵³ By the 1960s, 3M knew that PFOS were toxic.⁵⁴ During this timeframe, DuPont also observed that PFOS increased the size of the spleen, liver, and kidney.⁵⁵ In the 1970s, DuPont called PFOS incredibly toxic when inhaled, and in the 1980s DuPont was alerted that PFOS and PFOA are carcinogenic.⁵⁶ By 2012, a panel facilitated by DuPont published findings that exposure to PFOS was linked to high cholesterol, ulcerative colitis, thyroid disease, testicular cancer, kidney cancer, and hypertension.⁵⁷ DuPont, 3M, and other companies used PFOS and PFOA for decades knowing they had adverse health impacts before finally largely halting their use in 2013 and replacing those two chemicals with other chemicals, like GenX, with unknown health impacts.⁵⁸ Companies are gambling that these new chemicals do not follow the same path as PFAS and lead to a recurring forever chemical crisis in the near future.⁵⁹

Studies have shown that high levels of PFAS are linked to harmful health effects in humans and animals.⁶⁰ Humans and animals ingest PFAS through their food or drinking water, but PFAS can also transfer into human and animal tissue directly through contact with an item manufactured with PFAS or through the air or water when PFAS is produced in a factory.⁶¹ In humans, PFAS cause

49. See Max G. Levy, *Are Forever Chemicals Harming Ocean Life?*, THE REVELATOR (2020), <https://therevelator.org/pfas-ocean-wildlife> [<https://perma.cc/K9DR-6TLZ>].

50. See generally Robert W. Adler & Carina E. Wells, *Plastics and the Limits of U.S. Environmental Law*, 37 HARV. ENV'T. L. REV. 38 (2023).

51. *Id.*

52. The Devil They Knew: PFAS Contamination and the Need for Corporate Accountability: Hearing Before the Subcommittee on Environment, 116th Congress, *supra* note 6 at 3.

53. Luigi Zingales & Roy Shapira, *Is Pollution Value-Maximizing? The DuPont Case*, Nat'l Bureau of Econ. Rsch., Working Paper No. 23866, 8, https://www.nber.org/system/files/working_papers/w23866/w23866.pdf [<https://perma.cc/NJ8V-ED7G>].

54. Adashek, *supra* note 6.

55. Zingales & Shapira, *supra* note 53, at 9.

56. *Id.*

57. *Id.* at 7 (panel was only formed as part of a settlement related to a class action lawsuit).

58. *Id.*

59. See Isaac Serratos, *A Case Study on its Current Costs and How to Regulate Toxic Chemicals in the Future*, 27 HASTINGS J. ENV'T. L. & POL'Y 207, 211 (2021).

60. Fenton, *supra* note 10.

61. Johnson, *supra* note 19, at 98.

infertility and high blood pressure in pregnant women.⁶² PFAS also have a special tendency to accumulate in the liver, causing disease and other chronic health conditions.⁶³ In children, PFAS are proven to lead to developmental delays including, but not limited to, low birth weight and hormone interference — which can alter when puberty occurs or cause certain bone variations.⁶⁴ Forever chemicals cause an increased risk of certain forms of cancer, including prostate, kidney, and testicular.⁶⁵ PFAS impair the immune system, limiting the body's natural ability to fight infections, and can reduce the effectiveness of certain vaccines.⁶⁶ Increased cholesterol levels and a risk of obesity, kidney, and thyroid disease have also been observed and tied to high PFAS levels.⁶⁷ Scientists have even found PFOS in the breast milk of pregnant women in the remote North Atlantic Archipelago, far from where it was produced.⁶⁸ DuPont had known this long before the public, as evidenced by their decision to move pregnant employees away from the daily handling of the chemical.⁶⁹

In the United States, an estimated 83 percent of waterways contain at least one PFAS compound.⁷⁰ Estimates from the Environmental Working Group in 2021 approximate that 30,000 facilities discharge forever chemicals into United States waters or to wastewater treatment plants.⁷¹ In New Jersey, high PFAS levels have prompted many health advisories for PFAS in water and fish.⁷² Studies in that state have found fourteen of the sixteen water sources across numerous counties contain PFAS.⁷³ These concentrations are higher when the tested fish were collected in closer proximity to military bases or

62. See Our Current Understanding of the Human Health and Environmental Risks of PFAS, *supra* note 18; M. Elizabeth Goss, *Rectifying the Safe Drinking Water Act and the Clean Water Act: Per- and Poly- Fluoroalkyl Substances (PFAS)—A Case Study*, 110 KY. L.J. 576, 578–79 (2021).

63. U.S. ENV'T PROT. AGENCY, *supra* note 18; Goss, *supra* note 62, at 580–81.

64. U.S. ENV'T PROT. AGENCY, *supra* note 18; Kristen M. Rappazzo, Evan Coffman & Erin P. Hines, *Exposure to Perfluorinated Alkyl Substances and Health Outcomes in Children: A Systematic Review of the Epidemiologic Literature*, 14 INT'L J. ENV'T. RES. PUB. HEALTH 2 (2017).

65. U.S. ENV'T PROT. AGENCY, *supra* note 18; Serratos, *supra* note 59; Goss, *supra* note 62, at 578–79.

66. Goss, *supra* note 62, at 579.

67. U.S. ENV'T PROT. AGENCY, *supra* note 18; Johnson, *supra* note 19, at 101.

68. Anna Turns, How 'Forever Chemicals' Are Using Marine Life to Travel the World by Sea, THE GUARDIAN (Feb. 14, 2022), <https://www.theguardian.com/environment/2022/feb/14/forever-chemicals-pcb-pfas-use-marine-life-to-travel-world-by-sea> [https://perma.cc/EN7C-EZUJ].

69. Zingales & Shapira, *supra* note 53, at 10.

70. KELLY H. FOSTER ET AL., INVISIBLE UNBREAKABLE UNNATURAL: PFAS CONTAMINATION OF U.S. SURFACE WATERS 13 (2022).

71. *Id.*

72. Goss, *supra* note 62, at 581.

73. *Id.*

industrial facilities presumably discharging PFAS.⁷⁴ In Michigan, similar tests found PFAS in six bodies of water across three different counties.⁷⁵

Located in air and water, wildlife and plants, rain, snow, groundwater, rivers, lakes, and oceans, PFAS are everywhere. These chemicals are a global concern, as they deleteriously impact ecosystems and the environment. High concentrations of these chemicals are found increasingly in animals higher up in the food chain.⁷⁶ PFOS and PFOA migrate from contaminated water to plants, then to the animals that eat those plants, to the animals that eat those animals, and ultimately into human beings.⁷⁷ The ocean currents ensure that PFAS are transported all over the world, even to remote environments that do not use or produce the chemicals.⁷⁸

A. *Forever Chemicals in Ecosystems*

Marine and freshwater ecosystems are extremely resilient but cannot continue to thrive while serving as a bottomless sink for the world's garbage. The solution to pollution must no longer be dilution.⁷⁹ Ecosystems and the animals in them are ill-equipped to meet the PFAS challenge alone. Thanks to six decades of research, the public is well aware of the harmful effects PFOS and PFOA have on human beings, but the impact these chemicals have on animals and their ecosystems is less certain.⁸⁰ Studies providing documented instances of PFAS causing mortality or disability in wildlife are meager.⁸¹ By contrast, habitat destruction, a warming planet, overfishing, and stormwater and municipal runoff are all confirmed causes of disease and death in plants and animals.⁸²

Coastal and low-lying aquatic environments are especially vulnerable to the harmful effects of PFOS and PFOA.⁸³ Not coincidentally, the nation's coastlines are also home to many military bases, and the terminus for rivers and

74. *Id.*

75. *Id.* at 582.

76. Leticia M. Diaz & Margaret R. Stewart, "Forever Chemicals": Forever Altering the Legal Landscape, 7 BELMONT L. REV. 353 (2020).

77. *Id.*; Levy, *supra* note 49.

78. Levy, *supra* note 49.

79. See generally Howard Dryden & Diane Duncan, *Climate Disruption Caused by a Decline in Marine Biodiversity and Pollution*, J. ENV'T. & CLIMATE CHANGE 3414 (2022); Levy, *supra* note 49.

80. Levy, *supra* note 49; The Devil They Knew: PFAS Contamination and the Need for Corporate Accountability: Hearing Before the Subcommittee on Environment, 116th Cong., *supra* note 6, at 36. (Statement of Jane Luxton); Tom Perkins, *Alarming toxic 'forever chemicals' found in animals' blood – study*, THE GUARDIAN (Feb. 22, 2023), <https://www.theguardian.com/environment/2023/feb/22/animal-toxic-pfas-contamination-study> [https://perma.cc/48WS-VBK].

81. Kurunthachalam Kannan, Emily Perrotta & Nancy J. Thomas, *Association between Perfluorinated Compounds and Pathological Conditions in Southern Sea Otters*, 40 ENV'T. SCI. TECH. 4943 (2006); Perkins, *supra* note 90.

82. Kannan, Perrotta & Thomas, *supra* note 81; Johnson, *supra* note 19, at 100.

83. See Levy, *supra* note 49.

streams that carry PFAS from their source.⁸⁴ Animals living in marshlands like the Everglades are bioaccumulating a dangerous amount of PFOS and PFOA. Studies from the early 2000s show that PFOS can survive decades-long journeys from their point source to the ocean.⁸⁵ PFOS is different from some dangerous chemicals of the past, such as Dichlorodiphenyltrichloroethane (DDT).⁸⁶ DDT will stick to algae, killing the algae and dragging it to the ocean floor where the DDT then remains stagnant.⁸⁷ In part because PFOS does not kill so quickly, it lacks this tendency to sequester itself and instead exists over lengthy periods of time in the food chain, consumed again and again by apex predators.⁸⁸

B. *Forever Chemicals in Florida*

The ecosystems and biota that exist in Florida have all the risk factors for high PFAS levels. Florida is home to a high concentration of both commercial and private airports, where PFAS-laden foam suppressants have been used extensively in runway fires.⁸⁹ The state also has several large military bases that used those same foam suppressants, and the Kennedy Space Center near Orlando has a history of using a wide variety of chemicals that contain PFOS and PFOA.⁹⁰ Furthermore, Florida is home to numerous industries and cities that discharge PFAS, and is downstream from several states that do the same.⁹¹ Finally, the state's large amount of annual rainfall and low elevation mean that the state is consistently inundated with water which carries PFAS across the state and into its surrounding bays and coastal areas like the Everglades.⁹²

In Florida, oysters living off the shore in Tampa Bay, Biscayne Bay, and Marco Island were culled and tested to determine whether PFAS were present, and if so what impact the chemicals had on the oysters.⁹³ The bay oysters contained PFAS at a frequency of 87 percent of tests, while Marco Island oysters contained PFAS in 83 percent.⁹⁴ The concentrations of PFAS in the

84. See *id.*

85. *Id.*

86. *Id.*

87. *Id.*

88. *Id.*

89. Leila Soledade Lemos et al., *American Oysters as Bioindicators of Emerging Organic Contaminants in Florida, United States*, in 835 SCI. OF THE TOTAL ENV'T 155316, 155317 (2022); *The Devil They Knew: PFAS Contamination and the Need for Corporate Accountability: Hearing Before the Subcommittee on Environment, 116th Cong., supra* note 6, at 1.

90. Lemos et al., *supra* note 89.

91. *Id.*

92. The University of Florida, with funding from the EPA, is currently working to understand how large influxes of water caused by extreme weather influences the transportation of PFAS in the Florida environment. See FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION, PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) DYNAMIC PLAN (2022), 9.

93. See *id.*

94. Lemos et al., *supra* note 89, at 155323.

surrounding bay waters themselves were also high; Biscayne Bay measured at levels approximately 74 times higher than those found near the less populated, less industrial Marco Island area.⁹⁵

Miami's overall PFAS levels exceed averages in the rest of the state, due in large part to the consistent discharge of PFAS-saturated consumer products by the city's large population.⁹⁶ Discharge sites close to Miami include the airport, military air bases, landfills, wastewater treatment plants, agriculture, and industry.⁹⁷ The study found that the higher the concentration of PFAS in the oysters, the lighter and smaller the oyster, indicating that PFAS may impair the development of the oysters.⁹⁸ The study also hypothesized that the most important factor when determining the detrimental impact of the chemicals is duration of exposure.⁹⁹

Another study which analyzed surface water in several coastal areas found elevated PFOS levels in the Banana River.¹⁰⁰ Second was the southern Indian River, third the northern Indian River, and finally the Atlantic Coast itself.¹⁰¹ The most abundant fluorinated compound found in all four areas was PFOS.¹⁰² These levels make sense since PFOS has been the most widely used and manufactured compound since the middle of the 20th century. The Banana River and Indian River Lagoon in Florida exhibit high levels of PFOS thanks to extensive historical use of firefighting foams at military and municipal airports, and direct discharges from collocated industrial facilities.¹⁰³ The Indian River Lagoon contains the most diverse estuary in North America, and has been designated as an Estuary of National Significance.¹⁰⁴ The Lagoon is comprised of almost 150,000 square miles of aquatic environments, protected wildlife species, and a 156-mile coastline that hosts many tourists who come to view the wildlife and visit beaches such as Cocoa Beach.¹⁰⁵ In the Indian River Lagoon near Patrick Air Force Base, concentrations of PFOA and PFOS have exceeded 4,000,000 parts per trillion.¹⁰⁶ High levels of PFAS, over three

95. *Id.*

96. *Id.*

97. *Id.*

98. *Id.*

99. *Id.*

100. Emily K. Griffin et al., *Quantitative and Spatial Assessment of Per- and Polyfluoroalkyl Substances (PFAS) in the Indian River Lagoon and Atlantic Coast of Brevard County, FL*, 301 CHEMOSPHERE 134478, 134498 (2022).

101. *Id.* at 134480.

102. *Id.*

103. *Id.* at 134481; Jim Waymer, 'Forever Chemicals' Lurk Everywhere Florida Looks for them in the Indian River Lagoon [sic], FLORIDA TODAY (Jun. 7, 2022), <https://www.floridatoday.com/story/news/local/environment/lagoon/2022/06/07/pfas-forever-chemicals-lurk-everywhere-florida-looks-them/7487187001> [<https://perma.cc/BTW6-UCQR>].

104. Griffin et al., *supra* note 107 at 134484-85.

105. *Id.*

106. *Id.* at 134484.

times above EPA health advisories, are found in the drinking water in these communities.¹⁰⁷

High levels of PFOA and PFOS don't only deleteriously impact humans and drinking water: their impact on our flora and fauna is immense. In sea birds who live almost exclusively on United States coastline, PFAS has been found in the brain, liver, kidney, lungs, and heart.¹⁰⁸ The compounds have also been found in fish, alligators, and manatees inhabiting the wetlands surrounding the Kennedy Space Center.¹⁰⁹ Alligator plasma tested for PFOS measured at a median level of 185 ng/g.¹¹⁰ These wetlands, especially the Indian River Lagoon, suffer from a loss of sea grass due to PFAS,¹¹¹ a poor indicator for the manatees who rely almost exclusively on that sea grass for sustenance.¹¹²

PFAS in alligators is particularly pervasive, likely due to their habitat and status as an apex predator. As an apex species, they eat other animals that have bioaccumulated PFAS chemicals.¹¹³ A recent study provides evidence of various physiological effects of PFAS exposure in alligators. Healthy alligators, despite frequently being wounded through natural interactions with their species, rarely suffer infections.¹¹⁴ The study examined 75 alligators in the Cape Fear River in North Carolina which bore signs of PFAS exposure and found that they had open, infected wounds.¹¹⁵ The presumed source of the PFAS contamination was upstream chemical manufacturing plants, like the Chemours facility that sits on the Cape Fear River.¹¹⁶ The study was able to infer PFAS exposure in these alligators due to elevated levels of a secreted immune protein that has been correlated in other contexts with higher levels of 14 different PFAS chemicals in the blood.¹¹⁷ Samples found in alligators from areas with less PFAS exposure had significantly lower levels of the protein—sometimes 400 times lower—than the Cape Fear alligators.¹¹⁸ In contrast to North Carolina, where this variability in contamination levels is thought to be based on distance to a PFAS-discharging point source, Florida's marshes tend to have

107. *Id.*

108. Levy, *supra* note 49.

109. Griffin et al., *supra* note 100 at 134484; Waymer, *supra* note 103.

110. Jacqueline T. Bangma et al., *Variation in perfluoroalkyl acids in the American Alligator (Alligator Mississippiensis) at Merritt Island National Wildlife Refuge*, 166 CHEMOSPHERE 72 (2017).

111. Griffin et al., *supra* note 100, at 134494.

112. *Id.*

113. See Greaves, *supra* note 39, (arguing that polar bears, despite their remote location, still bioaccumulate high concentrations of PFOA and PFAS due to their place at the top of the food chain).

114. T. C. Guillette et al., *Blood concentrations of per- and polyfluoroalkyl substances are associated with autoimmune-like effects in American alligators from Wilmington, North Carolina*, 4 FRONT. TOXICOL., 9 (2022).

115. *Id.*,

116. *Id.*

117. *Id.*

118. *Id.*

more numerous, diverse, and small sources which could lead to more consistent contamination.

Other animals, such as dolphins, sea turtles, and sea otters, constitute a few named species of the many animals negatively impacted by PFAS chemicals around Florida and the United States. Immune-based diseases are on the rise in sea turtles and dolphins, as well as immune dysfunction.¹¹⁹ One study determined that PFOS triggers chronic immune activation in the bottlenose dolphin.¹²⁰ In bottlenose dolphins, PFOS is the predominant compound, ranging from 49 ng/g wet weight in dolphins from Bermuda to 1171 ng/g wet weight in Charleston dolphins.¹²¹ An increase in PFAS contamination was associated with reduced blubber thickness in dolphins inhabiting areas ranging from the Indian River Lagoon to the Sarasota Bay.¹²² Sea otter studies indicated that PFOS and PFOA leads to weight gain, especially in the liver, and decreased resistance to infectious disease.¹²³ Disease-related mortality in otters has also been linked to PFAS.¹²⁴

C. *Forever Chemicals' Evidentiary Significance*

Florida is not alone in grappling with the prevalence of PFAS in its ecosystems, plants, and animals. The United States at large is wrestling with PFAS oversaturation. For example, in North Carolina, Cape Fear River striped bass showed impaired immune and liver function after testing for PFOS at a level as high as 490 ng/ml.¹²⁵ This is an enormous jump relative to striped bass grown through aquaculture, which only tested at a level of 9.4 ng/ml.¹²⁶ Studies conducted on the Cape Fear bass found that an increased PFAS concentration was positively correlated with lysozyme activity, signaling an immune response to the presence of PFOS.¹²⁷ Each striped bass that was tested contained some level of PFAS.¹²⁸ In New Jersey, health advisories were issued as a result of the high levels of PFAS found in fish from 14 of 16 water sources close to military bases

119. Levy, *supra* note 49.

120. Levy, *supra* note 49.

121. Magali Houde et al., *Polyfluoroalkyl Compounds in Free-Ranging Bottlenose Dolphins (*Tursiops truncatus*) from the Gulf of Mexico and the Atlantic Ocean*, 39 ENV'T. SCI. TECH. 6591 (2005).

122. *Id.*

123. Kannan, Perrotta & Thomas, *supra* note 81.

124. *Id.*

125. T. C. Guillette et al., *Elevated Levels of Per- and Polyfluoroalkyl Substances in Cape Fear River Striped Bass (*Morone saxatilis*) are Associated with Biomarkers of Altered Immune and Liver Function*, 136 ENV'T INT., 6 (2020).

126. *Id.* at 5.

127. *Id.*

128. *Id.* (noting that in many cases DuPont is still to blame for increased levels of PFAS in the environment. Often, the PFAS is attributed to subsidiaries of the DuPont parent company to shield DuPont from liability). See Tom Lotshaw, *DuPont Spinoffs Must Face PFAS Claims, NC Justices Say*, LAW360, <https://www.law360.com/articles/1546904/dupont-spinoffs-must-face-pfas-claims-nc-justices-say> [<https://perma.cc/2BA7-ZTML>] (last visited Nov 9, 2022).

and manufacturers.¹²⁹ On the opposite coast, sea otter livers contain among the highest levels of PFOA ever tested.¹³⁰ High levels of PFAS can be significantly associated with disease and mortality in otters and other marine mammals.¹³¹

Across the globe, forever chemicals have been identified in 330 plant and animal species.¹³² Between 1986 and 2013, fifteen different PFAS were measured in the muscle tissue and plasma of harvested North American pilot whales.¹³³ PFOS increased significantly during the tested time frame.¹³⁴ In locations as remote as Arctic East Greenland, polar bears exhibited PFAS levels in their brain tissue which scientists were concerned could cause neurologic damage.¹³⁵ PFOS in polar bear plasma has been reported at levels from 1.26 to 3.09 ng/g.¹³⁶ PFOS in gull and kittiwake eggs tested the highest among all seabirds.¹³⁷ White-tailed eagle liver was also extremely high, with PFOS levels averaging 18.3 ng/ml.¹³⁸ Otters and minks recorded the highest PFAS levels found in the liver.¹³⁹

The further proliferation of these chemicals from the coasts into the greater ocean when their animal hosts decompose or are eaten by marine predators only stands to make the PFAS problem more complex. As more predators consume the contaminated animals, and those predators are consumed by still larger predators, the top predator then contains massive amounts of not only bioaccumulated PFAS, but also other pollutants that then create a toxic mix.¹⁴⁰ Determining which substance is responsible for adverse health impacts then becomes a near-impossible task. It can be difficult to parse out what adverse impacts are a direct result of forever chemicals, when oceans and coasts are also impacted by habitat destruction, global warming, and municipal runoff of other chemicals and pollutants. Overfishing also causes populations

129. Goss, *supra* note 62, at 581 (Similarly, six water bodies spread over only three Michigan counties led to health recommendations to avoid eating harvested fish in any quantity).

130. Kannan, Perrotta & Thomas, *supra* note 81.

131. *Id.* at 4947.

132. *Wildlife warning: More than 330 species contaminated with 'forever chemicals'*, ENV'T WORKING GROUP (2023), <https://perma.cc/T2CM-KGN6>.

133. Clifton Dassuncao et al., *Temporal Shifts in Poly- and Perfluoroalkyl Substances (PFASs) in North Atlantic Pilot Whales Indicate Large Contribution of Atmospheric Precursors*, 51 ENV'T SCI. TECH. 4512, 4513 (2017).

134. *Id.*

135. Levy, *supra* note 49; Turns, *supra* note 68; *The Devil They Knew: PFAS Contamination and the Need for Corporate Accountability: Hearing Before the Subcommittee on Environment, 116th Congress, supra* note 6, at 1; Greaves, *supra* note 42, at 721.

136. Dorte Herzke et al., *Targeted PFAS Analyses and Extractable Organofluorine – Enhancing Our Understanding of the Presence of Unknown Pfas in Norwegian Wildlife*, 171 ENV'T. INT' L. 12 (2022), <https://papers.ssrn.com/abstract=4162937> [<https://perma.cc/L38K-M5YK>] (last visited Oct. 29, 2022).

137. *Id.* at 11–12.

138. *Id.*

139. *Id.* at 14.

140. Turns, *supra* note 68.

to decrease, reducing the gene pool and causing other harmful second- and third-order effects for a species which can make causation related to PFOS and PFOA more difficult to determine.¹⁴¹

Proving that adverse impacts are a direct result of the presence of PFOS and PFOA requires toxicological and controlled animal feeding studies.¹⁴² Natural Resource Damage assessments under CERCLA are one way, perhaps the best way, to ensure this science is fleshed out and correlation solidified to causation. What sets the NRD assessment apart from other more traditional testing methods is that the cost of the scientific assessment can be passed to those responsible for the release and damage of PFAS.

II. CERCLA AND NATURAL RESOURCE DAMAGE ASSESSMENTS

Under CERCLA, responsible parties are liable for not only removing and remediating hazardous substances, but also “damages for injury to, destruction of, or loss of natural resources, including the reasonable costs of assessing such injury, destruction, or loss resulting from such a release.”¹⁴³ The Act defines natural resources as “land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States”¹⁴⁴ The Act’s broad definition of natural resources allows for widespread and holistic remediation not available in common law litigation, which is defined to make whole a specifically defined party or parties.

CERCLA authorizes the federal government to respond to contamination or spills of hazardous materials in several unique ways.¹⁴⁵ The U.S. Environmental Protection Agency (EPA) may opt to clean a contaminated site using the Superfund.¹⁴⁶ After this cleanup, it may sue for reimbursement of cleanup costs from responsible parties.¹⁴⁷ Alternatively, the government may sue to order responsible parties to clean up a contaminated site if it represents a substantial danger to the environment.¹⁴⁸

A responsible party need not bear the brunt of an entire cleanup alone if that party is not wholly responsible. Among the responsible parties, joint and

141. See generally JAMES P. BENOIT, *A PRACTICAL GUIDE TO THE LAW OF THE SEA* (2021), 198–201.

142. See Kannan, Perrotta, and Thomas, *supra* note 81 at 4948.

143. 42 U.S.C. § 9607(a)(4)(C); Allan Kanner, *Issues Trustees Face in Natural Resource Damage Assessments, Part II*, 8 J. ENV’T. PROT. 482, 486 (2017).

144. 42 U.S.C. § 9601(16).

145. The EPA may: Monitor or conduct surveys under 42 U.S.C. § 9604(a)(1); seek injunctive relief to abate “an actual or threatened release of a hazardous substance from a facility,” under 42 U.S.C. § 9606; order cleanup of contaminated sites under 42 U.S.C. § 9604.

146. The Superfund allows the EPA to clean up contaminated sites in the absence of a viable responsible party. 42 U.S.C. § 9611; *New York v. Shore Realty Corp.*, 759 F.2d 1032, 1041 (2d Cir. 1985).

147. 42 U.S.C. § 9607.

148. 42 U.S.C. § 9606(a).

several liability or contribution actions are available.¹⁴⁹ To resolve contribution actions, courts may allocate costs among the responsible parties using equitable factors.¹⁵⁰ Full liability can be imposed on any one of the multiple parties if, for instance, the other responsible parties are not known or are insolvent.¹⁵¹ The causation requirement is streamlined for responsible parties, though it does still exist. So long as a party contributed to the release of hazardous substances, there is no need to prove that any specific damage was caused by any particular discharge.¹⁵²

Responsible parties under CERCLA are limited to four distinct categories.¹⁵³ First, the current owner or operator of a vessel or facility is subject to strict liability for the contaminated site, even if the owner did not cause the contamination.¹⁵⁴ Second, the owner or operator at the time of the hazardous substance's disposal may be held liable for cleanup costs.¹⁵⁵ Third, responsibility could fall on any entity who arranged for the transport of the hazardous substance.¹⁵⁶ Finally, the transporter of the hazardous substance may also be held liable.¹⁵⁷ These four responsible parties are potentially liable for costs the government has incurred for cleaning up releases of their hazardous substances, costs of health assessments, injunctive relief, and natural resource damages.¹⁵⁸ CERCLA fails to legislate liability for any party outside of these four categories.

In a PFAS context, the generator of a PFOS or PFOA is likely to escape liability for anything but a direct discharge into a single natural resource.¹⁵⁹ While the courts have determined the limits of these four culpable categories, they have not successfully found applicable producers of hazardous substances liable once they sell that hazardous substance to another manufacturer or even an end user as a "useful product," as opposed to a waste, which can include nonstick pans, waterproof jackets, or sale of the chemicals to create those items.¹⁶⁰ These manufacturers are ultimately responsible for producing and releasing PFAS chemicals into the environment, but they escape liability under CERCLA. Congress must act to attach liability to these

149. 42 U.S.C. § 9613(f); *NCR Corp. v. George A. Whiting Paper Co.*, 768 F.3d 682, 694, 707 (7th Cir. 2014) (holding that contribution actions are available to responsible parties in the NRD context).

150. 42 U.S.C. § 9613(f)(1).

151. *Von Duprin LLC v. Major Holdings, LLC*, 12 F.4th 751, 761 (7th Cir. 2021); DONALD S. BERRY, 1 BROWNFIELDS LAW AND PRACTICE § 3.02 (2022).

152. Johnson, *supra* note 19, at 109.

153. 42 U.S.C. § 9607(a).

154. 42 U.S.C. § 9607(a)(1); *New York v. Shore Realty Corp.*, 759 F.2d 1032, 1043 (2d Cir. 1985).

155. 42 U.S.C. § 9607(a)(2).

156. 42 U.S.C. § 9607(a)(3).

157. 42 U.S.C. § 9607(a)(4).

158. 42 U.S.C. § 9607(a)(4).

159. The Resource Conservation and Recovery Act (RCRA) provides for generator liability but does not contain natural resource damage provisions. *See* 40 C.F.R. § 262.

160. *See Burlington N. & Santa Fe Ry. Co. v. United States*, 556 U.S. 599, 610 (2009).

manufacturers as potentially responsible parties or risk the public and the environment atoning for their negligence the way the citizens of New York suffered through Love Canal.

A. *Protecting the Public Trust*

The public depends on natural resources for survival and enjoyment, and those resources are limited. Polluters must internalize their pollution costs, not pass them on to the public at large.¹⁶¹ The natural resource damage provisions under CERCLA are intended to make the public whole by holding polluters (usually corporations) accountable for their injuries to the environment.¹⁶² CERCLA seeks to “transform parts of ecological disaster areas . . . and to restore valuable services to the public.”¹⁶³ The Act’s essential goal is the restoration or replacement of natural resources damaged by unlawful releases of hazardous materials; thus, the natural resource damage provisions codified in CERCLA have the greatest capacity to compel broad, sweeping, and expensive cleanup.¹⁶⁴

In addition to the more common removal and remediation provisions of CERCLA, the Act provides for responsible party liability for “damages for injury to, destruction of, or loss of natural resources, including the reasonable costs of assessing such injury . . . resulting from such release.”¹⁶⁵ Not only do costs include liability for the damage to the natural resource itself, but also the cost of assessing the extent of the injury, which most often includes in-depth scientific studies.¹⁶⁶ An NRD assessment must be completed before a trustee can file suit in court for damages.¹⁶⁷ Once the assessment is complete, the court considers that assessment and the data contained therein as a rebuttable presumption in favor of the trustee in any judicial or administrative proceeding.¹⁶⁸

161. See Allan Kanner, *Issues Trustees Face in Natural Resource Damage Assessments, Part I*, 8 J. ENV’T. PROT. 503–04 (2017).

162. Natural resource damage claims under CERCLA must not be comingled with state natural resource damage suits. While states may have laws like natural resource damage laws under CERCLA, the state suits are often still based in common law product liability theories or consumer protection, rather than releases of a specific hazardous substance. New Jersey and California are two states that are currently litigating several of these common law natural resource cases. See Matthew Conley, *State Natural Resource Damages Suits: What Cos. Must Know*, LAW360, <https://www.law360.com/articles/1504653/state-natural-resource-damages-suits-what-cos-must-know> [<https://perma.cc/2HRY-B6LY>] (last visited Mar 17, 2023).

163. Kanner, *supra* note 28, at 6; 15 C.F.R. § 990.53(d).

164. See *New Mexico v. Gen. Elec. Co.*, 467 F.3d 1223, 1244–45 (10th Cir. 2006); BERRY, *supra* note 151.

165. 42 U.S.C. § 9607(a)(4)(c).

166. 42 U.S.C. §§ 9601(6), 9607(a)(4)(C).

167. In *New Mexico v. Gen. Elec. Co.*, New Mexico’s Trustee sued on behalf of New Mexico to recover NRD from GE for contamination that the city had already been remedying for years. The Court found that the Trustee erred because she did not first conduct a damage assessment. 467 F.3d at 1235.

168. BERRY, *supra* note 151.

Trustees are representatives of the public and wildlife. Without the CERCLA-designated trustee, members of the public would be forced to bring suits under common law theories, spend millions of dollars of their money, prove their standing, and spend years in court to prove by a preponderance of evidence that they suffered a specific injury caused by a particular party. The United States has yet to adopt rights of nature theories of justice; therefore, without trustees, the wildlife and natural resources would be left without a champion for their cause.¹⁶⁹ Federal trustees are designated by certain federal agencies pursuant to the National Contingency Plan for all the natural resources under their purview.¹⁷⁰ The National Oceanic and Atmospheric Administration (NOAA) and Department of the Interior are the two agencies most responsible for federal natural resources.¹⁷¹ At the state level, the governor must assign officers of the state to act as trustees for its natural resources in their contingency plans.¹⁷²

B. *Natural Resource Damages at Common Law*

While the Act's NRD provisions have the potential to order polluters to pay massive amounts to restore natural resources, courts have made it clear that they will not force companies to issue blank checks to the government.¹⁷³ This is especially true when there is no plan on how the funds requested will be spent. The law mandates that damages issued as the result of the natural resource damage provisions in CERCLA are not to be placed in the treasury.¹⁷⁴ Rather, these funds must be used to restore the damaged natural resources, thereby protecting the public interest in a healthy and thriving natural environment.¹⁷⁵ Any funds that are sought in excess of the cost necessary to fund the restoration of the natural resource are not permitted.¹⁷⁶ Only under state nuisance doctrines or negligence theories will any funds in excess of restoration and rehabilitation funds be awarded.¹⁷⁷

The common law public trust doctrine, with roots in British common law, reflects the early foundation of the natural resource damage provisions found

169. The Rights of Nature is a legal theory that natural entities, like wildlife and bodies of water, are legal subjects containing intrinsic values that are independent of humans and should therefore have their own legal standing. *See generally*, Alex Putzer *et al.*, *Putting Rights of Nature on the Map. A Quantitative Analysis of Rights of Nature Initiatives Across the World*, 18 J. OF MAPS 1 (2022).

170. Kevin Murray *et al.*, *Natural Resource Damage Trustees: Whose Side Are They Really On?*, 5 ENV'T L. 407, 418 (1999).

171. *Id.*

172. *Id.*

173. *See generally* Ohio v. U.S. Dep't of the Interior, 880 F.2d 432, 454 (D.C. Cir. 1989).

174. Murray, *supra* note 170, at 433.

175. *Id.*; 42 U.S.C. § 9607(f)(1); Ohio v. U.S. Dep't of the Interior, *supra* note 173, at 447.

176. Murray, *supra* note 170, at 430.

177. *See* New Mexico v. Gen. Elec. Co., 467 F.3d 1223, 1247 (2006); BERRY, *supra* note 151.

in CERCLA.¹⁷⁸ The public trust doctrine provides that tidelands, waters, animals, air, and other common areas containing natural resources are held in trust by the state for use by current and future citizens of the state.¹⁷⁹ In certain circumstances, the interest in public access to natural resources is so great that it must overcome a single private party's interest in the resource.¹⁸⁰ These interests need not be purely commercial. Aesthetic, recreational, and spiritual interests in natural resources are also recognized.¹⁸¹ As a fiduciary of these resources, the government's responsibility is to protect the resources for use by the public and future generations.¹⁸²

In English common law dating back to the 1500's, all wild animals were the property of the King, managed pursuant to his authority as sovereign.¹⁸³ Those animals were reserved for the King to dispose of and utilize as he saw fit.¹⁸⁴ The sovereign could grant those animals to citizens, and killing, taking, or using game for the common good was subject to absolute state control.¹⁸⁵ Even the Napoleonic Code reflected that certain resources belong to no one in particular, and the use of those resources is left to regulations that direct the manner in which those things may be enjoyed.¹⁸⁶

This power in England passed to the states after the American Revolution.¹⁸⁷ The state ownership doctrine explains that the state owns all wildlife in trust for use by its citizens. The Court in *Georgia v. Tennessee Copper* recognized the state's sovereign interest in protecting its environment for its citizens, explaining "[T]he state has an interest independent of and behind the titles of its citizens, in all the earth and air within its domain. It has the last word as to whether its mountains shall be stripped of their forests and its inhabitants shall breathe pure air."¹⁸⁸ Similarly, subsequent courts concluded that wild game within a state belongs to the people within the state in their collective sovereign capacity. The state does not own these natural resources; rather, it is tasked with preserving these resources for use by its citizens.

178. See William H. Rodgers, Jr. et al., *The Exxon Valdez Reopener: Natural Resources Damage Settlements and Roads Not Taken*, 22 ALA. L. REV. 189–90 (2005); See Murray, *supra* note 170, at 420.

179. ERIC GOBLE & ERIC FREYFOGLE, *WILDLIFE LAW: CASES AND MATERIALS* 257-8 (3d ed. 2017); Allan Kanner, *Environmental Gatekeepers: Natural Resource Trustee Assessments and Frivolous Daubert Challenges*, 49 ENV'T L. REP. 10420, 10426 (2019).

180. Murray et al., *supra* note 170, at 420 (citing Ill. Cent. R.R. Co. v. Illinois, 146 U.S. 387, 435–37 (1892); Nat'l Audubon Soc'y v. Super. Ct. of Alpine Cnty., 658 P.2d 709, 719 (Cal. 1983)).

181. Kanner, *supra* note 31, at 365.

182. Kanner, *supra* note 25.

183. See GOBLE & FREYFOGLE, *supra* note 179, at 118–19.

184. *Id.*

185. *Id.* at 118–20.

186. *Id.* at 289. (citing *Geer v. Connecticut*, 161 U.S. 519 (1896)).

187. See *id.* at 121–23.

188. Rodgers, Jr., *supra* note 178, at 140 (citing *Georgia v. Tenn. Copper*, 206 U.S. 230, 237 (1907)).

As recently as 2008, the courts have affirmed this idea of the public trust.¹⁸⁹ Wildlife is included in the public trust doctrine —not just land, air, and other natural resources. The state's responsibility to preserve the public's interest through preservation and wise use of natural resources is a current imperative.¹⁹⁰ The state must not abdicate its duty to preserve and protect the public's interest in common natural resources.¹⁹¹ An example of the public trust doctrine can be found in the Constitution of Alaska, which reflects that the state is responsible for shepherding the common ownership and stewardship of the natural resources found within the state.¹⁹²

The doctrine of *parens patriae*, or “parent of the country,” provides for the common law public trust, and states have used this doctrine to bring suits to protect natural resources for years.¹⁹³ This doctrine gives states standing to sue polluters and confirms that the state is the guardian of the natural resources found within it.¹⁹⁴ In *Geer v. Connecticut*, the Court held that natural resources are to be protected by the government: “[T]his common ownership, is to be exercised, like all other powers of government, as a trust for the benefit of the people.”¹⁹⁵ Over the years, the states expanded this doctrine to include suits to recover damages to submerged land, navigable waters, and wetlands.¹⁹⁶ Wildlife is also protected by the public trust doctrine. “Wildlife are generally transient and not easily confined, through the centuries and across societies they have been held to belong to no one and therefore to belong to everyone in common.”¹⁹⁷

Absent the public trust doctrine, alternative theories of retribution for damage to property in common law were typically claims of nuisance or trespass. In these scenarios, the cost of damages to the property is limited to the lesser of the diminution of market value or restoration.¹⁹⁸ Natural resource damage law recognizes that natural resources are worth more to the public than just their market value. The cost of restoration is often more than the

189. See GOBLE & FREYFOGLE, *supra* note 179 at 349–55. (discussing *Ctr. for Biological Diversity, Inc. v. FPL Grp., Inc.*, 166 Cal.App.4th 1349 (2008)).

190. GOBLE & FREYFOGLE, *supra* note 179, at 353.

191. *Id.*

192. Rodgers Jr., *supra* note 178, at 139.

193. See Sharon K. Shutler & Elinor Colburn, *Natural Resource Restoration: The Interface Between the Endangered Species Act and CERCLA's Natural Resource Damage Provisions*, 24 ENV'T L. 717, 739 (1994); Rodgers, Jr. et al., *supra* note 178, at 139–40.

194. Rodgers Jr., *supra* note 178, at 139–40.

195. GOBLE & FREYFOGLE, *supra* note 179, at 286 (discussing *Geer v. Connecticut*, 161 U.S. 519 (1896)).

196. Shutler & Colburn, *supra* note 193, at 739.

197. Goble & Freyfogle, *supra* note 179, at 352. (citing James L. Huffman, *Speaking of Inconvenient Truths – A History of the Public Trust Doctrine*, 18 DUKE ENV'T L. & POL'Y F. 1, 86 (2007)).

198. James L. Nicoll, Jr., *Marine Pollution and Natural Resource Damages: The Multi-Million Dollar Damage Award and Beyond*, 5 U.S.F. MAR. L.J. 323, 333 (1993).

market value of the lost natural resource, and so damages are theoretically more than the diminution of market value.¹⁹⁹

Congress likely intended NRD to carry these common law notions of the public trust and the government's role as caretaker of that trust.²⁰⁰ This is evidenced by Congress' use of common law terms of art like trust and trustee in the statute, and the legislative history in which a committee notes that the legislation's purpose was to protect that public trust in the nation's natural resources.²⁰¹ The public trust doctrine reflects a fundamental understanding that the people of the state share in the state's natural resources, and that private property rights or takings of those natural resources are limited by the public's interest.²⁰² Government leaders have an obligation to ensure that NRD assessments are fully exercised to pass the costs of remediating PFAS damage onto the polluter, and not the public. This obligation is consistent with, if not implied by, the public trust doctrine's specific purpose of protecting those natural resources for use by the people.

III. NATURAL RESOURCE DAMAGE ASSESSMENTS

CERCLA endeavors to ensure that polluters pay.²⁰³ When the nation's natural resources are alienated by private parties, CERCLA permits the government to bring suit on behalf of the public, and the NRD assessment process is the mechanism through which that is possible and the public is made whole.²⁰⁴ The process collects and analyzes data to determine the numeric money damages required to remedy damage done by hazardous substances.²⁰⁵ The procedures contained within 43 C.F.R. part 11 are not mandatory, except that for the trustee to obtain a rebuttable presumption in her findings, she must show that she used the procedures contained in part eleven.²⁰⁶

Damages from these assessments are applied exclusively to restore the ecosystems, plants, and animals damaged by PFAS.²⁰⁷ These assessments will help analyze existing science and provide further study to prove causation from PFAS chemicals, helping to bridge the gap between correlation and proof.²⁰⁸ This will draw clearer lines of damage back to the myriad problems ecosystems face — from global warming, overfishing, and climate change to plastic and PFAS contamination.

199. *Id.* at 333-34.

200. Murray, *supra* note 170.

201. *Id.*

202. Kanner, *supra* note 25, at 46-47.

203. 42 U.S.C. §§ 9601(6), 9607(a)(4)(C).

204. Kanner, *supra* note 25, at 55-56.

205. 43 C.F.R. § 11.14(aa) (2023).

206. *See* 42 U.S.C. § 9607(f)(2)(C); *New Mexico v. Gen. Elec. Co.*, 467 F.3d 1223, 1235 (2006); BERRY, *supra* note 151, § 3.02.

207. 42 U.S.C. § 9607(f)(1).

208. *See generally* Goss, *supra* note 62, at 578.

Each natural ecosystem and each environmental injury is unique.²⁰⁹ Every natural resource damage assessment first requires a pre-assessment, followed by an assessment, and then a post-assessment.²¹⁰ Assessments typically include three phases: 1) injury determination phase, 2) quantification phase, and 3) damage determination phase.²¹¹ Ultimately, five steps (comprised of pre-assessment, the three phases, and post-assessment), are necessary in more complex assessments.²¹² PFAS damage claims will rarely qualify for simplified assessments due to the long-term environmental exposure of the chemicals.²¹³

In the pre-assessment, trustees identify all potentially responsible parties. In Florida, these are plentiful, and more abundant still if generator and manufacturer liability is expanded. Emergency response teams will act concurrently with pre-assessment, and impacted biota (like alligators) will be identified, and tracked as the impact of the hazardous PFAS sets in. Upon identification, potentially responsible parties, whether they be owners, operators, arrangers, or transporters of the hazardous substance, will also be asked to participate in the overall assessment. Next, in the injury determination phase, injuries will be documented and the pathways the PFAS took to get to the injured natural resource will be clarified. The resource's baseline condition must be identified. This is necessary to show the extent the previously identified injury has limited the value of the natural resource. Damages for the loss of services are quantified, and a path to restoration of the resource is forged. Finally, the post-assessment provides a mechanism to request damages from the responsible parties, and a path to litigation if a settlement cannot be reached.²¹⁴

Part IV of this paper will describe what a natural resource damage assessment for PFAS chemicals might look like, before Part V describes how an assessment for the Florida Alligator may differ from more conventional NRD assessments. In this exercise, a damage assessment seeking to restore only a portion of an ecosystem will likely fail. For a chemical with a global impact like PFAS, restoring a single animal will ultimately lead to recontamination of that resource. This process will suggest that any NRD focusing on a single species is destined to fail, as only an all-encompassing approach can truly remediate damages perpetrated by PFAS. This recommended holistic approach aligns with the Act's congressional intent, as the drafters of CERCLA often referred

209. Kanner, *supra* note 161.

210. 43 C.F.R. § 11.13 (2023).

211. 43 C.F.R. § 11.13 (e) (2023).

212. 43 C.F.R. § 11.13 (2023).

213. See Tex. Parks and Wildlife Dep't, Tex. Comm'n on Env't Quality & Tex. Gen. Land Off., *Natural Resource Damage Assessment Plan - Mountain Creek Lake: Naval Air Station Dallas and Naval Weapons Industrial Reserve Plant*, 14 (2021).

214. The post assessment phase, while not germane to this paper, involves the trustee providing the NRD assessment report, along with a written demand for money damages, to the responsible parties. See 43 C.F.R. § 11.90 (2023); see generally Kanner, *supra* note 181; see generally Dale B. Thompson, *Valuing the Environment: Courts' Struggles with Natural Resource Damages*, 32 ENV'T. L. REP. 57 (2002).

not to a singular damaged “natural resource,” but to all “natural resources” in the environment.²¹⁵

A. *Discovering Parties and Hazardous Substances*

The pre-assessment phase is implemented when the trustee is first notified of a hazardous substance release.²¹⁶ While emergency personnel act, a pre-assessment screen is implemented to provide a review of available information by the trustee to determine whether a full damage assessment should be performed.²¹⁷ The trustee, in coordination with other agencies responding to the release, should sample resources to determine their level of contamination and preserve data.²¹⁸ For example, counts of dead or injured alligators should take place immediately and continuously because of their perishable nature.²¹⁹

A variety of information must be gathered during the pre-assessment to determine whether codified criteria are present to proceed with a complete NRD assessment.²²⁰ The information needed includes the type of hazardous substance released, the period over which the release occurred, and the potential responsible parties.²²¹

Many NRD assessments stop at the pre-assessment as this stage may give the parties enough data to reach a settlement.²²² However, a pre-assessment alone can be massive in scope. After the Exxon Valdez oil spill on March 24, 1989, the various trustees established a trustee council with representatives

215. Kornfeld, *supra* note 32, at 340–41.

216. See 43 C.F.R. § 11.20(a)(2) (2023); When coexisting or contiguous natural resources exist or concurrent agency jurisdiction over a resource, a “lead authorized official,” authorized to act on behalf of all affected Federal and State trustees, will make initial determinations. 43 C.F.R. § 11.14(w) (2023).

217. 43 C.F.R. § 11.13(b) (2023). Costs associated with the preassessment phase are also attributable to responsible parties. These costs include identifying release detection and trustees, determining which resources are injured, initial sampling and data collection, and preassessment screen costs. Costs must be reasonable and necessary. 43 C.F.R. § 11.23(g) (2023).

218. 43 C.F.R. § 11.22(b) (2023).

219. 43 C.F.R. § 11.22(b)(3) (2023).

220. 43 C.F.R. § 11.23(e) (2023). These criteria are: (1), a discharge of a hazardous material occurred, (2) natural resources under the trustee’s purview is likely to have been harmed, (3) the amount of hazardous substance exists in the resource in a sufficient concentration to cause injury, (4) data is available and sufficient to support a full NRD assessment, and (5) response actions already taken or planned will not sufficiently remedy the injury without further action. *Id.*

221. 43 C.F.R. § 11.24(a) (2023); Kanner, *supra* note 161, at 512. Legislatures typically incorporate joint and several liability into environmental statutes to assist trustees in meeting their burden of proof. One responsible party may be liable for indivisible harms caused by multiple dischargers of one or several hazardous substances. The burden then shifts to the responsible party to prove that other dischargers should be held responsible as well. See *United States v. Rohm & Haas Co.*, 939 F. Supp. 1142, 1155 (D. N.J. 1996).

222. GOV’T ACCOUNTABILITY OFF., *Natural Resources Damage Assessment Information on Study of Seabirds Killed by Exxon Valdez Oil Spill*, 3 (1991).

from all government interested parties in May of 1989.²²³ The initial plan, published in 1989, included sixty-three studies addressing thirty-two different biota within the Sound as well as lost coastal habitat.²²⁴ Exxon agreed to pay \$900 million in damages over time to several natural resource trustees, including the United States and Alaska.²²⁵ Due to the nature of the preliminary assessment and the broad array of species and natural resources impacted, the study only estimates the number of species lost and amount of damages.²²⁶

Due in part to the early settlement, Exxon agreed to a reopener clause in the event any undiscovered and unanticipated natural resources were damaged, since toxic, long term exposure data cannot be collected in a three-year time frame.²²⁷ One positive side effect of these reopener clauses is that both the trustee and the responsible party will continue to monitor the impacted resource in order to see if the reopener needs to be exercised.²²⁸

In the instance that the trustee determines that a complete assessment is warranted, she must develop a plan for that assessment to ensure it takes place in an organized and comprehensive manner and that funds will be spent responsibly.²²⁹ Assessments involving PFAS typically begin with explaining the damaged water resources, both surface and groundwater, since this is the pathway through which all other natural resources are also contaminated.²³⁰ Descriptions of contaminated biota include explanations that the presence of chemicals has led to bans on hunting or fishing and the concentration of chemicals in plants and animals.²³¹

Before launching into a complete assessment, the parties potentially responsible for the release of the hazardous substance must be contacted and offered the opportunity to participate in the assessment, as well as notified of a

223. *Id.*

224. *See generally id.*; Rodgers, Jr. et al., *supra* note 178.

225. *See* Rodgers, Jr. et al., *supra* note 178, at 151.

226. *Id.* at 153.

227. *Id.*; Knudsen, *supra* note 32, at 1538. (arguing that these early settlements are detrimental to restoration efforts, since the entire harm is not captured). A reopener will be a beneficial tool in the case of PFAS, as complete immediate mitigation is a near impossibility due to the chemical's prevalence.

228. Knudsen, *supra* note 32, at 1542.

229. Costs of the assessment are also recoverable. *See* 43 C.F.R. § 11.30(c) (2023); 43 C.F.R. § 11.31 (2023). Due to the complex and novel nature of a natural resource damage assessment involving forever chemicals, this article will assume that type B procedures will be used, and that the simplified procedures contained in the C.F.R. for type A assessments are not applicable. *See* 43 C.F.R. § 11.35 (2023).

230. *See* Tex. Parks and Wildlife Dep't, Tex. Comm'n on Env't Quality & Tex. Gen. Land Off., *supra* note 213, at 10–11 (discussing scenario in which decades of PFAS from airport operations on a Naval base contaminated surrounding ecosystems, water resources, and biota).

231. *Id.* at 12–13.

preliminary estimate of damages, to include a “no action” alternative.²³² Public notice must also be invited before the assessment plan is approved.²³³

B. *Injuries and Pathways*

The first step of the damage assessment phase is to determine the nature of the injury to the natural resource.²³⁴ To prevail in an NRD claim, the moving party (trustee) must generally provide scientific evidence sufficient to show more than correlation between PFAS and a specific injury, but may show less than a preponderance of evidence.²³⁵

For some contamination events, like the Deepwater Horizon Spill, the damage is so massive and all-encompassing that the only way to perform the assessment is an ecosystem-wide approach to address ecosystem-wide injuries.²³⁶ Often, pathways from PFAS exposure and damages are numerous and range from waste disposal, accidental spills, purposeful discharges, leaching from consumer products, and wastewater treatment into surface or groundwater.²³⁷

CERCLA has been involved in several assessments and subsequent settlements involving the freshwater mussel.²³⁸ These species are particularly susceptible to injury from hazardous chemical exposure “due to their sessile nature and filter feeding biology.”²³⁹ In 1998, in the upper Clinch River in Virginia, approximately 18,000 mussels were killed when a tanker truck operating for Certus, Inc. spilled 1,350 gallons of a rubber accelerant into the river, turning the river white.²⁴⁰ In 1996, Lone Mountain Processing, Inc. released six million gallons of coal slurry into the Powell River in Virginia, impacting a 105 km section of the river.²⁴¹ The result was a mixture of water, coal, and clay called blackwater.²⁴² Estimated fish deaths were as high as 11,240, with many

232. 43 C.F.R. §§ 11.32(a)(2), 11.38 (2023).

233. 43 C.F.R. § 11.32(c) (2023).

234. 43 C.F.R. §§ 11.13(e)(1), 11.61(a)(1) (2023).

235. See 42 U.S.C. § 9607(f)(2)(C); Kanner, *supra* note 159, at 512. The notion of strict, joint and several liability in CERCLA, combined with the trustee’s rebuttable presumption in NRD assessments, create this middle ground burden of proof.

236. Kanner, *supra* note 161, at 507.

237. Tex. Parks and Wildlife Dep’t, Tex. Comm’n on Env’t Quality & Tex. Gen. Land Off., *supra* note 213, at 15.

238. Of the 300 species of freshwater mussels, 88 are endangered and 15 are threatened under the Endangered Species Act. Water pollution and water quality are the main causes of their extirpation. See James Murray Hyde, Evaluation of the Certus, Inc. and Lone Mountain Processing, Inc. Natural Resource Damage Assessment and Restoration Cases to Restore Mussels in the Clinch and Powell Rivers in Virginia and Tennessee (Dec. 7, 2021) (Ph.D. dissertation, Virginia Polytechnic Institute and State University).

239. *Id.* at 2.

240. *Id.* at 1, 4.

241. *Id.* at 3.

242. *Id.* at 5.

harmed species serving as hosts for the mussels.²⁴³ This disaster led to a ban on hunting and fishing during the investigation and NRD assessment.²⁴⁴

In this assessment, the injury was specifically felt by the fishermen due to their lost use, enjoyment, profit, and the general inherent value of the resource.²⁴⁵ In these mussel assessments, the damage was clear. A specific chemical, discharged in a specific location, caused a specific injury —death— to a specific species. Similarly, Deepwater Horizon involved a single discharger and a single substance, even though the impact was markedly broader.

PFOA and PFOS are much more difficult to assess than the spills referenced above in that PFAS induced injuries are not immediate as it takes time for PFAS to bioaccumulate and cause harm. An injury must be observable for a resource to be considered damaged, and this damage must be a measurable and adverse change in the natural resource.²⁴⁶ These changes can be long-term or short-term changes to the chemical or physical qualities or viability of a natural resource.²⁴⁷

The standard of proof for natural resource damages is less than a preponderance of evidence.²⁴⁸ Some explain that a trustee need only show a nexus or connection between the hazardous substance and the defendant and the impacted natural resource.²⁴⁹ While this is a relaxed standard that does not require proximate cause, some causal connection between the defendant and the injured resource is required.²⁵⁰ That causation requirement need not be absolute. If PFAS is a contributing factor to an injury sustained by a natural resource, that is sufficient.²⁵¹ The potentially responsible parties are then left to determine additional parties to bring contribution claims.²⁵² “Organisms exist in a complex ecosystem, and there can be multiple facts that contribute to injury or death. Plaintiffs need only show that defendants’ release are one of these factors.”²⁵³ Important indicators of injury within a natural resource that has been damaged include biological conditions or abnormal behaviors,

243. *Id.*

244. Tex. Parks and Wildlife Dep’t, Tex. Comm’n on Env’t Quality & Tex. Gen. Land Off., *supra* note 213, at 18.

245. Thompson, *supra* note 211, at 57 (noting that market-based arguments can be effective, as seen in NRD litigation related to the Exxon Valdez spill where fishermen were successful arguing the market-based value of fish that perished during the oil spill should be included in NRD assessment).

246. Nicoll, *supra* note 198, at 348-49.

247. *Id.*

248. 42 U.S.C. § 9607(f)(2)(C).

249. Kanner, *supra* note 143, at 490 (*citing* Dedham Water v. Cumberland Farms, 889 F.2d 1146, 1154 (1st Cir. 1989)).

250. *Id.*

251. *Id.* at 492.

252. *Id.*

253. *Id.*

ecological processes and functions, or negative changes to the quality of the resource's habitat.²⁵⁴

The determination of an injury occurrence within water or air resources usually involves first sampling the resource and proving that the hazardous substance exists in the resource.²⁵⁵ Then, it must be determined that the substance exists at a level exceeding the water or air quality standards codified in statute or federal regulations.²⁵⁶ Documenting injury to a biological resource can be more difficult. An injury to a biological resource occurs only if the concentration of the hazardous substance is sufficient to "cause the biological resource or its offspring to have undergone . . . death, disease, behavioral abnormalities, cancer, genetic mutations, physiological functions . . . or physical deformations."²⁵⁷

Furthermore, scientific literature must support the finding that the biological response is the result of the hazardous substance.²⁵⁸ The biological response of the resource must also be markedly different from other similarly situated species who were not exposed to the hazardous substance.²⁵⁹ At the outset, trustees typically do not know what injury to natural resources they will encounter, and instead explain the tests they will accomplish to quantify injury to the natural resource.²⁶⁰ This again indicates the importance of NRD assessments in pushing the science of PFOS and PFOA forward.

Coupled with injury analysis, another essential part of the injury determination phase is the configuration of the exposure pathways, tracing the journey the substance takes from point source to infected natural resource. To determine the hazardous substances pathway, the trustee must consider the characteristics of the chemical and the mechanism of transport from release to natural resource.²⁶¹ Satisfying this element means showing that the substance currently exists or existed in that pathway.²⁶² This shows that the substance could have taken this pathway to reach the injured resource. The most effective mechanism to determine where the chemical originated is by identifying the chemical discharge in a permit issued under an applicable statutory scheme like the Clean Air Act (CAA) or CWA.²⁶³ Strict joint and several liability in

254. Kanner, *supra* note 161, at 515.

255. See 43 C.F.R. § 11.62(b)–(d) (2023).

256. *Id.*

257. 43 C.F.R. § 11.62(f)(1)(i) (2023).

258. 43 C.F.R. § 11.62(f)(2) (2023); 43 C.F.R. § 11.62(f)(4) (2023) (lists several biological responses that are approved injury mechanisms under the act).

259. 43 C.F.R. § 11.62(f)(2) (2023); If a state health agency has issued a directive to limit the presence of a hazardous substance in a biological resource, like fish, and those levels have been exceeded, an injury will have occurred. 43 C.F.R. § 11.62(f)(1)(ii) (2023).

260. Texas Parks and Wildlife Department, Texas Commission on Environmental Quality, and Texas General Land Office, *supra* note 213, at 17–18.

261. 43 C.F.R. § 11.63(a) (2023).

262. 43 C.F.R. § 11.63(a)(2) (2023).

263. This will not be an effective means of identifying PFOA or PFOS until after they

CERCLA assists trustees when satisfying their burden of proof here.²⁶⁴ If one exposure pathway can be effectively mapped, it then becomes the responsible party's best interest to assist the trustee and find additional pathways to additional polluters.

Once the trustee proves that one party caused a release and that the established release damaged a natural resource, the responsible party is then able to bring contribution claims against the other parties who may have also damaged the resource.²⁶⁵ Plaintiffs' firms have negatively highlighted that this contribution claim process will lead to an increased number of "lawsuits against downstream companies and peripheral products," but in any case, contribution liability primarily takes the burden off of the government to prove liability and places that burden squarely on the shoulders of the responsible parties, making the source-finding mission associated with PFAS contamination less cumbersome for the government.²⁶⁶ Even hurdles like the comingling of hazardous substances may not pose a concern where one party contributing to the discharge may be held liable for the entirety of the damage.²⁶⁷ If joint and several liability applies, the NRD assessment need not quantify or distinguish between sources of pollution, as all liable parties can be held accountable.²⁶⁸

Biological pathways can, and often do in the PFAS context, indirectly and directly carry the hazardous substance from resource to resource.²⁶⁹ When a biological species carries the substance, trustees are directed to assess the presence of the substance in an "indicator species" of general availability in the contaminated area in order to provide circumstantial evidence that similar species indeed carried the substance between different resources.²⁷⁰ In Florida, potential indicator species may be mussels or fish. The statute requires that collection of that species for testing] not exceed the minimum amount necessary to provide a sample volume for analysis, to avoid excess deaths and further disturbing the ecosystem.²⁷¹ All testing and methodologies used throughout the injury determination phase must be supported by best available science.²⁷²

are designated as hazardous, as dischargers are not required to procure permits for non-hazardous substances. See Kanner, *supra* note 161, at 512.

264. *Id.* at 515.

265. See generally Johnson, *supra* note 19, at 107; see also 42 U.S.C. § 9613(f).

266. See Craig T. Liljestrand, *PFAS Exposure: A Comprehensive Look at Emerging Facts and Studies, Risk and Liability Assessment, Litigation History, Evolving Regulations and Future Predictions*, 89 DEF. COUNSEL J. 32 (2022).

267. Kanner, *supra* note 161, at 512 (providing no minimum requirement, unlike for reporting violations under § 9603). Comingling occurs when a chemical is released from various responsible parties operating at numerous locations, blending at one end point.

268. *Id.*

269. See 43 C.F.R. § 11.63(f) (2023).

270. When determining pathways, special rules apply depending on the medium through which the chemical passes. 43 C.F.R. § 11.63(f)(4)(ii)(A) (2023).

271. 43 C.F.R. § 11.63(f)(4)(B) (2023).

272. See generally 43 C.F.R. § 11.64 (2023).

C. *Quantifying the Baseline*

The second step of the damage assessment is the quantification phase. This phase requires the determination of a baseline, which is defined as the conditions that would have existed at the assessment area but for the discharge of the hazardous substance.²⁷³ Restoration goals cannot be accomplished without determining the baseline state in which the natural resource existed prior to the release of the hazardous substance.²⁷⁴ The purpose of this phase is to quantify the resource's adverse change and reduction in ecosystem service(s) due to the hazardous substance.²⁷⁵ This quantification allows the next phase to assign a money value to those services and determine the work required to restore the resource.²⁷⁶

Wherever available, historical data should be utilized to establish the baseline.²⁷⁷ Upstream reference points (areas in a body of water before the discharge occurred) and control areas are also encouraged as a means to determine the baseline, but the abundance of PFAS may make this difficult to do.²⁷⁸

Options exist to restore animals close to baseline conditions. Injured or destroyed animals can be replaced at the location from which they were lost.²⁷⁹ Those animals can either be the exact species that was taken, or a similar species capable of filling the habitat void left by the lost species.²⁸⁰ Alternatively, those animals can be replaced at a different location with similar biological and physical characteristics to the ecosystem from which they were taken.²⁸¹ Only on-site replacement using the precise species that was lost can assure all services provided by the lost species are returned to the baseline.²⁸²

The designation of the ecosystem services normally provided by the injured resource when in its baseline condition is an important step in this quantification process, as it aids in the calculation of the change from baseline to damaged status.²⁸³ Services offered by biological resources include recreation and other products or services that are used by humans, such as flood control.²⁸⁴ Incorporating the baseline shifts the focus, “not merely on assessing environmental damages—the approach taken by CERCLA—but on developing and implementing plans for restoring and rehabilitating damaged

273. 43 C.F.R. § 11.72(b)(1) (2023); 43 C.F.R. § 11.14(e) (2023).

274. 43 C.F.R. § 11.70 (2023).

275. 43 C.F.R. § 11.70(b); Nicoll, *supra* note 198, at 349; 43 C.F.R. § 11.13(e)(2).

276. *Id.*

277. 43 C.F.R. § 11.72(c) (2023).

278. Kanner, *supra* note 161.

279. Shutler and Colburn, *supra* note 193, at 740.

280. Shutler and Colburn, *supra* note 193.

281. *Id.*

282. *Id.* at 740–41.

283. Quantification Phase – Service Reduction Quantification, 43 C.F.R. § 11.71(b) (2023); Kanner, *supra* note 143, at 485.

284. 43 C.F.R. § 11.71(e) (2023).

resources or services.”²⁸⁵ The total area impacted by the release and the degree to which the resource has been affected are appropriate considerations, as well; the proportion of damaged resources compared to the whole should also be analyzed.²⁸⁶ For water and air resources, the quantification phase largely focuses on determining the total area impacted, and then working to determine how those resources cannot be used after the release as compared to before the release.²⁸⁷

For biological resources like animals, the consideration of entire populations at the ecosystem or habitat level is more important than that of the individual animal.²⁸⁸ Special attention should be given to biological resources that provide significant services, represent a large component of an ecosystem, or are especially sensitive to the hazardous substance.²⁸⁹ For example, mussels regulate the ecosystem in a myriad of different ways. They provide biofiltration of water, which cycles nutrients in and out of rivers and provides for habitat modification.²⁹⁰ Additionally, they serve as a food source.²⁹¹ Mussel shells are also used in consumer products and provide aesthetic value.²⁹² Measuring the growth or reduction of a species can be accomplished using established scientific practices like capturing, marking, and releasing.²⁹³ However, the “natural recolonization of injured mussel assemblages may take many years, during which such services provided by them would be lost.”²⁹⁴

Because natural recolonization takes so long, and many of these hazardous substance releases completely eradicate mussel populations, restoration is required.²⁹⁵ Since mussels must be brought back to a baseline level where they can again provide the services mentioned above, repopulation by replacement of mussel populations is often the only available option.²⁹⁶ Usually, the type of mussel is altered in the repopulation process, which allows an easier-grown species to repopulate an area after the endangered species has been eradicated.²⁹⁷ Another potential option for returning populations like that of the mussel close to baseline conditions is their attempted colonization outside of the impacted area and away from hazardous contaminants that may still linger in their old habitat.²⁹⁸

285. Thompson, *supra* note 245 at 66. (citing *General Electric v. United States Department of Commerce (General Electric)*, 767, 770 (D.C. Cir. 1997)).

286. *Id.* § 11.71(c).

287. *Id.* § 11.71(h)–(j).

288. *Id.* § 11.71(i)(1)–(2).

289. *Id.*

290. Hyde, *supra* note 238, at 44.

291. *Id.*

292. *Id.*

293. 43 C.F.R. § 11.71(i)(5) (2023).

294. Hyde, *supra* note 238, at 44.

295. *Id.*

296. *Id.*

297. *Id.* at 46.

298. *Id.* at 44.

The final portion of the quantification phase is resource recoverability analysis, which requires that the trustee determine the time needed for the injured resource to recover to the baseline.²⁹⁹ This estimate should consider the “no action” alternative, where a natural recovery alone is left to take place without human intervention.³⁰⁰ In order to be all-encompassing, this estimate must include factors such as reproductive patterns, life cycles, tolerance to the hazardous substance, bioaccumulation, and the extent to which the hazardous substance is in the affected resource’s food chain.³⁰¹ Natural removal rates of the hazardous substance out of the ecosystem through dispersion, dilution, and biological degradation must also be incorporated in the estimate.³⁰² Setting an achievable timeline is the final step in the injury quantification stage aimed at restoring the resource to baseline conditions.

D. *Restoration, Damages, and Scope*

The final phase pulls the previous two together, using the injury, baseline, and pathway data to determine how to restore the biota to that baseline and what money damages are necessary to achieve that restoration goal. CERCLA “evinces a clear congressional intent to make restoration costs the basic measure of damages,” and measuring those damages economically often underestimates the resource’s value to the greater ecosystem.³⁰³ As defined, damages must be sufficient to restore the lost resource back to baseline conditions.³⁰⁴ For example, this could be the cost of restoring mussel populations in an affected area by growing substitute mussels in hatcheries, or cultivating them from other clean portions of rivers, and then transporting them to the affected area.³⁰⁵

When endangered species and those species that are notoriously difficult to cultivate are involved, damages may be the cost of introducing similar species to help bring the ecosystem back to the baseline.³⁰⁶ In the event of a total loss of a resource, it may be replaced with an exact replica of the lost resource or of “equivalent natural resources capable of providing such services.”³⁰⁷ Note that while the above examples include both restoration and replacement strategies, the distinction between the two is important because it provides trustees with alternatives when determining a course of action to return an ecosystem to

299. Quantification Phase – Resource Recoverability Analysis 43 C.F.R. § 11.73(a) (2023).

300. *Id.* § 11.73(a)(1).

301. *Id.* § 11.73(c)(2)(i)–(ii).

302. *Id.* § 11.73(c)(2)(iv).

303. *Ohio v. U.S. Dep’t of the Interior*, 880 F.2d 432, 448 (D.C. Cir. 1989).

304. *Id.* at 442.

305. *See generally*, Hyde, *supra* note 238.

306. *See id.* at 5.

307. 43 C.F.R. § 11.13(e)(3) (2023); 43 C.F.R. § 11.80(b) (2023); Kanner, *supra* note 159, at 508161; Nicoll, *supra* note 198, at 335.

the baseline.³⁰⁸ For the majority of damaged ecosystems, this flexibility to decide which avenue to take will allow trustees to better spend recovered dollars.³⁰⁹

While early assessments found that economic measurements alone determined the cost of a lost natural resource, this approach is now seen as outdated.³¹⁰ An adequate accounting of damages requires consideration above the monetary value of the resource, to include use value, nonuse value, and the ability of the ecosystem to recover.³¹¹ Use value is the value of a resource to the people who use the resource.³¹² Two types of use values exist: consumptive and non-consumptive.³¹³ Consumptive use is a use that consumes the resource, like drinking water or eating an animal.³¹⁴ Non-consumptive uses do not reduce the availability of the resource, like swimming in the ocean, wildlife viewing, or scuba diving.³¹⁵

If it is determined that as long as the hazardous release is stopped, the resource will recover naturally without additional interference, the cost of damages would only include the loss of the resource's interim use.³¹⁶ However, natural recovery is not a viable solution for resources affected by PFAS due to the forever chemicals' proven longevity in the environment.³¹⁷ This will continue to be the case in the absence of a future technological breakthrough.

Resource Equivalency Analysis provides a mechanism for analyzing services provided by the natural resource, rather than the natural resource itself.³¹⁸ This type of analysis can be seen when a non-native species is introduced into an ecosystem in order to restore the services provided by the lost species.³¹⁹ This approach has been utilized to quantify damages for mussels and account for a return to the baseline service provided by the mussel.³²⁰ This option is more cost effective than on-site restoration, and focuses on replacing or replenishing the damaged population with a different species capable of similar ecosystem services.³²¹

308. Shutler & Colburn, *supra* note 193, at 744.

309. *Id.*

310. Economic use measurements alone underestimate the true extent of a damaged or lost resource, as economic evaluations usually only focus on use values and fail to incorporate non-use values of a resource. See Thomas A Grigalunas et al., *The Natural Resource Damage Assessment Model for Coastal and Marine Environments (NRDAM/CME)*, 543–544 (1987).

311. See 42 U.S.C. § 1951(c)(2); *Ohio v U.S. Dep't of the Interior*, 880 F.2d at 443.

312. Nicoll, *supra* note 198, at 338.

313. *Id.*

314. *Id.*

315. *Id.*

316. *Id.* at 338–39.

317. Griffin et al., *supra* note 100, at 2.

318. Hyde, *supra* note 238, at 88; Texas Parks and Wildlife Department, Texas Commission on Environmental Quality, and Texas General Land Office, *supra* note 210 at 19; Thompson, *supra* note 211, at 75.

319. Hyde, *supra* note 238.

320. *Id.*

321. *Id.* at 89.

Another example of this approach is seen when an oil spill damages acres of wetlands, and the responsible party remediates this by providing a similarly sized bank of uncontaminated wetlands in another location.³²² The downside to this approach is that non-use and certain aesthetic values, like protecting endangered species or knowing that a certain animal exists in the wild, are not always restored back to baseline conditions.³²³

The Prop Scar Restoration Project is a notable example of resource equivalency in the state of Florida.³²⁴ In this case, a treasure hunter who had destroyed almost two acres of sea grass due to a scavenging operation, was ordered (following an NRD assessment) to restore an area apart from the area he damaged, but equal in size.³²⁵ The trustees determined that the area destroyed by the treasure hunter could not be restored, so repairing a separate but equal swath of sea grass was an appropriate resource equivalency remedy.³²⁶ This was an effective approach for the acute injury inflicted by the treasure hunter. Unfortunately, however, resource equivalency strategy falls short when applied to PFAS. Without a holistic approach to the entire ecosystem, transplanting a PFAS-free alligator into a PFAS-ridden environment will only serve to contaminate another resource.

Trustees may seek to recover damages for non-economic harms as well, such as those linked to aesthetic and intrinsic values, vicarious enjoyment, existence value, and loss of saving the resource for future enjoyment.³²⁷ This is particularly relevant when endangered species are harmed or threatened by a hazardous substance.³²⁸ Recreation is also a widely recognized measure of harm that is not tethered to economic value.³²⁹ The loss of intrinsic value can be applied even to those who do not currently use the natural resource, and simply want to preserve the opportunity for themselves or their children to use the resource, like the many retirees who hermit themselves in air conditioned buildings for the duration of the summer months.³³⁰ Existence value, or the knowledge that a particular resource exists, is still a valid basis for damages for those not actively enjoying the resource.³³¹ While NRD assessments have used these methods in the past, courts have been skeptical of this approach, finding that it lacks scientific backing.³³²

322. Thompson, *supra* note 245, at 67.

323. Hyde, *supra* note 238, at 88.

324. Thompson, *supra* note 245, at 74–75.

325. *Id.*

326. *Id.* at 75–76.

327. *Id.*

328. *See* Tenn. Valley Auth. v. Hill, 437 U.S. 153, 185 (1978).

329. Kanner, *supra* note 181.

330. Nicoll, *supra* note 198, at 339.

331. Often these nonuse values are quantified through surveys. Thompson, *supra* note 245, at 82–84.

332. *Id.*

Before implementing a recovery plan, public commentary must be included as a part of the completed report of assessment.³³³ As discussed, Natural Resource Damage assessments are rooted in the public trust.³³⁴ Therefore, the public must be provided a platform to describe how the prevalence of PFAS in the Florida environment, and in alligators specifically, has impacted their use and enjoyment to ensure that no method of valuation is overlooked. A blending of resource equivalency, lost use and non-use values, and primary restoration will be necessary to implement an all-encompassing damage assessment for the Florida alligator.

IV. THE REMEDY; CLARIFYING THE SCIENCE AND THE RESPONSIBLE PARTIES

Natural resource damage assessments are superior to other avenues of restorative litigation because NRD assessments allow for the holistic remediation of entire ecosystems, blending strategies to measure baselines and damages while restoring both the alligator and their ecosystem. Rarely does a plaintiff have the power or legal standing to remediate more than their own property. However, this powerful tool cannot be utilized until the EPA designates PFOA and PFOS as hazardous.

Recent years have seen the EPA take increasingly drastic measures to curb the spread of PFAS. In June 2022, the EPA released drinking water health advisories for PFAS.³³⁵ The EPA also announced one billion dollars would be allocated in infrastructure grants to address PFAS in drinking water of disadvantaged communities.³³⁶ Perhaps most significantly, on August 26, 2022, the EPA proposed a rulemaking to designate PFOA and PFOS as hazardous substances under CERCLA.³³⁷ The EPA's reasoning for its action is "based on significant evidence that PFOA and PFOS may present a substantial danger to public health or welfare or the environment."³³⁸ They specifically cited many of the same health risks and concerns described in Section I, including PFAS' persistence in the environment and human epidemiology studies showing a wide range of impairments.³³⁹

333. 43 C.F.R. § 11.81(c) - (d)(3) (2023).

334. *Center for Biological Diversity, Inc. v. FPL Group, Inc.*, 83 Cal Rptr. 3d. 588 (Cal Ct. App. 2008); Kanner, *supra* note 31.

335. U.S. Env't Prot. Agency, *EPA Actions to Address PFAS*, (2018), <https://www.epa.gov/pfas/epa-actions-address-pfas> (last visited July 31, 2023) [<https://perma.cc/G8QG-XCTG>].

336. *Id.*

337. Designation of Perfluorooctanoic Acid (PFOA) and Perfluorooctanesulfonic Acid (PFOS) as CERCLA Hazardous Substances, 87 Fed. Reg. 54415 - 42 (proposed Sept. 6, 2022) (to be codified at 40 C.F.R. pt. 302).

338. *Id.*

339. *Id.*

Once the rule is finalized, any releases of PFOA and PFOS amounting to one pound or more within a 24-hour period must be reported pursuant to CERCLA section 103(a).³⁴⁰ The rule intends to provide enhanced transparency for the government and the public to identify releases of these hazardous substances.³⁴¹ This allows the EPA to “get upstream of the problem,” by limiting the release of these hazardous substances by industrial discharge facilities.³⁴² This approach would also enhance transparency by allowing authorities and federal, state, and local levels to obtain information on the location and extent of PFOS and PFOA releases.³⁴³

In addition to other implications under CERCLA for potentially responsible parties under the act, this rule appears drafted with the express intention of catalyzing the actions discussed in this paper, allowing “delegated agencies [to] recover PFOA and PFOS cleanup costs from potentially responsible parties, to facilitate having polluters and other potentially responsible parties, rather than taxpayers, pay for these cleanups.”³⁴⁴ The proposed rule would allow natural resource damage trustees to sue responsible parties, ordering them to remediate natural resources that have been contaminated and damaged due to releases of PFAS chemicals.³⁴⁵ The proposals in this paper assume that PFOA and PFOS will imminently be listed as hazardous, thus bringing them under the CERCLA umbrella and susceptible to NRD assessments.

This proposed EPA rulemaking for PFOS and PFOA was published in the Federal Register for public comment in April 2023.³⁴⁶ The rule was scheduled to publish in the summer of 2023, however, the period for public comments was extended to June 12, 2023.³⁴⁷ The agency has 24,084 comments to review before publishing the final rule. A final rule is now expected in 2024.³⁴⁸ The rule is facing considerable pushback by industries that produce or use PFOS and PFOA.³⁴⁹ These industries complain of the extremely high costs of compliance with the new rule, who estimate that it could potentially cost them \$1

340. *Id.* (Thousands of chemicals in the PFAS class exist. The EPA has proposed to list only two. The chemicals presence and variations make them extremely difficult to study and determine human health and environmental risks for certain). See Our Current Understanding of the Human Health and Environmental Risks of PFAS, *supra* note 18.

341. 87 Fed. Reg. 54415 (Sept. 6, 2022) (to be codified at 40 C.F.R. Part 302).

342. U.S. ENV'T PROT. AGENCY, PFAS STRATEGIC ROADMAP: EPA'S COMMITMENTS TO ACTION 2021–2024 (2021), 6.

343. *Id.* at 20.

344. 87 Fed. Reg. 54415 (Sept. 6, 2022) (to be codified at 40 C.F.R. Part 302).

345. See 42 U.S.C. § 9607(a)(4)(c).

346. Addressing PFAS in the Environment, 88 Fed. Reg. 22399 (Apr. 13, 2023) (to be codified at 40 C.F.R. 302).

347. *Id.*

348. *Id.*

349. Michael Scaturro, *Proposed Rule on PFAS “Forever Chemicals” Could Cost Companies \$1 billion, But Health Experts Say it Still Falls Short*, CBS NEWS (Jul. 3, 2023), <https://www.cbsnews.com/news/pfas-forever-chemicals-epa-rule-cost-health> [<https://perma.cc/L42Z-ZQXD>].

billion.³⁵⁰ Conversely, some say the proposed rule does too little, as the European Union may ban or limit 10,000 PFAS chemicals.³⁵¹

A natural resource assessment has the potential to remediate entire coastlines, bays, estuaries, everglades, and states.³⁵² This section first explains how these natural resource damage provisions of CERCLA apply to one animal in existence since the dinosaurs and now threatened by PFAS: the Florida alligator. Next, this section will explore how exercising science-based NRD assessments will clarify damage caused by PFAS chemicals, ultimately moving the science from correlation between PFAS and injury to causation. While strict causation is not required in NRD assessments, mere correlation will likely be insufficient.

This final section will also explore regulatory changes that may help make CERCLA more effective in its attempted remediation of damages from PFAS contamination. Hopefully, this paper will prove that the public may utilize CERCLA as an effective mechanism to curb the damage wrought by forever chemicals.

A. *The Remedy*

At their baseline, alligators provide many ecosystem services. They are a food source for humans, and as an apex predator, they control the population of the animals that are cohabitants of their ecosystems. These reptiles live in swampy or marshy areas like the Everglades, which frequently provide flood control and pollutant filtration services. Additionally, these ancient creatures are a tourist attraction and hold aesthetic value.

Simply paying to replace contaminated resources, like the alligator, is not enough, as this approach only addresses a sliver of the damage. Much of the public is wary of using PFAS-infested waters in both non-consumptive or consumptive fashions, either by swimming in or drinking from underground aquifers that rise above the EPA's recommended levels for PFAS.³⁵³ Additionally, many of the plants and animals the public rely on for subsistence contain elevated levels of PFAS.³⁵⁴ Accounting for use and non-use provides some assurance that, when assigning damages for PFAS, the trustee does not fail to capture more than just the economic value of the resource. Lost use (and non-use) value is beneficial when a natural resource is damaged from PFAS without suffering a total collapse, as PFAS typically needs to bioaccumulate before inflicting any real harm.³⁵⁵ This is important because the public may choose to cease using a resource at the first sign of PFAS, at which point the lost-use value of that resource could appropriately be determined.

350. *Id.*

351. *Id.*

352. *See* Kanner, *supra* note 31, at 378–76 (2015).

353. *See generally* Goss, *supra* note 62; Diaz & Stewart, *supra* note 76

354. *Id.*; *see generally* Levy, *supra* note 49.

355. *See* U.S. ENV'T PROT. AGENCY, *supra* note 3.

To replace lost alligators in Florida, alligators grown in PFOS-free hatcheries can be deposited into Florida waters, or culled from PFOS-free natural environments and released into Florida waters.³⁵⁶ These alligators need not be the exact species of the lost gators to satisfy NRD requirements.³⁵⁷ However, benefits of a particular species of alligator may not be fully understood until that species is gone from the environment.³⁵⁸ For a charismatic megafauna like the Alligator, the public surely will not accept the replacement with a non-alligator capable of assuming the apex role, and potentially may reject an alligator species from another part of the world as a replacement. A reopener clause may be beneficial to address these potential wrinkles.

CERCLA currently accounts for recoverable natural resource damages, injury to biota, and injury to the ecosystems and food chains upon which those biotas depend, with a “focus on assessing environmental damages.”³⁵⁹ Entire critical habitats or ecosystems can and should be cleansed of PFOS and PFOA on the responsible party’s dime, but this can only be done with a holistic approach to the NRD assessment.³⁶⁰

One of the many problems with solely taking action to remediate sites contaminated with PFAS is the risk of recontamination.³⁶¹ If only groundwater is treated, or only the soil is treated, the untreated resource will leach contaminants back into the treated resource.³⁶² Simply treating affected animals without treating the surrounding soil and water means these animals will quickly be contaminated again.³⁶³ Longer or repeated treatment cycles for PFAS can also be expected without a holistic approach.³⁶⁴ To fully remediate an ecosystem contaminated with chemicals that will not dissipate on their own, an analysis of the entire ecosystem is required so that the restored animals are not contaminated by unrestored water, soil, and plants.

The entire ecosystem and beyond may require remediation for even a single species to reach its baseline condition. Some courts have agreed with this analysis, finding that money damages are inappropriate where the funds will be used for replacement resources placed back into a contaminated habitat.³⁶⁵ This approach seems to make logical sense, as its unwise to chase lost

356. It is a trickier proposition to cleanse existing alligators of their PFAS. PFAS chemicals can be remediated from drinking water by using granular activated carbon, ion exchange, or reverse osmosis. No clear method of remediating animals of PFAS has emerged. See Cody Bahr, *Drinking Water and PFAS: Learning from Minnesota’s 3M PFAS Settlement*, 2021.

357. See Shutler and Colburn, *supra* note 193, at 740–41.

358. *See id.*

359. *Id.* at 739.

360. *See id.*

361. Johnson, *supra* note 19, at 96.

362. *Id.*

363. *See id.*

364. *Id.*

365. *See, e.g., Puerto Rico v. SS Zoe Colocotroni*, 628 F.2d, 652, 677 (1st Cir. 1980)

money. However, we should attempt remediation and prove definitively what is effective rather than embrace old mantras applicable in another arena.

B. *Lack of Clear Injury from PFAS – Using NRD to Fund Science*

While the harmful effects PFOS and PFOA have on human beings is well established, the impact these chemicals have on ecosystems and animals is less certain.³⁶⁶ PFOS and PFOA are present in alligators. These contaminated alligators have immune deficiencies causing increased rates of bacterial infections.³⁶⁷ However, it is unclear that the presence of the PFAS alone caused immune deficiencies in the alligators.

Plaintiffs should hurry to bring NRD suits following EPA's CERCLA designation so that a complete NRD assessment of Florida may commence. The state has been inundated with many types of PFAS. Alligators and their habitat are adversely impacted by various human-caused environmental factors including climate change, surface runoff, and loss of habitat. While PFAS has been found in alligators and their habitats, a thorough accounting of specific injuries and their root causes is required to prove the role of PFAS. NRD assessments offer polluter-funded damage assessments to sift through the reeds of data. Assessments must include complete documentation of all injuries and complete documentation of PFAS levels to advance this science.³⁶⁸

Alligators exist almost exclusively in swamps, nature's greatest filter and repository, where everything from trash to treasure accumulates. Because PFOS and PFOA are so prevalent and wild animals can consistently expose themselves, pathway and injury analysis is and will continue to be difficult. The circumstances of the release and the terrain or body of water involved are important here, as are the toxicological properties of the PFAS.³⁶⁹ Direct water, air, and food chain contact are all important to consider and become more complex the more apex the predator.³⁷⁰ An estimate should be determined as to the total exposed area where impacts of the hazardous substance may be felt, to assist in specifying all impacted resources.³⁷¹

Understanding the impact of long-term toxic exposure to chemicals is not a problem unique to PFAS.³⁷² NRD assessments have advanced understanding of exposure to toxic substances before. After the Deepwater Horizon

(holding that district court erred in awarding NRD to replace organisms that could not be restored or replaced because their habitat was still contaminated with oil).

366. *The Devil They Knew: PFAS Contamination and the Need for Corporate Accountability: Hearing Before the Subcommittee on Environment, 116th Congress, supra* note 6, at 36.

367. Gillette, *supra* note 123.

368. 43 C.F.R. § 11.61(b).

369. 43 C.F.R. § 11.25(a)(2).

370. 43 C.F.R. § 11.25(a)(3). The concentration of the hazardous substance in the natural resource is also important. *See* 43 C.F.R. § 11.25(d).

371. 43 C.F.R. § 11.25(b).

372. Knudsen, *supra* note 32, at 1509.

oil spill in 2010, academics, industry, and the government descended on the Gulf Coast to study the ecological impacts of the oil spill.³⁷³ NRD science provided an opportunity to examine the entire coastal and marine ecosystem as a whole.³⁷⁴ Importantly, these players stayed and studied the long term impacts of the spill—a pivotal necessity when understanding the impact of bioaccumulating chemicals like PFAS.³⁷⁵ Often, these studies discover that the long term exposure is more detrimental than the initial acute injury.³⁷⁶ Chronic exposure to anti-bacterial soap, continuous exposure to benzene in the workplace, and pesticides in groundwater are among the other areas where long-term scientific study was necessary and proved beneficial.³⁷⁷

NRD assessments are an “immensely useful source of understanding ecological harms from both acute and chronic toxic exposure,” and will help determine new and more effective ways to remediate PFAS from the environment.³⁷⁸ Science will be funded by the government initially (reimbursed by industry), conducted by scientists, and overseen by government officials.³⁷⁹ To address the potential issue of conflicts of interest, NRD assessments will also likely be supplemented by additional studies funded separately by industry. After the Exxon spill, Exxon privately funded 400 studies over the 20 years following the spill, to ensure that the publicly conducted NRD assessment was in line with their expectations.³⁸⁰

In early hazardous chemical spills analyzed under natural resource damage assessments, portions of the settlement money went towards hiring scientific professionals. Their job was to conduct the assessment and work at mussel hatcheries to assist with cultivating the species.³⁸¹ This created a mussel hatchery industry, and jobs to go along with it. This investment through NRD supported consistent improvement in technology for mussel hatcheries and culture.³⁸² As intended, the NRD process created a polluter-funded mechanism to explore efficiencies and identify more cost-effective ways to address the problem in the future.

Scientific breakthroughs catalyzed by NRD assessments will clarify the impacts of PFAS on the environment, ushering in the continuous discovery of new and better ways to remediate these impacts. The task is daunting in the present, but an environmental undertaking to restore the Florida alligator’s

373. *Id.* at 1513.

374. *Id.* at 1514.

375. *Id.* at 1505–06.

376. *Id.* at 1510.

377. *Id.* at 1511–12.

378. *Id.* at 1507.

379. *See generally id.*

380. *Id.* at 1527.

381. *See Hyde, supra* note 238; Knudsen, *supra* note 32.

382. *Id.* Through their work, scientists also learned that releasing juvenile mussels from the hatcheries and into the rivers and tributaries led to increased mortality rates, so scientists adjusted and permitted those mussels to mature before releasing future groups.

ecosystems to pristine conditions is a worthwhile task to ensure future generations can enjoy these national treasures. The tools created and refined here can be replicated on a national scale for all the Nation's species impacted by forever chemicals of the present and future. This cannot begin in earnest until PFOS and PFOA are listed as hazardous.

The kind of adversarial science that is inherent in natural resource damage assessments will help polluters and legislators determine the true impacts of toxic discharges.³⁸³ In doing so, additional information will surface on the long- and short-term impacts of PFAS on the environment and on its inhabitants.³⁸⁴ Without the NRD process, it is unlikely that multiple parties will risk expensive and scientifically demanding research or litigation to support ecosystems and alligators crippled by PFAS. Without the NRD process, the science around PFAS causation may stagnate at correlation; the public may never prove that PFAS caused particularized damages, instead only annotating that damaged resources were also impacted by PFAS.

Sixty years of science conducted largely by a few very large corporations established enough proof that PFOS and PFOA cause injuries in humans.³⁸⁵ With the listing of PFOA and PFOS as hazardous chemicals in 2023, perhaps natural resource damage assessments can produce this same level of certainty on a more expeditious timeline.

C. *Relief for the Public Trust*

Listing PFAS as a CERCLA hazardous substance will immediately and drastically alter the legal landscape, increasing government oversight and catalyzing cleanup efforts. Unfortunately, the listing may force publicly-owned water treatment works to remediate a large portion of the contamination—a notion antithetical to the public trust.³⁸⁶

Publicly-owned water treatment facilities collect PFAS-laden water, treat the water, and then discharge some amount of PFAS back into the environment, where it makes its way to swamps and streams where alligators live. These industries refer to themselves as passive receivers because they did not intentionally receive PFAS or create it, yet they will likely be on the hook for damages under CERCLA's NRD provisions. Even if these treatment facilities could completely remove all PFAS from the water, they would still need to dispose of the PFAS they collect from the water in some way. Unfortunately, this places the burden of PFAS cleanup on the very people Congress intended to protect when drafting NRD provisions into CERCLA: the public.

383. See generally Knudsen, *supra* note 32.

384. Knudsen, *supra* note 32, at 1505.

385. See Zingales & Shapira, *supra* note 53; Adashek, *supra* note 6.

386. Dean Scott & Pat Rizzuto, *Cleanup Liability Among Concerns About EPA's Hazardous PFAS Plan*, BLOOMBERG LAW (Nov. 17, 2022), <https://news.bloomberglaw.com/environment-and-energy/cleanup-liability-among-concerns-about-epas-hazardous-pfas-plan> [<https://perma.cc/Z3AU-J5XT>].

While CERCLA exempts many responsible parties from accountability, it also holds publicly-owned water treatment works and municipal waste facilities unfairly liable. These utilities take- in a variety of waste and inevitably discharge at least trace amounts back into the environment.³⁸⁷ Selective enforcement is one potential solution to this problem, but it is likely destined to fail. In this scenario, trustees would simply choose to not seek recovery from potentially responsible parties, the publicly or municipally owned treatment and waste facilities.³⁸⁸ While trustees very well may avoid seeking to hold these publicly funded entities liable, other potentially responsible parties that are also liable could and will choose to seek recovery costs or contribution actions from the publicly funded water works or waste management sites. No law prevents a corporation assessed damages under NRD from seeking to share liability costs by filing a contribution suit against a municipal treatment facility.³⁸⁹ Indeed, those responsible parties are well served to seek out as many parties in a contribution claim as possible to diffuse the liability costs.

Since these treatment works entail intaking a hazardous substance and then arranging for its disposal, they become a potentially responsible party, falling into the arranger or site owner/operator category of liability.³⁹⁰ Airports, also publicly funded entities, likely face additional liability under this rule change as well because many have historically used foams with high concentrations of PFAS to fight fires and prevent leaks in storage tanks.³⁹¹ Publicly funded services didn't create the PFAS, but as the last known holder of the chemicals, they may be left holding the bill.

Conversely, taxpayers are fortunate that CERCLA does not regulate consumer products like plastic packaging or household chemicals, which likely contain large amounts of PFAS. If liability could be tied back to household waste, then PFAS leaching from consumer products would infinitely broaden the liability net to unmanageable breadth. Big companies complain of high costs, but the EPA says they are not considering costs, as CERCLA precludes the EPA from taking costs into account when designating hazardous substances.³⁹² Contaminated site owners and operators will be forced to reassess the value of their properties and liabilities.³⁹³

387. Dean Scott & Pat Rizzuto, *Tackling PFAS With Superfund Law Risks Shifting Costs to Public*, BLOOMBERG LAW (Nov. 30, 2022), <https://news.bloomberglaw.com/environment-and-energy/superfund-laws-exemptions-elusive-as-epa-pushes-pfas-actions> [<https://perma.cc/K2ER-5BPN>].

388. *Id.*

389. *Id.*

390. *See* 42 USC 9607(a).

391. Davina Pujari et al., *Potential Impacts of The EPA's Designation Of PFAS As Hazardous Substances*, WILMERHALE (Sept. 26, 2022), <https://www.wilmerhale.com/en/insights/client-alerts/20220926-potential-impacts-of-the-epas-designation-of-pfas-as-hazardous-substances> [<https://perma.cc/4HEC-59GE>].

392. Scott & Rizzuto, *supra* note 386.

393. Pujari, *supra* note 391.

On April 28, 2022, organizations representing the nation's drinking water and wastewater utilities sent a letter (the American Water Works letter) to the Senate Committee on Environment and Public Works (EPW).³⁹⁴ This letter explained that once PFOA and PFOS are listed as hazardous substances, wastewater and drinking water utilities and the public, who fund them, will bear the brunt of CERCLA liability costs from natural resource damage assessments and Superfund sites.³⁹⁵ This will, ironically, shift the liability burden not onto the polluter, as CERCLA intended, but directly onto the public.³⁹⁶ The authors of the American Water Works letter advocated for a public water utility and wastewater treatment facility exemption from PFAS liability, arguing that communities funding those utilities will be forced to pay when the utilities filter PFAS out of water, or discharge water with even trace amounts of PFAS in it.³⁹⁷ The water utilities argue that this is an inevitability since large corporations have ensured that PFAS is ubiquitous in all the nation's waterways.³⁹⁸

Without congressional action, the public, through its waste and water treatment facilities, will disproportionately shoulder the liability burden under the CERCLA NRD provisions. The American Water Works should be granted their request, and publicly funded entities already fighting to remediate the country from PFAS should be shielded from liability by Congress.

D. *Expanding the Responsible Party*

PFOA and PFOS originate from an almost limitless number of potential sources. In addition to traditional polluters like airports, military installations, water treatment facilities, and manufacturers, even plastic containers can be a source of PFAS.³⁹⁹ PFAS typically travels a significant distance to get to the contaminated site.⁴⁰⁰ For example, it is possible that the PFOS and PFOA contaminating the alligators in Florida originated in surrounding states, Minnesota, New Jersey, or even Europe. New Jersey's claims included direct discharges from PFAS industry into air via stacks and lists discharges from wastewater treatment plants into surface water and landfill leachate into ground water.⁴⁰¹ Thanks to joint and several liability, the trustee can attempt to hold every potential source as a potential responsible party, creating a damage assessment greater in scope than any environmental statute.⁴⁰²

394. American Water Works Association et al., *Re: Necessity of Protecting Water Systems from CERCLA Liability for PFAS* (Apr. 28, 2022), [https://www.nacwa.org/docs/default-source/resources--public/cercla-water-system-hill-letter-4-28-22.pdf?sfvrsn=4dfcc461_2\[https://perma.cc/9NX5-2UN8\]](https://www.nacwa.org/docs/default-source/resources--public/cercla-water-system-hill-letter-4-28-22.pdf?sfvrsn=4dfcc461_2[https://perma.cc/9NX5-2UN8]).

395. *Id.*

396. *Id.*

397. *Id.*

398. *Id.*

399. See generally Adler & Wells, *supra* note 50.

400. See Levy, *supra* note 49.

401. See Conley, *supra* note 162.

402. The trustee should not be held responsible for determining contribution. The PRP

The most glaring liability gap pertains to manufacturers or generators of PFAS. Manufacturers will most commonly fall outside of the definition of a potentially responsible party. After PFOA and PFOS are listed as hazardous, it will still be difficult to tie PFAS-contaminated resources back to manufacturing facilities like DuPont or 3M.⁴⁰³ The issue is that PFAS manufacturers commonly do not have manufacturer, arranger, or owner or operator liability for PFAS after their sale of the chemical to others who then use and dispose of them.⁴⁰⁴ Arguably, the initial generator of the hazardous substance that bioaccumulates in most every living organism should shoulder the heaviest burden for remediating that chemical's many damages.

Analyzing the pathways PFOS and PFOA take to pollute the Florida marine environment is a difficult but not impossible task. Determining PFAS's various pathways and assigning blame amongst various parties is challenging when an indeterminate number of parties are responsible in fact but not responsible under the Act. Expanding CERCLA's definition of "responsible party" will help solve this problem and permit NRD assessments to properly trace the pathways PFOS and PFOA take back to responsible parties who can then be held accountable for cleanup and remediation.

The current structure of CERCLA limits recovery to four groups designated as responsible parties. Current and former owners or operators of facilities (often large manufacturers of PFAS like DuPont or 3M) are liable only some of the time.⁴⁰⁵ Entities who arrange for the transport of hazardous waste, and those who transport the waste to the disposal site are also liable.⁴⁰⁶ Large corporations often avoid CERCLA liability completely when they sell large amounts of the chemical itself to the manufacturers of other products, or when they sell a product like a Teflon made with and containing PFAS, to be used in another product. Once the item is sold as a useful product in the first instance, CERCLA liability vanishes and the generator of the PFAS is off the hook.⁴⁰⁷ In the 2009 *Burlington Northern and Santa Fe Railway Co. v. United States* case, the Supreme Court held that a company that makes, but does not dispose of, a product is not liable under CERCLA for damages caused because of the sold product.⁴⁰⁸

PFAS is ubiquitous in the environment; the chemical companies who placed PFAS into the market as a "useful product," but did not take part in the chemical's disposal, are currently exempt from all four classes of liability under

is jointly and severally liable for all the resulting injury unless it can prove that the injury is divisible. See Kanner, *supra* note 161.

403. Larry Silver & Tarek Saba, *What EPA Designation of PFAS As Hazardous Means For Cos.*, LAW360 (Dec. 9, 2022) <https://www.law360.com/articles/1555342> [<https://perma.cc/3FCT-UH2P>].

404. *Id.*

405. 42 U.S.C. § 9607(a); *New York v. Shore Realty*, 759 F.2d 1032, 1043 (1985).

406. 42 U.S.C. § 9607(a).

407. See *Burlington*, 556 U.S. at 610.

408. *Id.*

CERCLA, even after it is listed as hazardous.⁴⁰⁹ This runs afoul of the polluter pays principle that CERCLA was built upon.⁴¹⁰ The negligent actions of a few hazardous chemical manufacturers should not be subsidized by the very public whose trust they have violated. Shockingly, certain industry groups oppose granting exemptions to municipally owned entities like water treatment works and waste sites, as their exemption takes away the publicly funded tax dollar, and instead hangs a hefty liability tag on those polluters.⁴¹¹

The original manufacturer of the PFOS and PFOA, along with all entities who handled and refined the substance to create new PFOS and PFOA laden products, must be brought into CERCLA's liability purview. While tracing these chemicals all the way back to the source may seem a daunting task, companies typically maintain purchase and sale receipts for all products and will be required to do so once PFOA and PFOS are listed as hazardous in 2024. One way for Congress to forge this liability stream is to eliminate the exemption for companies selling a "useful product," and no longer pardoning them from liability once that useful product leaves their doors. These companies do not need to be shielded from liability by the courts, especially when the public is left paying the bill. An additional option for Congress is to include generators of PFOS and PFOA as potentially responsible parties. RCRA defines waste generators as any entity or person whose act or process produces hazardous waste or whose act first causes hazardous waste to become subject to regulation.⁴¹² Including these generators as a fifth party to share in CERCLA liability would also ensure that these polluter-generators pay.

CONCLUSION

Forever chemicals tell the familiar story of unchecked capitalism. An industry booms free of government oversight, creating goods and services for which the public clamors. Inevitably, history proves that a corporation acting only in the best interests of their shareholders will perpetually sell the public and the environment down a toxic river in pursuit of a dollar.

The damage forever chemicals inflict is long-lasting, complex, and far-reaching. PFAS typically needs to bioaccumulate before inflicting any real harm, making it especially difficult to grapple with thanks to its delayed effect.⁴¹³ Manufacturers of these chemicals made business decisions that led to the known release of these substances into the environment. Unfortunately, the federal government, by its own admission, has largely idled while

409. *Id.*

410. *See generally id.*; American Water Works Association *et al.*, *supra* note 394.

411. Suzanne Yohannan, *Industry Battle Brews Over Calls for Narrow PFAS Liability Waivers*, 26 INSIDE EPA'S RISK POLICY REP. 1, 9 (2019).

412. *See* Resource Conservation and Recovery Act, 40 C.F.R. § 260.10.

413. Our Current Understanding of the Human Health and Environmental Risks of PFAS, *supra* note 18; U.S. ENV'T PROT. AGENCY, *supra* note 3.

these companies mine the planet for corporate profits.⁴¹⁴ Even after learning that these products were harmful, corporations continued to utilize PFOS and PFOA, sell them to third parties, and discharge the production remnants into the environment.⁴¹⁵ This practice placed profits above the public.

Throughout history, the law has resisted this tragedy of the commons, fighting to preserve natural resources not for a few corporations, but for the public at large. This ideal, known as the public trust, is found in the Napoleonic Code, English and our own common law, and even the Constitution of Alaska.⁴¹⁶ Today the law provides for the public trust through CERCLA, a mechanism to force those responsible for the spread of these pollutants to rehabilitate infected natural resources.⁴¹⁷

Through NRD actions, trustees can represent the streams, the swamps, and the alligators who rely on these waters, freeing these resources of hazardous chemicals. NRD assessments allow for the remediation of entire ecosystems, even if the initial goal is saving one specific species or population, like the Florida alligator. Rarely does a litigant have the power to remediate more than their own superfund site. The public trust promises that certain resources must be held in trust for the use and enjoyment of the citizenry, and for the use and enjoyment of future generations. The NRD process can provide the science to prove these chemicals are causing significant damage to natural resources while also catalyzing remediation of those resources.

Action by the presidential administration and the EPA is not enough; Congress must amend CERCLA to grant waivers of liability to utilities that belong to the public, so the burden of remediation does not fall on that public. Congress must also act to ensure that parties do not escape liability by washing their hands of these harmful products as they leave their production room floor. It will take time, effort, and political willpower to accomplish the goal of removing PFOS, PFOA, and other similar chemicals from the environment. The reward for acting is saving ancient natural resources like the alligator for future generations.

414. *The Devil They Knew: PFAS Contamination and the Need for Corporate Accountability: Hearing Before the Subcommittee on Environment, 116th Congress, supra* note 6, at 2.

415. Adashek, *supra* note 6; Zingales & Shapira, *supra* note 53, at 9.

416. Rodgers, Jr., *supra* note 178, at 139.

417. *See* Johnson, *supra* note 19 (arguing that most suits against forever chemical polluters still focus on common law theories of negligence or nuisance).