Between Sky and Space: NEPA's Extraterritorial Application to the Stratosphere and Implications for SpaceX's Starlink Satellite Constellation

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TABLE OF CONTENTS

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INTRODUCTION

The National Environmental Policy Act of 1969 ("NEPA") has been a cornerstone of American environmental law since its inception, but courts have continually grappled with NEPA's scope and whether its provisions apply extraterritorially, from the high seas[1] to Antarctica.[2] This question has now reached the final frontier. There has been an explosion in the use of satellites in recent years led by Space Exploration Technologies Corporation's ("SpaceX") Starlink.[3] SpaceX's deployment of its First Generation Starlink system ("Gen1") and recently

1. *Compare* Nat. Res. Def. Council v. U.S. Dep't Navy, No. CV-01-07781 CAS(RZX), 2002 WL 32095131, at *11 (C.D. Cal. Sept. 17, 2002) (noting the high seas are a global commons akin to Antarctica), *with* Basel Action Network v. Mar. Admin., 370 F. Supp. 2d 57, 71 (D.D.C. 2005) ("[T]he Court finds that there is no legal or policy reason to extend NEPA to the high seas.").

2. *Compare* Env't Def. Fund, Inc. v. Massey, 986 F.2d 528, 532-33 (D.C. Cir. 1993) (holding that NEPA's application to activities in Antarctica does not present an issue of extraterritoriality and distinguishing NEPA from the Federal Tort Claims Act), *with* Smith v. United States, 507 U.S. 197, 204 (1993) (holding that the Federal Torts Claim Act does not apply to activities in Antarctica and its application is barred by the presumption against extraterritoriality).

3. The company's website describes Starlink as a high-speed, low-latency service that is made possible via the world's largest constellation of highly advanced satellites operating in a low orbit around Earth. *See World's Most Advanced Broadband Satellite Internet*, STARLINK, https://www.starlink.com/technology (last visited Mar. 12, 2023).

approved Second Generation Starlink system ("Gen2") has renewed the discussion regarding NEPA's scope—and whether the statute can be applied extraterrestrially.[4] Although the growth in satellite use will undoubtedly provide benefits to mankind, there are growing concerns about the environmental impact of these mega-constellations,[5] ranging from orbital debris and collisions to light pollution and impacts to the atmosphere.[6]

There have been a number of scholarly articles published examining NEPA's application to space.[7] Alexander Gilbert and Monica Viadurri published an article in 2021 specifically advocating for the application of NEPA to federally authorized outer space activities.[8] The authors examine this broader question while recognizing that they are not analyzing whether NEPA would require analysis of a specific environmental impact.[9]

This Article will not rehash the question of NEPA's extraterrestrial application. Instead, this Article extends Gilbert and Viadurri's work by examining Starlink and other mega-constellations' impact on the stratosphere—especially in light of the FCC's repeated refusal to conduct an Environmental Assessment ("EA") for Starlink's Gen1 and Gen2 systems.[10] Although it is uncertain whether NEPA applies to space, NEPA should be interpreted to apply to the Earth's stratosphere, which is part of the "human environment." Moreover, NEPA's application to the stratosphere does not trigger the presumption against extraterritoriality because it is a global commons area akin to Antarctica or the high seas and the "focus" of the

4. Although there is significant literature and case law regarding NEPA's *extraterritorial* application (i.e., the statue's application outside of the United States), the statute's *extraterrestrial* application (i.e, outer space) is unknown.

5. NASA defines "large constellations" as those containing at least 100 active satellites. U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-22-105166, LARGE CONSTELLATIONS OF SATELLITES: MITIGATING ENVIRONMENTAL AND OTHER EFFECTS 3 (2022), https://perma.cc/N9DR-VMLH [hereinafter GAO ASSESSMENT] (citing NASA, *Orbital Debris Mitigation Standard Practices* at 7 (Nov. 2019), https://perma.cc/QXL9-F8QC).

6. *See, e.g.,* Aaron C. Boley & Michael Beyers, *Satellite Mega-Constellations Create Risks in Low Earth Orbit, the Atmosphere and on Earth*, SCI. REP., May 20, 2021, at 1, 5, https://perma.cc/TCF3-C99P.

7. *E.g.,* Michael B. Runnels, *On Launching Environmental Law into Orbit in the Age of Satellite Constellations*, 88 J. AIR L. & COM. 181 (2023), https://perma.cc/WW3F-LNAQ; Alexander Q. Gilbert & Monica Vidaurri, *Major Federal Actions Significantly Affecting the Quality of the Space Environment: Applying NEPA to Federal and Federally Authorized Outer Space Activities*, 44 ENVIRONS ENV'T. L. & POL'Y J. 233 (2021), https://perma.cc/L2G2-HF9A; Michael J. Ellis, *Keep Environmental Red Tape Out of Outer Space*, Heritage Foundation Legal Memorandum No. 288 (Aug. 6, 2021), https://perma.cc/44ME-V23R; Ramon J. Ryan, Note, *The Fault in Our Stars: Challenging the FCC's Treatment of Commercial Satellites as Categorically Excluded from Review Under the National Environmental Policy Act,* 22 VAND. J. ENT. & TECH. L. 923 (2020).

8. Gilbert & Vidaurri, *supra* note 7.

9. *Id*. at 241.

10. Space Expl. Holdings, LLC, Request for Modification of the Authorization for the SpaceX NGSO Satellite Sys., 36 F.C.C. Rcd. 7995, 8036 (2021), https://perma.cc/BSP9-BNAD [hereinafter Final Gen1 Order] (authorizing modification for SpaceX's Gen1 Starlink system); Space Expl. Holdings, LLC, Request for Orbital Deployment and Operating Authority for the SpaceX Gen2 NGSO Satellite Sys., File No: SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105 para. 103 (2022) (partially granting SpaceX's Gen2 Starlink system) [hereinafter Final Gen2 Order].

statute is undoubtedly domestic. Opponents of these mega-constellations, thus, are more likely to succeed in obtaining the appropriate NEPA review if the proposed action is reframed as impacting the stratosphere, ozone layer, and greater atmosphere, as opposed to outer space.

Part I of this Article provides an overview of the satellite industry and the potential atmospheric impacts from increased launches and satellite reentries with a particular focus on aluminum oxide. Part II provides an overview of NEPA and the statute's extraterritorial application. Part III discusses the constitutional requirement for standing with a focus on diffuse harms, such as climate change and ozone depletion (i.e., atmospheric-type injuries). Part IV provides a case overview of *Viasat v. FCC*[11] and summarizes the debate about NEPA's extraterrestrial application. Part V proceeds in three parts. First, it argues that the stratosphere is part of the "human environment" and NEPA's application to the stratosphere does not run afoul of the presumption against extraterritoriality. Second, it argues that standing can be met when challenging the deployment of satellite constellations. Part V concludes by highlighting the policy benefits of NEPA's application to the stratosphere, including informed decision making via the precautionary principle, consistency with Department of Defense ("DoD") policy, and adherence to the United States' obligations under the Outer Space Treaty.

I. THE COMMERCIALIZATION OF SPACE

At the outset of 2023, there were near-daily headlines regarding the deployment of commercial satellites—with SpaceX's Starlink as the primary player in this growing arena.[12] This exponential growth is set to continue for the foreseeable future. There is, however, growing scientific concern that satellites, primarily large mega-constellations, will adversely impact Earth's atmosphere due to increased rocket launches, which are needed to deploy the satellites, and satellite reentry (i.e., disintegration) into the upper bounds of Earth's atmosphere.[13] As noted by the Government Accountability Office ("GAO"), the deposition of aluminum oxide (alumina) from reentering satellites into the stratosphere is particularly concerning given its potential impact on the ozone layer.[14]

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11. Viasat, Inc. v. FCC, 47 F.4th 769 (D.C. Cir. 2022).

12. *E.g.*, Richard Tribou, *SpaceX Launches Starlink Satellites Early Sunday*, Orlando Sentinel (Feb. 12, 2023), https://perma.cc/LK46-P3ZN (launch of 55 Starlink satellites); Stephen Clark, *Space Launches First Batch of Second-Generation Starlink Internet Satellites*, Spaceflight Now (Feb. 27, 2023), https://perma.cc/V8X8-UUSR (launch of 21 Starlink satellites); Jackie Watts, *SpaceX Launches Next-Generation GPS Satellite*, CNN (Jan. 18, 2023), https://perma.cc/K6WL-YHZ5 (SpaceX launch of GPS satellite on behalf of U.S. military); Andrew Jones, *China Launches 14 Commercial Satellites Into Orbit Atop Long March 2D Rocket*, Space, (Jan. 19, 2023) https://perma.cc/WTC8-NCPN (noting China's fifth launch in 2023).

13. *See* Boley & Beyers, *supra* note 6, at 6.

14. *See* GAO ASSESSMENT, *supra* note 5, at 12.

A. THE EXPONENTIAL GROWTH OF COMMERCIAL SATELLITES

The use of satellites has grown significantly since the launch of Sputnik in 1957, and their benefits are now ubiquitous in modern society, from having global positioning ("GPS") in the palm of our hands to receiving up-to-the-minute weather updates for nearly any location on Earth.[15]

As of June 9, 2024, there were approximately 8,815 active satellites in low Earth orbit ("LEO"), with an additional 760 satellites in medium Earth Orbit ("MEO") and geosynchronous orbit ("GEO").[16] LEO is defined as the area from Earth's surface to 1,240 miles above the surface.[17] This is the preferred band for many commercial satellites since there is a shorter lag time between the satellites and users on the ground.[18] "Mega constellations" (i.e., constellations containing at least 100 satellites) have driven this exponential increase of satellites in LEO in recent years.[19] Beyond LEO lies MEO, which extends from 1,240 miles to 22,320 miles.[20] This band is primarily used by GPS satellites.[21] Beyond 22,320 miles lies GEO.[22] Satellites in GEO are able to provide wider fields of view in exchange for lower image resolution.[23] Figure 1 depicts MEO and LEO in relation to the layers of Earth's atmosphere.

15. *See id.* at 1, 3.
16. Orbiting Now, ORBIT.ING-NOW.COM, https://orbit.ing-now.com/(last visited June 9, 2024).
17. GAO Assessment, supra note 5, at 3.
18. *Id.*
19. See GAO Assessment, supra note 5, at 3.
20. *Id.* at 5.
21. *Id.* at 4.
22. *Id.*
23. *Id.*

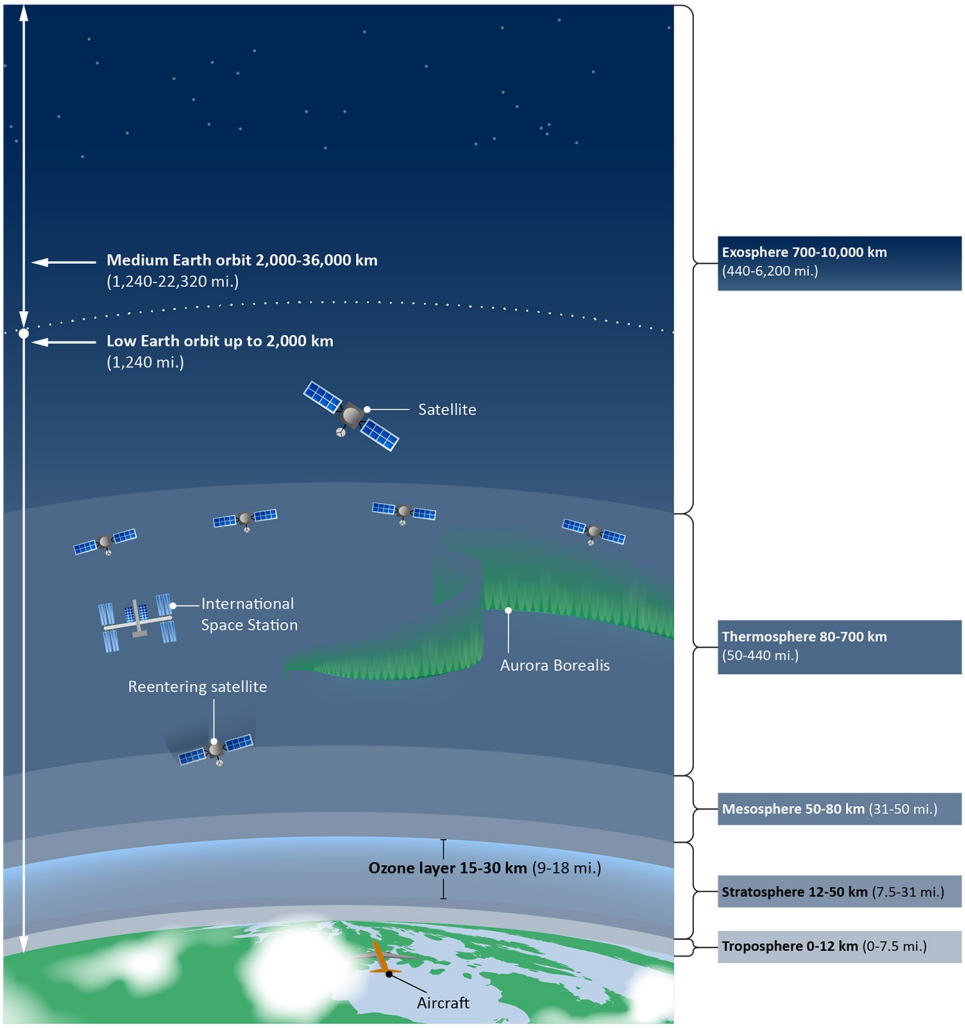

FIGURE 1. Layers of Earth's Atmosphere.[24]

As Figure 1 depicts, satellites operate in nearly all of Earth's atmospheric layers: the troposphere, stratosphere, mesosphere, thermosphere, and exosphere. The stratosphere is of particular importance when examining impacts from these mega-constellations since the stratosphere plays an important role as the "ozone layer."[25] The U.S. Environmental Protection Agency ("EPA") notes that "[t]he

24. *Id*. at 11. Image not to scale.
25. EPA, *Ozone Layer Protection* (2022), https://perma.cc/GJ47-RA3J.

stratospheric ozone layer is Earth's 'sunscreen'—protecting living things from too much ultraviolet radiation from the sun."[26]

Due to the exponential growth of the satellite industry, Congress commissioned the GAO to assess the impacts of these constellations and provide policy options on mitigating their adverse effects.[27] The GAO anticipates the use of satellites to continue its upward trajectory and notes multiple experts have predicted a ten-fold increase by the end of this decade (or roughly 58,000 additional satellites).[28] This estimate, however, is only based on proposals that were filed with the FCC *as of 2016*.[29]

Another study found that approximately 100 companies and agencies were proposing launching their own satellite constellations as of 2020.[30] These proposals include over 40,000 satellites for SpaceX's Starlink system (both Gen1 and Gen2), over 12,000 satellites as part of China's SatNet, 13,000 for Astra, 7,700 for Amazon's Kupier, and nearly 5,800 for Boeing—to name a few examples.[31] In total, the study found that the 10 largest proposals alone would result in nearly 92,000 additional satellites in their fully deployed configurations.[32] Most of these satellites are expected to reenter Earth's atmosphere at the end of their lifecycle, thus requiring the deployment of additional satellites as replacements.[33] Beginning in 2040, the authors of this study project that approximately 15,500 satellites on average will be launched every year (twice the number of satellites in orbit in 2021), and the same amount of satellites will be reentering the atmosphere each year.[34]

According to the GAO, this exponential growth is driven primarily by commercial enterprises taking advantage of lower costs for satellites and rocket launches.[35] These private companies typically seek to deploy mega-constellations in LEO in order to provide expanded communications, internet access, and Earth observation.[36] The use of satellites also has a direct military application, as they can be used to provide secured communications, missile warnings, and conduct intelligence.[37]

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26. *Id.*
27. *See* GAO ASSESSMENT, *supra* note 5, at 1-2.
28. *Id.* at 1.
29. *Id.* at 6, n. 7.
30. Loïs Miraux et al., *Environmental Sustainability of Future Proposed Space Activities*, 200 ACTA ASTRONAUTICA 329, 334 (2022) (citing Giacomo Curzi et al., *Large Constellations of Small Satellites: A Survey of Near Future Challenges and Missions*, 40 AEROSPACE Sept. 2020, at 1, 9-11).
31. *Id.* at 334, tbl. 5.
32. *Id.* at 334.
33. *Id.*
34. *Id.* at 338.
35. *See* GAO ASSESSMENT, *supra* note 5, at 6.
36. *See id.* at cover page 1, 1; *see also* Miraux et al., *supra* note 30, at 329 ("The space sector is undergoing a period of fast expansion and change driven by a set of technological and business model innovations, which leads to a significant decrease in satellite and launch vehicle financial costs.").
37. GAO ASSESSMENT, *supra* note 5, at 3.

The GAO examined a number of potential impacts stemming from the increased deployment of satellites, including the increase in orbital debris, emissions into the upper atmosphere, and disruption of astronomy (i.e., light and radio pollution).[38] This Article will only examine the impacts to the atmosphere, with particular attention paid to the stratosphere.

B. STRATOSPHERIC IMPACTS FROM SATELLITE REENTRIES AND ROCKET LAUNCHES

The exponential growth in satellite use also means more rocket launches and more satellite reentries, each of which produces emissions that can affect the Earth's atmosphere.[39] In 2021, 48 rockets were launched from the U.S. This number is expected to reach nearly 120 per year by 2030.[40] Globally, FAA officials are predicting nearly 200 launches per year by 2030.[41]

All satellites orbiting Earth eventually reach the end of their lifecycle and many of them disintegrate in the atmosphere, with a small percentage reaching Earth's surface.[42] When satellites reenter the atmosphere they are subject to extreme mechanical and thermal stresses, which, in turn, leads to disintegration and the release of gas and particle end-products into the atmosphere.[43] Depending on their composition, disintegrating satellites can produce aluminum, nickel, titanium, iron, silicon, nitrogen oxides, alumina, and other potential exotic materials upon reentry.[44] Moreover, disintegrating satellites "could produce around 7 times more aluminum emissions than natural reentry emissions from meteoroids."[45] Although meteoroid entries also produce emissions, satellite emissions are mostly metal, whereas meteoroids are primarily non-metal.[46]

The GAO assessment found that the increase in emissions from rocket launches and satellite reentries *could* "change the temperature of the stratosphere and deplete the ozone layer, which could increase the amount of harmful ultraviolet solar radiation reaching Earth."[47] The assessment, however, notes that "more information is needed to determine how significant these effects may be, particularly with the potential for almost 3 times the current number of rocket launches for the future."[48]

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38. GAO ASSESSMENT, *supra* note 5, at cover page 1.
39. *Id*. at 10.
40. *Id*.
41. *Id*.
42. NASA Astromaterials Research and Exploration Science, *See Frequently Asked Questions, Question 13: Is Reentering Debris a Risk to People and Property on Earth?*, NASA, https://perma.cc/2GTQ-H4MN (last visited Mar. 31, 2024).
43. Jessica Delaval, *On the Atmospheric Impact of Spacecraft Demise Upon Reentry*, European Space Agency: The Clean Space Blog (Aug. 11, 2022), https://perma.cc/5DVC-VAA5.
44. GAO ASSESSMENT, *supra* note 5, at 12 (citing Leonard Schulz & Karl-Heinz Glassmeier, *On the Anthropogenic and Natural Injection of Matter into Earth's Atmosphere*, 67 ADVANCES IN SPACE RESEARCH 1002 (2021)).
45. *Id*.
46. *Id*. at 12, n.13 (citing Schulz & Glassmeier, *supra* note 44, at 1002-25).
47. *Id*. at 12.
48. *Id*.

The GAO cautions that particular emissions, such as aluminum oxide (also known as "alumina"), are more concerning than other gas emissions such as water vapor and carbon dioxide.[49] Specifically, the assessment notes that "[a]lumina particles emitted from rocket launches could accumulate in the stratosphere, causing both stratospheric warming and ozone depletion."[50] It continues, "[a] study comparing reflection versus absorption of alumina particles predicts that they absorb 3 times as much solar energy as they reflect to space, resulting in an overall warming effect. Alumina particles can also enhance ozone depletion by creating a surface for ozone depleting chemical reactions to occur."[51] Experts suggest that satellites could also form alumina during reentry.[52]

The assessment also notes a number of other particles and gas emissions from launches and reentry can impact the stratosphere and other atmospheric layers, including black carbon particles, carbon dioxide, water vapor, nitrogen oxides, chlorine chemicals, and other exotic materials.[53] Taken together, rocket emissions and satellite reentries "can affect Earth's temperature and deplete ozone . . . could change the temperature of the stratosphere . . . [and] may also deplete the ozone layer, which would increase the amount of harmful solar radiation reaching Earth's population."[54]

The GAO assessment concludes by noting that understanding of the atmospheric impact of satellite reentries and increased launches is in its infancy, and there remains significant uncertainty regarding the magnitude of alumina's impact on warming and ozone depletion.[55] The agency recommends collecting additional observational data, establishing measurable metrics, developing an emissions database, sharing satellite composition data among stakeholders, and ultimately developing regulations for both launches and satellite reentries.[56]

A number of other governmental bodies and peer-reviewed studies have examined the impact of satellite reentries and the impact of alumina on the atmosphere. A 2021 peer-reviewed study published in *Scientific Reports* notes that satellites reentering the atmosphere "will produce fine particulates that could greatly exceed natural forms of high-altitude aluminum deposition."[57] The authors add, "[a]nthropogenic deposition of aluminum in the atmosphere has long been proposed in the context of geoengineering as a way to alter Earth's albedo [i.e., how much sunlight is reflected back to space]."[58] This deposition of alumina into the

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49. *Id*. at 12-13.
50. *Id*. at 13.
51. *Id*. (citing Martin N. Ross & Patti M. Sheaffer, *Radiative Forcing Caused by Rocket Engine Emissions*, 2 EARTH'S FUTURE 177 (2014)).
52. *Id*. at 13.
53. *Id*. at 13-16.
54. *Id*. at 7, 12.
55. *See id*. at 10.
56. *Id*. at 16-17.
57. Boley & Byers, *supra* note 6, at 4.
58. *Id*.

atmosphere is concerning in light of the use of mega-constellations. As of May 2021, the authors noted that Starlink satellites had a mass of approximately 260 kg and, at the time, the company was seeking to deploy 12,000 satellites.[59] Based on these numbers, the authors surmised that a 5-year satellite life cycle would result in nearly 2 tonnes of aluminum entering the atmosphere daily.[60] However, as of December 2022, SpaceX was approved to deploy approximately 12,000 satellites and is seeking to deploy an additional 30,000.[61] Thus, SpaceX's Starlink alone would be depositing over 6 tonnes of aluminum into Earth's upper atmosphere on a daily basis. SpaceX is not alone in the use of these mega-constellations. As discussed above, other commercial entities are proposing their own constellations.[62]

In November 2022, a group of European Scientists published a study examining the life cycle of future space activities from 2022-2050.[63] This quantitative assessment examined a range of space operations, including launch activity associated with deploying satellite constellations, space tourism, moon missions, space-based solar power, Earth-to-Earth transportation, and Mars colonization.[64] The study did not fully analyze the impacts of satellite reentry, but the authors noted that, if they assume that satellites oxidize into alumina upon reentry, about three times as much alumina will be deposited into the atmosphere from reentry than from launch events.[65] The study concluded, "[o]zone depletion from launch events could reach significant levels (6% of annual global impacts), while in a decade emissions of black carbon and aluminum oxide [alumina] from rockets may alter the radiative balance of the atmosphere as much as present-day global aviation," although the authors cautioned that "these effects are uncertain and poorly understood yet."[66]

In addition, the authors determined that "by the 2040s constellation activities would lead to a significant increase across all impact categories, leading to a multiplication of yearly impacts of the space sector with respect to . . . climate change and ozone depletion."[67] The authors cautioned that "climate impacts due to launches and reentry would be much more difficult to mitigate deeply due to the emission of non-CO2 climate forces [such as alumina] and their interaction with the radiative balance of the atmosphere . . . could have significant effects."[68]

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59. *Id*.
60. *Id*.
61. Final Gen2 Order, *supra* note 10, at 1, 4.
62. Miraux et al., *supra* note 30, at 334.
63. *Id*. at 330.
64. *Id*.
65. *Id*. at 339.
66. *Id*. at 329.
67. *Id*. at 339.
68. *Id*. at 342. Although the majority of these activities are beyond the scope of this Article (and some are very speculative), the study is useful since it demonstrates the full scale of environmental impacts associated with the expansion of space operations.

Others, however, have noted that the atmospheric impacts of reentry remain uncertain. In 2019, the European Space Agency ("ESA") commissioned two studies to examine the atmospheric impact of spacecraft reentry.[69] The ESA summarized the main findings, noting "the atmospheric short-term impact due to a single spacecraft demise is modest" and the greatest long-term impacts would be to the mesosphere and upper stratosphere with significant impacts to the polar regions."[70] The studies noted, however, that these impacts are negligible compared to other anthropogenic activities (e.g., use of CFCs).[71] The two ESA studies assumed the disintegration of between 450-764 tonnes per year.[72] Both studies concluded that the atmospheric impact of spacecraft reentries was relatively low, but there were still high-level uncertainties due to aerothermodynamics and a lack of observational data to evaluate models.[73]

Taken together, there is growing evidence and concern in the scientific community regarding satellites' impacts on the atmosphere, although additional evidence and studies are warranted to fully gauge the scope of these impacts. The deposition of alumina into the atmosphere, in particular, may have profound effects on the climate and Earth's ozone layer.

II. NEPA'S STRUCTURE, BROAD PURPOSE, AND EXTRATERRITORIAL APPLICATION

Although procedural in nature, NEPA is one of the cornerstone environmental laws in the United States and is often at the center of litigation challenging agency actions. Understanding the statute's purpose, structure, and extraterritorial application is necessary to determine the scope of the law's applications, and, ultimately, whether the statute would apply to atmospheric impacts from satellite deployments. Courts have grappled with NEPA's scope beyond U.S. borders, finding in some instances that the law applies to the "global commons," such as Antarctica,[74] but limiting the statute's reach in other circumstances, such as when the matter involves national security or foreign policy.[75]

A. NEPA'S STRUCTURE: ENSURING "HARD LOOKS"

NEPA does not mandate specific, environmentally friendly actions but rather requires agencies to take a "hard look" at the environmental impacts of any major

69. Delaval, *supra* note 43.

70. Delaval, *supra* note 43.

71. Delaval, *supra* note 43.

72. Delaval, *supra* note 43. As discussed above, if SpaceX's Starlink is fully approved, roughly 6 tonnes of satellites will reenter the atmosphere daily, or approximately 2190 tonnes per year, in addition to all other satellite reentries occurring globally.

73. Delaval, *supra* note 43.

74. *See* Env't Def. Fund, Inc. v. Massey, 986 F.2d 528, 536-37 (D.C. Cir. 1993).

75. Greenpeace USA v. Stone, 748 F. Supp. 749, 758 (D. Haw. 1990) ("[T]he President's decision under the unique circumstances of this case involves foreign policy concerns which are beyond this court's review.").

federal action significantly affecting the quality of the *human environment*.[76] Nearly every provision of NEPA has been challenged and interpreted by courts due to the statute's vague terminology.[77] NEPA does not specifically define "human environment," but the Council on Environmental Quality ("CEQ"), the agency tasked with overseeing NEPA's implementation, defines it as: "comprehensively the natural and physical environment and the relationship of present and future generations of Americans with that environment."[78]

NEPA has two primary objectives: (1) it "places upon an agency the obligation to consider *every* significant aspect of the environmental impact of a proposed action . . . *before* taking a major action . . ." (2) in order to assure the public that the agency is engaged in well-informed decision making.[79] Courts generally have held that NEPA requires examination of not only those actions that *may* impact the environment but also certain low probability events, or even when the impacts are unknown.[80] But, "the finding that the probability of a given harm is nonzero does not, by itself, mandate an EIS [Environmental Impact Statement]: after the consequences of the harm in proportion to the likelihood of its occurrence, the overall expected harm could still be insignificant and thus could support a FONSI [Finding Of No Significant Impact]."[81]

NEPA's implementing regulations and key definitions were modified multiple times between the Obama, Trump, and Biden administrations, with the Trump administration narrowing NEPA's scope and the Biden administration restoring many of the provisions.[82] The regulations now state that "'significantly' as used in NEPA requires considerations of both context and intensity," and when assessing "intensity," the reviewing agency should consider "[t]he degree to which the

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76. 42 U.S.C. § 4332(2)(C); Kleppe v. Sierra Club, 427 U.S. 390, 410 n. 21 (1976) ("The only role for a court is to ensure that the agency has taken a 'hard look' at environmental consequences.").

77. DANIEL R. MANDELKER, ROBERT L. GLICKSMAN, ARIANNE M. AUGHEY, DONALD MCGILLIVRAY, & MEINHARD DOELLE, NEPA LAW AND LITIG. § 1:5 (2d ed. 2023) ("NEPA's vague terminology requires extensive judicial interpretation.").

78. 40 C.F.R. § 1508.1(m) (2023).

79. Balt. Gas & Elec. Co. v. Nat. Res. Def. Council, Inc., 462 U.S. 87, 97 (1983) (emphasis added).

80. *See, e.g.*, New York v. Nuclear Regul. Comm'n, 681 F.3d 471, 478 (D.C. Cir. 2012) ("Under NEPA, an agency must look at both the probabilities of potentially harmful events and the consequences if those events come to pass.") (citing Carolina Env't Study Grp. v. United States, 510 F.2d 796, 799 (D.C. Cir. 1975)); Am. Bird Conservancy v. FCC, 516 F.3d 1027, 1033 (D.C. Cir. 2008) ("A precondition of certainty before initiating NEPA procedures would jeopardize NEPA's purpose to ensure that agencies consider environmental impacts before they act rather than wait until it is too late."); *see also* MANDELKER ET AL., *supra* note 77, at § 8:52 (reviewing NEPA cases involving low probability risk and uncertain environmental effects).

81. New York v. Nuclear Regul. Comm'n, 681 F.3d at 482 (citing Carolina Env't Study Group, 510 F.2d at 799). A "FONSI," or Finding of No Significant Impact, occurs when an agency determines that an action will not result in a significant impact to the environment. *Id.* at 476–77.

82. KRISTEN HITE, CONG. RSCH. SERV., R47205, JUDICIAL REVIEW AND THE NATIONAL ENVIRONMENTAL POLICY ACT 2-3 (2022), https://crsreports.congress.gov/product/pdf/R/R47205; *see* National Environmental Policy Act Implementing Regulations Revisions, 87 Fed. Reg. 23453, 23453 (Apr. 20, 2022) (to be codified at 40 C.F.R. pts. 1502, 1507–08) [hereinafter Biden NEPA Revisions] ("The amendments generally restore provisions that were in effect for decades before being modified in 2020.").

possible effects on the human environment are *highly uncertain or involve unique or unknown risks*."[83]

An agency's consideration of environmental impacts primarily comes in one of four forms (or a combination thereof): an environmental assessment, an environmental impact statement, a categorical exclusion ("CATEX"), or a finding of no significant impact ("FONSI"). Agencies must produce an EIS if it is *known* that the proposed action will have a significant environmental impact.[84] In addition to other administrative requirements, the EIS must contain discussion regarding the purpose and need of the proposal, available alternatives to the proposal, a description of the affected environment, and the environmental consequences of the proposal.[85] Environmental impact statements, however, only comprise a small amount of the total number of NEPA reviews conducted in any given year.[86]

If an agency is uncertain whether a proposed activity will have a significant impact on the human environment, it is required to prepare an EA.[87] The purpose of an EA is to aid the agency in complying with NEPA when no EIS is required, to facilitate the preparation of the more comprehensive EIS, or to make a FONSI.[88]

Finally, agencies may not be required to conduct either an EIS or EA if they determine that the activity fits within a CATEX.[89] Each federal agency is responsible for promulgating its own regulations specifically defining which projects, in their view, have no significant environmental impacts.[90] For example, the FCC has determined all of its activities constitute CATEXs except for a specifically enumerated list of activities.[91]

Even when an agency determines a project constitutes a CATEX, they must still "evaluate the action for extraordinary circumstances in which a normally excluded action may have a significant effect."[92] If there are extraordinary circumstances present, the agency may still classify the project as a CATEX if "there are circumstances that lessen the impacts or other conditions sufficient to avoid significant effects."[93] The definition of what constitutes an "extraordinary

83. 7 C.F.R. § 650.4(k)(2)(v) (2023) (emphasis added).
84. *See* 40 C.F.R. § 1502.3 (2023).
85. 40 C.F.R. §§ 1502.13–.16 (2023).
86. U.S. GOV'T. ACCOUNTABILITY OFF., GAO-14-370, NATIONAL ENVIRONMENTAL POLICY ACT: LITTLE INFORMATION EXISTS ON NEPA ANALYSES 8 (2014), https://perma.cc/66LG-SYMW ("CEQ estimates that about 95 percent of NEPA analyses are [CATEXs], less than 5 percent are EAs, and less than 1 percent are EISs.").
87. 40 C.F.R. § 1501.5(a) (2023).
88. 40 C.F.R. § 1501.5(c) (2023).
89. 40 C.F.R. § 1501.4(a) (2023).
90. 40 C.F.R. § 1507.3(d) (2023).
91. 47 C.F.R. § 1.1306 (2022).
92. 40 C.F.R. § 1501.4(b) (2023).
93. 40 C.F.R. § 1501.4(b)(1) (2023).

circumstance" is left to each individual agency's discretion and some agencies, such as the FCC, have failed to promulgate any regulations defining the term.[94]

B. NEPA'S BROAD PURPOSE, TEXT, AND LEGISLATIVE HISTORY

Congress passed NEPA in 1970 to address growing environmental concerns.[95] The congressional declaration is worth sharing in full since it outlines the intent of the statute and its scope:

> The Congress, recognizing the profound impact of man's activity on the interrelations of all components of the natural environment, particularly the profound influences of population growth, high-density urbanization, industrial expansion, resource exploitation, and new and expanding technological advances and recognizing further the critical importance of restoring and maintaining environmental quality to the overall welfare and development of man, declares that it is the continuing policy of the Federal Government, in cooperation with State and local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans.[96]

The declaration further notes that "it is the continuing responsibility of the Federal Government to use all practicable means . . . to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may . . . fulfill the responsibilities of each generation as trustee of the environment for succeeding generations."[97] The declaration lists a number of other goals, including assuring that all Americans enjoy "safe, healthful, production, and esthetically and culturally pleasing surroundings"[98] and "attain the widest

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94. *See* U.S. GOV'T ACCOUNTABILITY OFF., GAO-23-105005, SATELLITE LICENSING: FCC SHOULD REEXAMINE ITS ENVIRONMENTAL REVIEW PROCESS FOR LARGE CONSTELLATIONS OF SATELLITES 25-26 (2022) [hereinafter GAO SATELLITE RECOMMENDATION] ("FCC rules provide that potential extraordinary circumstances can be identified by FCC staff independently or determined after review of a petition FCC receives from an interested party . . . [The] FCC has not provided guidance . . . documenting either internally or for the public what may constitute an extraordinary circumstance, other than those circumstances identified in its categorical exclusion."). The FCC also has not updated its categorical exclusions since the Commission originally promulgated its regulations in 1986. *Id.* at 23-24 ("[The] FCC has not revisited its NEPA procedures to consider whether or how they should be revised for large constellations of satellites as the space industry has evolved . . . [despite] CEQ guidance from 2010 [that] recommends agencies periodically review their categorical exclusions at least every 7 years to ensure they remain current and appropriate.").

95. LINDA LUTHER, CONG. RSCH. SERV., RL33152, THE NATIONAL ENVIRONMENTAL POLICY ACT (NEPA): BACKGROUND AND IMPLEMENTATION 4 (2011), https://crsreports.congress.gov/product/pdf/RL/RL33152 [hereinafter CRS NEPA BACKGROUND].

96. 42 U.S.C. § 4331(a) (2024).

97. *Id.* at § 4331(b)(1).

98. *Id.* at § 4331 (b)(2).

range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences."[99]

NEPA also contains a section titled, in part, "International and National Coordination of Efforts," which notes, "Congress authorizes and directs that, *to the fullest extent possible* . . . the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in [NEPA]."[100] It further adds that "all agencies of the Federal Government shall . . . *recognize the worldwide and long-range character of environmental problems* and, where consistent with the foreign policy of the United States, lend appropriate support to initiatives, resolutions, and programs designed to maximize international cooperation in anticipating and preventing a decline in the quality of mankind's world environment."[101]

The legislative history of NEPA also indicates its broad scope. The Senate Report on the bill provides additional context regarding the intended reach of the statute. The report notes that the Senate bill "would provide all agencies and all Federal officials with a legislative mandate and a responsibility to consider the consequences of their actions on the environment."[102] The House Report on NEPA recognizes that "implicit in [NEPA] is the understanding that the international implications of our current activities will also be considered, inseparable as they are from the purely national consequences of our actions."[103] The bill's sponsor, Senator Henry M. Jackson, remarked when submitting the Conference Committee Report that the bill is a "congressional declaration that we do not intend . . . to initiate actions which endanger the continued existence or the health of mankind . . .. [W]e will not intentionally initiate actions which will do irreparable damage to the air, land, and water which support life on earth."[104]

A congressional white paper was published in 1969 summarizing the congressional debate about NEPA.[105] As summarized by another commentator:

> The White Paper contains some evidence that Congress assumed not only that NEPA would apply extraterritorially, but also that the requirements of NEPA

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99. *Id*. at § 4331(b)(3).

100. *Id*. at § 4332(f) (emphasis added).

101. *Id*. (emphasis added); Joan R. Goldfarb, *Extraterritorial Compliance with Nepa Amid the Current Wave of Environmental Alarm,* 18 B.C. ENV'T AFF. L. REV. 543, 555 (1991) ("[Section 4332 (f)], therefore, is the statute's most express authorization for extraterritorial application.").

102. S. REP. NO. 91-296, at 14 (1969).

103. H. REP. NO. 91-378, at 9 (1969); *see also* Gilbert & Vidaurri, *supra* note 7, at 252 ("[T]he relevant House Committee believed that the EIS requirement covered the high seas, Antarctica, and outer space and did not believe it needed to amend the statute.").

104. 115 CONG. REC. 40,416 (1969) (Statement of Senator Henry M. Jackson) (emphasis added); *See also* Enewetak v. Laird, 353 F. Supp. 811, 817 (D. Haw. 1973) ("The remarks of Senator Jackson, NEPA's principal sponsor, in submitting the Conference Committee's Report to the Senate are representative [of NEPA's broad scope].").

105. Congressional White Paper on a National Policy for the Environment, 115 CONG. REC. 29,078 (1969).

> would be adapted continually to new scientific understanding. The White Paper included a section recognizing the importance of considering environmental impacts of international projects. The White Paper acknowledged the basic principle that everything in the world environment is linked interactively. The White Paper also stipulated that, because Congress cannot predict future scientific discoveries or societal values, NEPA should be drafted so as to adapt to any future findings.[106]

Despite the modern debates around NEPA, Congress passed the law with relatively little opposition.[107] The Senate passed its version of NEPA with no amendments offered and no debate.[108] The House passed their version in a landslide vote of 372 to 15.[109]

C. NEPA'S EXTRATERRITORIAL APPLICATION: CASE LAW AND EXECUTIVE INTERPRETATIONS

There is little debate about NEPA's applicability to terrestrial actions occurring within the United States. Litigation in the early years after the statute's passage also established that NEPA applies to all U.S. territories.[110] The question that has challenged courts is whether NEPA applies to federal actions occurring in other nations and the global commons. To determine NEPA's applicability to satellite constellations and the stratosphere, this Article will exclusively examine cases regarding the global commons.

It is important first to discuss the principle known as the "presumption against extraterritoriality," which permeates these cases. The Supreme Court has described this presumption as:

> [A] longstanding principle of American law "that legislation of Congress, unless a contrary intent appears, is meant to apply only within the territorial jurisdiction of the United States." This "canon of construction . . .is a valid approach whereby unexpressed congressional intent may be ascertained." It serves to protect against unintended clashes between our laws and those of other nations which could result in international discord.[111]

This presumption applies unless (1) Congress clearly expressed an affirmative intention to extend the scope of the law to other sovereign nations, (2) if the failure to extend the statute would lead to adverse effects within the U.S., or (3) when the regulated conduct occurs within the U.S.[112] The Supreme Court has not

106. Goldfarb, *supra* note 101, at 556.
107. CRS NEPA BACKGROUND, *supra* note 95, at 4.
108. *Id.*
109. *Id.*
110. Enewetak v. Laird, 353 F. Supp. 811, 819 (D. Haw. 1973).
111. EEOC v. Arabian Am. Oil Co., 499 U.S. 244, 248 (1991) (internal citations omitted).
112. Env't Def. Fund, Inc. v. Massey, 986 F.2d 528, 531 (D.C. Cir. 1993).

directly addressed whether this presumption applies to NEPA, but lower courts have tackled this question with varying outcomes.

1. *Greenpeace USA v. Stone*

One of the earliest reported cases examining NEPA's applicability to the global commons, and not specifically other states' territories, is *Greenpeace USA v. Stone*.[113] In *Greenpeace*, the plaintiffs challenged the U.S. Army's movement of chemical munitions from West Germany to the Johnston Atoll in the Pacific Ocean (an incorporated U.S. territory) for the storage and eventual disposal of the munitions.[114] The U.S. Army prepared three separate EISs for the proposal, but, for the purposes of this Article, the most important EIS governed the movement of the munitions from a German port across multiple oceans to the Johnston Atoll.[115] Shipment of the munitions would occur beyond the territorial seas of any state in the "high seas," which the court identified as a "global common."[116] Plaintiffs argued that E.O. 12,114 required the Army to prepare an EIS since the shipment constituted a major federal action and occurred in "the global commons outside the jurisdiction of any nation (*e.g.*, the oceans or Antarctica)."[117]

The District Court held that it "[could] [] not conclude . . . that Executive Order 12,114 preempts application of NEPA to *all* federal agency actions taken outside the United States. Such an application of an Executive Order would be inappropriate and not supported by law."[118] The court ultimately found that the Army did not violate NEPA, in part because the transportation of the munitions across the Pacific Ocean was inextricably linked to its initial shipment from Germany, and, therefore, tied to foreign policy considerations that were already negotiated and approved by the President.[119]

2. *Environmental Defense Fund v. Massey*

Perhaps the most significant case exploring the application of NEPA to the global commons is *Environmental Defense Fund v. Massey*. The plaintiff, Environmental Defense Fund ("EDF"), challenged the National Science Foundation's ("NSF") decision to permit the incineration of waste at a research

113. Greenpeace USA v. Stone, 748 F. Supp. 749 (D. Haw. 1990).

114. *Id.* at 752-53.

115. *Id.* at 753.

116. *Id.* at 761 ("The global commons portion of the Army's action does not take place within the sovereign borders of a foreign nation or in concert with that foreign nation.").

117. *Id.* at 762. Executive Order 12,114 states the E.O. "furthers the purpose of [NEPA] . . . and represents the United States government's exclusive and complete determination of the procedural and other actions to be taken by Federal agencies to further the purpose of the [NEPA], with respect to the environment outside the United States, its territories and possessions." Exec. Order No. 12,114, 3 C.F.R 356 (1979).

118. *Greenpeace USA*, 748 F. Supp. at 762.

119. *Id.* at 763.

facility in Antarctica.[120] EDF challenged the agency's failure to prepare an EIS for the incinerator.[121] The district court dismissed EDF's claim, holding that NEPA did not apply in Antarctica because the statute did not contain a "clear expression of legislative intent through a plain statement of extraterritorial statutory effect."[122] The district court relied on the Supreme Court's ruling in *EEOC v. Aramco* "to conclude that NEPA does not apply to NSF's decision to incinerate food wastes in Antarctica."[123]

The D.C. Circuit Court of Appeals reversed the district court's ruling, finding that the presumption did not apply in this case. The holding is worth repeating in full:

> We reverse the district court's decision, and hold that the presumption against the extraterritorial application of statutes described in *Aramco* does not apply where the conduct regulated by the statute occurs primarily, if not exclusively, in the United States, and the alleged extraterritorial effect of the statute will be felt in Antarctica—a continent without a sovereign, and an area over which the United States has a great measure of legislative control.[124]

The court found a number of factors weighing against the presumption, including an examination of where a statute's effects occur (i.e., the "effects test") and the amount of legislative control the U.S. maintains over a given area.[125] The appellate court also articulated a number of unique factors about Antarctica, including:

- It is the sole continent which is not, and has never been, under the sovereign rule of any state;[126]
- The United States and 39 other states have agreed not to assert territorial claims to Antarctica, as outlined in the Antarctic Treaty in 1961;[127]
- The United States has some legislative control over the region; and
- There is little potential for conflict between U.S. laws and the laws of other states.[128]

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120. Env't Def. Fund, Inc. v. Massey, 986 F.2d 528, 529 (D.C. Cir. 1993).
121. *Id.*
122. *Id.* (quoting Envtl Def. Fund, Inc. v. Massey, 772 F.Supp. 1296, 1297 (D.D.C. 1991)).
123. *Id.*
124. *Id.*
125. *Id.* at 531 (citing Steele v. Bulova Watch Co., 344 U.S. 280 (1952) (applying U.S. antitrust laws extraterritorially); Laker Airways Ltd. v. Sabena, Belgian World Airlines, 731 F.2d 909, 925 (D.C. Cir. 1984) ("Jurisdiction exists under United States antitrust laws whenever conduct is intended to, and results in, substantial effects within the United States.")).
126. *Id.* at 529.
127. *Id.*
128. *See id.* at 533.

The court, in fact, analogized Antarctica to outer space and classified the continent as a "global common."[129] The court then outlined the exceptions to the presumption against extraterritoriality, as discussed above, and noted that NEPA "would never require enforcement in a foreign forum or involve 'choice of law' dilemmas."[130] "This factor alone," the court noted, "is powerful evidence of the statute's domestic nature."[131]

3. *Natural Resources Defense Council v. Navy*

In *NRDC v. Navy*, the Natural Resources Defense Council ("NRDC") sought to enjoin the Navy from carrying out certain sonar tests that may have been impacting marine wildlife until the department properly conducted the requisite NEPA analysis.[132] The Navy moved for summary judgment, arguing that the NRDC's claims were barred by the presumption against extraterritoriality since the sonar testing occurred outside of U.S. territorial waters and on the "high seas."[133]

The Navy, like NSF in *Massey*, argued that there was no clear indication of congressional purpose in NEPA to extend its coverage beyond U.S. territory, thus triggering the presumption against extraterritoriality.[134] The district court, however, cited *Massey* and noted that like the NSF, the Navy's planning takes place entirely within the U.S. and thus the presumption of extraterritoriality did not apply.[135] The district court noted that NEPA is a "purely procedural statute that . . . has no substantive effect outside of the United States," and this case did not raise the same foreign policy implications or infringement on another state's sovereignty as in *Greenpeace*.[136] The court concluded by finding that the open oceans (i.e., high seas) and the U.S. Exclusive Economic Zone ("EEZ") were part of the "global commons," although the court alternatively noted that the U.S. maintained substantial legislative control over the EEZ—one of the primary factors articulated in *Massey* to assess whether the presumption applies.[137] The court held, thus, that the presumption did not apply in either area.[138]

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129. *Id.* at 529 (citing Beattie v. United States, 756 F.2d 91, 99 (D.C. Cir. 1984)).
130. *Id.* at 533.
131. *Id.*
132. Nat. Res. Def. Council v. U.S. Dep't Navy, No. CV-01-07781 CAS(RZX), 2002 WL 32095131, at *1 (C.D. Cal. Sept. 17, 2002).
133. *See id.* at *9, *12.
134. *See id.* at *9.
135. *Id.* at *10.
136. *Id.*
137. *Id.* at *11-*12.
138. *Id.*

4. Post-Massey Developments

The growing case law supporting NEPA's application to the global commons was thrown into question by the Supreme Court's decisions in *Smith v. United States*[139] and *Sale v. Haitian Centers Council*.[140] In both cases, the Supreme Court examined the underlying text, structure, and legislative history of the applicable statute—the Federal Tort Claims Act ("FTCA") and Immigration and Nationality Act ("INA"), respectively—and determined that the U.S. law did not apply in Antarctica (*Smith)*[141] or the high seas (*Haitian Centers*),[142] both areas that are traditionally known as "global commons."[143]

In *Smith*, the Court held that the specific language and structure of the FTCA itself barred its application to Antarctica.[144] This holding does not bar the application of all U.S. laws in Antarctica—solely the FTCA. The facts of *Haitian Centers* were also unique. The case involved the President's power to establish a naval blockade to deny entrance to migrants.[145] The Court held, "[the] presumption [against extraterritoriality] has special force when we are constructing treaty and statutory provisions that may involve foreign and military affairs for which the President has unique responsibility."[146]

The Court's opinion in *RJR Nabisco, Inc. v. European Community* seemed to further broaden the presumption against extraterritoriality, throwing into question NEPA's extraterritorial scope.[147] Specifically, the Court articulated a two-step test. To determine whether a specific statute applies extraterritorially, courts must first examine the statute and determine whether it contains a "clear indication of extraterritorial effect."[148] That is, does the text, context, and legislative history give a "clear, affirmative indication that [the statute] applies extraterritorially?"[149] If the statute does not contain this clear congressional intent, then a court must examine the "focus" of the statute to determine whether the case involves a domestic application of the law.[150] At this second step, "if the conduct relevant to

139. Smith v. United States, 507 U.S. 197 (1993).

140. Sale v. Haitian Ctrs. Council, Inc., 509 U.S. 155 (1993).

141. *See Smith*, 507 U.S. at 204-05 ("[T]he presumption against extraterritorial application of United States statutes requires any lingering doubt regarding the reach of the FTCA be resolved against its accompanying torts committed in Antarctica.").

142. *Sale*, 509 U.S. at 188 (holding that the presumption against extraterritoriality was heightened for questions involving foreign and military affairs).

143. *See* Randall S. Abate, *Dawn of a New Era in the Extraterritorial Application of U.S. Environmental Statutes: A Proposal for an Integrated Judicial Standard Based on the Continuum of Context*, 31 COLUM. J. ENVTL L. 87, 113-17 (2006) (examining the application of the presumption against extraterritoriality in the global commons).

144. *Smith*, 507 U.S. at 204.

145. *Sale*, 509 U.S. at 155.

146. *Id.* at 188.

147. RJR Nabisco, Inc. v. Eur. Cmty., 579 U.S. 325 (2016).

148. *Id.* at 336.

149. *Id.* at 337.

150. *Id.*

the statute's focus occurred in the United States, then the case involves a permissible domestic application even if other conduct occurred abroad; but if the conduct relevant to the focus of the statute occurred in a foreign country, then the case involves an impermissible extraterritorial application regardless of any other conduct that occurred in U.S. territory."[151] Satisfying either step overcomes the presumption against extraterritoriality.[152]

The District Court of Nevada succinctly summarized the application of the presumption against extraterritoriality regarding NEPA in *Consejo de Desarrollo Económico de Mexicali, AC v. United States*.[153] Although this opinion was subsequently vacated, it nevertheless highlights the uncertainty regarding NEPA's application to the global commons moving forward, in large part due to the Supreme Court's post-*Massey* opinion in *Smith v. United States*.

The *Consejo* court first noted that "[c]ourts that have considered the extraterritorial application of NEPA, in addition to looking at the statute itself, have looked at whether the environmental impacts are wholly extraterritorial, whether the agency action was entirely within United States territory, and whether the United States has legislative control over the impacted area."[154] The court then summarized the lines of cases discussed above, in addition to a few other opinions:

- "If the environmental impacts fall exclusively within a foreign jurisdiction or in an area over which the United States has no legislative control, courts have held NEPA does not apply."[155]
- NEPA does not apply "to agency actions on foreign soil that would have foreign policy implications and interfere with a decision by the Executive branch."[156]
- "NEPA [does] not apply to agency action occurring on the high seas because the United States does not have 'legislative control over the high seas.'"[157]
- "However, if the agency action occurs within the United States and its impact will be felt in an area over which the United States maintains legislative control, courts have held that NEPA applies."[158]

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151. *Id.*

152. *Id.* at 337-38.

153. Consejo de Desarrollo Económico de Mexicali, AC v. United States, 438 F. Supp. 2d 1207, 1234-35 (D. Nev. 2006), *vacated and remanded* 482 F.3d 1157 (9th Cir. 2007).

154. *Id.* at 1235 (citing Env't Def. Fund, Inc. v. Massey, 986 F.2d 528, 529 (D.C. Cir. 1993); Natural Res. Def. Council, Inc. v. NRC, 647 F.2d 1345, 1347-48 (D.C. Cir. 1981)); *See* Basel Action Network v. Mar. Admin., 370 F. Supp. 2d 57, 71-72 (D.D.C. 2005).

155. *Consejo*, 438 F. Supp. 2d at 1235 (citing Natural Res. Def. Council, Inc. v. NRC, 647 F.2d 1345, 1348 (D.C. Cir. 1981)) (refusing to apply NEPA, in part, due to the foreign policy considerations and nature of nuclear exports/nuclear nonproliferation).

156. *Id.* (citing Greenpeace USA v. Stone, 748 F. Supp. 749, 761 (D. Haw. 1990)).

157. *Id.* (citing Basel Action Network v. Maritime Admin., 370 F. Supp. 2d 57, 71–72 (D. D.C. 2005)).

158. *Id.* (citing Env't Def. Fund, Inc. v. Massey, 986 F.2d 528, 529 (D.C. Cir. 1993)).

- NEPA may apply "where United States agency action abroad has direct environmental impacts within this country, or where there has clearly been a total lack of environmental assessment by the federal agency or foreign country involved."[159]

There has been limited case law post-*Massey* addressing NEPA's extraterritorial scope,[160] and the Supreme Court has not specifically ruled on NEPA's extraterritorial application, leaving the patchwork of lower federal court opinions and the *RJR Nabisco* test in place.

5. CEQ Interpretations of Extraterritorial Application

Although there have not been many developments in NEPA extraterritoriality case law in the past thirty years, the executive and federal agencies have made their marks. The State Department published a guidance memorandum in 1970 (the year of NEPA's passage) stating that NEPA applies to areas outside the jurisdiction of any other state, including the high seas and outer space, but not necessarily to other states' territories.[161] As noted by one commentator:

> The State Department gave two reasons for its interpretation. First, Congress expressed such an intent in the legislative history of NEPA. Second, the application of NEPA to this part of the human environment, unlike the application of NEPA to the territory of a foreign nation, would not even arguably interfere with the sovereignty of any foreign state.[162]

The D.C. Circuit in *Massey* cited this memorandum in support of its holding that NEPA extended to Antarctica as a global common.[163]

Executive Orders have also played an important role in NEPA's implementation. Executive Order 12,114, which President Carter issued in 1979, has been

159. *Id.* (citing *Greenpeace*, 748 F. Supp. at 761).

160. Gilbert & Viadurri, *supra* note 7, at 263 ("Since *EDF v. Massey*, there has been limited case law dealing explicitly with the extraterritorial application of NEPA to areas beyond national jurisdiction.").

161. Jeffrey E. Gonzalez-Perez & Douglas A. Klein, *The International Reach of the Environmental Impact Statement Requirement of the National Environmental Policy Act*, GEO. WASH. L. REV. 757, 783 (1994) (citing Memorandum from Christian A. Herter, Jr., Special Assistant to the Secretary of State for Environmental Affairs, to Russell Train, Chairman, Council on Environmental Quality (May 4, 1970), reprinted in Admin. of the Nat'l Env't Pol'y Act: Hearings Before the Subcomm. on Fisheries and Wildlife Conservation of the House Comm. on Merchant Marine and Fisheries, 91st Cong., 2d Sess., pt. 2, at 551 (1970)); *see also* Gilbert & Vidaurri, *supra* note 7, at 252 ("The testimony of the Department of State, the agency most aware of foreign policy concerns, supports the notion that EISs would apply to areas outside of the jurisdiction of other countries, including space, led to the House committee not attempting to amend NEPA to include an extraterritoriality clause [during the first oversight hearing for NEPA, which was held in 1970].").

162. Richard H. Mays, 4 Env't L. Forms Guide § 43:2 (2022).

163. Env't Def. Fund, Inc. v. Massey, 986 F.2d 528, 534 (D.C. Cir. 1993); *see also* Gilbert & Vidaurri, *supra* note 7, at 250 ("[T]he State Department memo itself is not a source of legislative history. However, comments related to it made by key NEPA Congressional cosponsors following passage can be used to gauge legislative intent.").

particularly important.[164] This Executive Order has been at the center of litigation surrounding NEPA's extraterritorial application.[165] The order "furthers the purpose of [NEPA] . . . consistent with foreign policy and national security policy of the United States, and represents the United States government's exclusive and complete determination . . . to further the purpose of [NEPA], with respect to the environment outside the United States."[166] The order notes that its authority is based on "independent authority."[167]

The order distinguishes between those areas controlled by other states and the global commons. The order explicitly states that agencies must prepare an EIS for "major Federal actions significantly affecting the environment of the global commons outside the jurisdiction of any nation (e.g., the oceans or Antarctica)."[168] Conversely, agencies need only prepare bilateral/multilateral environmental studies or produce concise reviews of environmental issues involved when the action affects the environment of a foreign nation.[169] The E.O., however, provides a carveout for certain national security matters, stating that no environmental review is needed for "actions taken by or pursuant to the direction of the President or Cabinet officer when the national security or interest is involved."[170]

Starting in 2010, the CEQ began publishing draft guidance on incorporating the impacts of climate change into NEPA analyses, which, of course, has extraterritorial effects.[171] Although the Trump administration rescinded the Obama-era final rule regarding the incorporation of climate-related factors in NEPA reviews, it did not eliminate the requirement wholesale.[172] Trump-era CEQ regulations in his first term, in fact, still recognized that NEPA may apply to certain extraterritorial effects (e.g., climate change) so long as those effects are not located solely outside the United States. Section 1508.1 declares NEPA does not apply to "[e]xtraterritorial activities or decisions, which means agency activities or decisions with effects *located entirely outside of the jurisdiction* of the United States."[173]

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164. Exec. Order No. 12144, 44 Fed. Reg. 1957 (Jan. 4, 1979).

165. *E.g.*, Greenpeace USA v. Stone, 748 F. Supp. 749, 762 (D. Haw. 1990).

166. Exec. Order No. 12144 at § 1-1.

167. *Id.*

168. *Id.* at §§ 2-3(a), 2-4(b)(i).

169. *Id.* at §§ 2-3(b)-(c), 2-4(b)(ii)-(iii).

170. *Id.* at § 2-5(iii).

171. Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions, 75 Fed. Reg. 8046-01 (proposed Feb. 18, 2010).

172. *See* Exec. Order No. 13783, 82 Fed. Reg. 16093 (Mar. 31, 2017); Withdrawal of Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews, 82 Fed. Reg. 16576-01 (Apr. 5, 2017); *see also* Thien T. Chau, *Implications of the Trump Administration's Withdrawal of the Final CEQ Guidance on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in NEPA Reviews*, 30 GEO. ENVT'L. REV. 713 (2018) (discussing how federal agencies and courts may interpret climate considerations in NEPA reviews following the Trump administration's rescission of Obama-era CEQ regulations).

173. 40 C.F.R. § 1508.1(q)(1)(i) (2024) (emphasis added).

The Biden administration repealed the majority of the Trump-era CEQ regulations.[174] The CEQ also published interim guidance on January 9, 2023 regarding the incorporation of climate change in NEPA reviews.[175] The interim guidance declares: "Climate change is a fundamental environmental issue, and its effects on the human environment fall squarely within NEPA's purview."[176] The guidance adds, "[f]ederal agencies have been analyzing climate change impacts and GHG emissions in NEPA documents for many years."[177] However, the guidance also notes that it does not (and cannot) "expand the range of Federal agency actions that are subject to NEPA."[178] As of writing, the CEQ has not issued final guidance. Regardless, it is clear that federal agencies will continue to review certain climate impacts stemming from their actions whether a Democratic or Republican administration is in power.

III. THE PRINCIPLES OF STANDING AND WIDESPREAD HARMS

There are two key hurdles to NEPA's application to the deployment of mega-constellations: standing and the statute's scope. Before determining whether NEPA extends to stratospheric impacts from increased satellite deployments, this Article will first examine the principles of standing, as standing will be a hurdle for any environmental plaintiff targeting the FCC's failure to complete an EA—as was evidenced in *Viasat v. FCC*.[179]

Federal courts are courts of limited jurisdiction. Article III, Section 2 of the U.S. Constitution limits courts to reviewing "cases or controversies."[180] This limitation upholds the separation-of-powers doctrine by reserving any matter that does not rise to the level of a "case" or "controversy" to the legislative and executive branches.[181] As the Supreme Court noted, "[n]o principle is more fundamental to the judiciary's proper role in our system of government than the constitutional limitation of federal-court jurisdiction to actual cases or controversies."[182]

To satisfy this requirement, plaintiffs are required to demonstrate that they have standing to bring their claims.[183] "Standing," in a broader sense, is part of the principle limiting courts to issues that are justiciable (i.e., can be resolved

174. Biden NEPA Revisions, *supra* note 82, at 23453 ("The amendments generally restore provisions that were in effect for decades before being modified in 2020.").

175. National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions and Climate Change, 88 Fed. Reg. 1196-01 (proposed Jan. 9, 2023) [hereinafter 2023 Proposed Climate Change NEPA Guidance].

176. *Id.* at 1197.

177. *Id.* at 1198.

178. *Id.*

179. 47 F.4th at 781.

180. U.S. CONST. art. III, § 2.

181. Lujan v. Defs. of Wildlife, 504 U.S. 555, 559-60 (1992).

182. Simon v. E. Ky. Welfare Rights Org., 426 U.S. 26, 37 (1976).

183. *Lujan,* 504 U.S. at 561 ("The party invoking federal jurisdiction bears the burden of establishing these elements.").

through the judicial process).[184] Standing is also often front and center in environmental suits—particularly NEPA cases.[185] Given the depth and breadth of this topic, this Article will focus on standing issues in cases involving extraterritorial impacts.

To satisfy Article III constitutional standing, a plaintiff must show (1) an injury-in-fact, (2) a causal connection, and (3) a court must have the ability to redress the issue (i.e., redressability).

A. INJURY-IN-FACT: DIFFUSE HARMS MAY BE CONCRETE, PARTICULARIZED, AND IMMINENT

The injury-in-fact prong itself has two subparts. To illustrate that plaintiffs have suffered an injury-in-fact, they must show that their injury is (1) concrete and particularized and (2) actual or imminent.

First, Plaintiffs must allege that the contested action will injure them in a "concrete and personal way."[186] The Supreme Court has clarified that when they "have used the adjective 'concrete,' [they] have meant to convey the usual meaning of the term—'real,' and not 'abstract.'"[187] The Supreme Court recently articulated why plaintiffs must demonstrate a "concrete harm:"

> To appreciate how the Article III "concrete harm" principle operates in practice, consider two different hypothetical plaintiffs. Suppose first that a Maine citizen's land is polluted by a nearby factory. She sues the company, alleging that it violated a federal environmental law and damaged her property. Suppose also that a second plaintiff in Hawaii files a federal lawsuit alleging that the same company in Maine violated that same environmental law by polluting land in Maine. The violation did not personally harm the plaintiff in Hawaii.[188]

The Court added:

> Even if Congress affords both hypothetical plaintiffs a cause of action (with statutory damages available) to sue over the defendant's legal violation, Article III standing doctrine sharply distinguishes between those two scenarios. The first lawsuit may of course proceed in federal court because the plaintiff has suffered concrete harm to her property. But the second lawsuit may not proceed because that plaintiff has not suffered any physical, monetary, or cognizable intangible harm traditionally recognized as providing a basis for a lawsuit in American courts. An uninjured plaintiff who sues in

184. *Id*. at 560 (citing Whitmore v. Arkansas, 495 U.S. 149, 155 (1990)).

185. MANDELKER ET AL., *supra* note 77, at § 4.19. The seminal case for analyzing standing in environmental suits is *Lujan v. Defenders of Wildlife*, 504 U.S. 555 (1992).

186. *Id*. at 581 (Kennedy, J., concurring).

187. Spokeo, Inc. v. Robins, 578 U.S. 330, 340 (2016), *as revised* (May 24, 2016) (first quoting *Black's Law Dictionary* 479 (9th ed. 2009); and then quoting WEBSTER'S THIRD NEW INTERNATIONAL DICTIONARY 472 (1971); and RANDOM HOUSE DICTIONARY OF THE ENGLISH LANGUAGE 305 (1967)).

188. TransUnion, LLC v. Ramirez, 594 U.S. 413, 427 (2021).

> those circumstances is, by definition, not seeking to remedy any harm to herself but instead is merely seeking to ensure a defendant's "compliance with regulatory law" . . .[189]

This requirement, the Supreme Court notes, "functions to ensure . . . that the scarce resources of the federal courts are devoted to those disputes in which the parties have a concrete stake."[190]

When alleging a deprivation of a procedural right, such as NEPA, plaintiffs must still demonstrate "some concrete interest that is affected by the deprivation."[191] That is, "deprivation of a procedural right without some concrete interest that is affected by the deprivation—a procedural right *in vacuo*—is insufficient to create Article III standing."[192]

Plaintiffs must not only establish a concrete harm but must also show the harm is particularized. To establish that an injury is "particularized," plaintiffs must show that the alleged harm may impact them "in a personal and individual way."[193] That is, this prong requires that the plaintiff "be himself among the injured," which is similar to the requirement to show a "concrete" harm.[194] Although courts often conflate these two requirements, the Supreme Court has recognized that they are, in fact, distinct.[195]

Under this requirement, plaintiffs must show that their alleged injury is distinct from one shared by the public.[196] As noted by one commentator, "[o]ne rationale for the particularity requirement is that harms affecting a wide swath of the population would be better addressed by the legislative and executive branches, which respond to majoritarian concerns, than by the judiciary, which ought to concern itself with individual rights."[197] That said, a number of courts have held that injuries related to diffuse harms, such as climate change (or stratospheric damage), may be sufficient to satisfy the concrete and particularized requirements.[198]

For example, the court in *Northwest Environmental Defense Center v. Owens Corning* examined whether harms to the ozone were sufficient to satisfy standing.[199] The Northwest Environmental Defense Center filed suit against a proposed polystyrene foam insulation manufacturing plant in Gresham, Oregon, arguing the plant failed to obtain a preconstruction permit pursuant to the Clean

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189. *Id.*

190. Friends of the Earth, Inc. v. Laidlaw Env't Serv., Inc., 528 U.S. 167, 191 (2000).

191. Summers v. Earth Island Inst., 555 U.S. 488, 496 (2009) (citing *Lujan*, 504 U.S. at 572, n.7).

192. *Id.*

193. Lujan v. Defs. of Wildlife, 504 U.S. 555, 560, n.1 (1992).

194. *Id.* at 563 (quoting Sierra Club v. Morton, 405 U.S. 727, 734-35 (1972)).

195. *Spokeo*, 578 U.S. at 331 ("Concreteness is quite different from particularization.").

196. *Lujan*, 504 U.S. at 577.

197. Rachel Bayefsky, *Constitutional Injury and Tangibility*, 59 WM. & MARY L. REV. 2285, 2297 (2018).

198. *See* MANDELKER ET AL., *supra* note 77, § 8.56, n.3 (listing NEPA cases wherein courts found standing).

199. Nw. Env't. Def. Ctr. v. Owens Corning Corp., 434 F. Supp. 2d 957, 960 (D. Or. 2006).

Air Act.[200] The plaintiff was concerned with a hydrochlorofluorocarbon known as HCFC-142b, which is a "potent greenhouse gas and ozone-depleting substance."[201] Plaintiff argued that, as a result of the plant, its members would be at an increased risk to contract diseases associated with heightened ultraviolet radiation and ozone depletion (e.g., lupus) and that the increased UV would harm other environmental resources the Center's members enjoyed.[202] Plaintiff also alleged that the plant would emit certain criteria pollutants that would directly impact the health of their members and the local environment.[203]

The District Court of Oregon found that the plaintiff "need not wait until after . . . [they have] been harmed before seeking relief," and that plaintiff's fear that they may be harmed (as opposed to "will" be harmed) is sufficient to satisfy the injury-in-fact requirement.[204] The court also noted that Congress specifically passed laws governing the emissions at issue (e.g., HCFCs) in various international agreements, which "weigh[s] against any suggestion that the threatened harm is entirely chimerical."[205] That is, congressional action signals that the harm is real and concrete.

The court also noted that the imminence of injury requirement (and redressability requirement) is lowered when plaintiffs are asserting a procedural claim.[206] This lowered bar is critical in NEPA suits since, unlike the hypothetical plaintiff in *TransUnion v. Ramirez* (i.e., the plaintiff in Hawaii that files suit based on pollution in Maine),[207] the procedural harm is actual or imminent.

Moreover, the court addressed the question of whether a diffuse harm, such as climate change or stratospheric damage, is sufficient to demonstrate an injury-in-fact. The court held:

> Adverse effects from the emissions will not necessarily be limited to Oregon, yet Plaintiffs' injuries are not diminished by the mere fact that other persons may also be injured by the Defendant's conduct. Standing has never required proof that the plaintiff is the *only* person injured by the defendant's conduct . . . [T]he notion that "injury to all is injury to none" does not correctly reflect the current doctrine.[208]

In short, the court found that the plaintiffs had concrete injuries resulting from defendant's conduct and plaintiffs properly explained how they would benefit from a favorable decision.[209]

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200. *Id.* at 959.
201. *Id.* at 960.
202. *Id.*
203. *Id.* at 961.
204. *Id.* at 963.
205. *Id.* at 963-64.
206. *Id.* at 964 (quoting *Lujan*, 504 U.S. at 573, n. 7.).
207. *See supra* notes 188-89 for discussion.
208. *Owens Corning,* 434 F. Supp. 2d at 965-66 (emphasis in original) (quoting Covington v. Jefferson Cnty., 358 F.3d 626, 651 (9th Cir. 2004) (Gould, J., concurring)).
209. *Id.* at 967.

A year later the Supreme Court also signaled in *Massachusetts v. EPA* that failing to consider the impacts of climate change could constitute a sufficient injury-in-fact under NEPA.[210] Citing *Lujan*, the Court concluded that "a litigant to whom Congress 'accorded a procedural right to protect his concrete interests . . . can assert that right *without meeting all the normal standards for redressability and immediacy*.'"[211] The Court added, "[w]hen a litigant is vested with a procedural right, that litigant has standing if there is some possibility that the requested relief will prompt the injury-causing party to reconsider the decision that allegedly harmed the litigant."[212] The Court then held that Massachusetts demonstrated an injury-in-fact since climate change "will only increase over the course of the next century" and sea level rise will permanently inundate the state's coastline.[213] The Court also noted that Massachusetts's injuries were not minimized simply because climate impacts are "widely shared."[214] Since *Massachusetts*, multiple courts have found plaintiffs have standing to assert NEPA claims for the failure of agencies to consider climate impacts.[215]

Even in climate cases involving substantive claims (i.e., non-procedural claims), courts have found that plaintiffs can satisfy the injury-in-fact requirement. For example, in *Juliana v. United States*, a suit alleging the government's climate policies violated a number of substantive due process rights, the Ninth Circuit Court of Appeals found that climate change was impacting the plaintiffs in concrete, specific ways, such as requiring one plaintiff to evacuate his coastal home due to flooding.[216] Similar to *Owens Corning*, the government argued that plaintiffs' injuries were not sufficiently particularized because climate change affects everyone.[217] The court, however, rejected this argument, noting "it does not matter how many persons have been injured if the plaintiffs' injuries are concrete and personal."[218]

The final element of the "injury-in-fact" prong is imminence. Plaintiffs must demonstrate that the alleged injury is "actual or imminent, not conjectural

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210. *See* MANDELKER ET AL., *supra* note 77, at § 4:20 ("*Massachusetts* appeared to open the doors to NEPA plaintiffs arguing that agencies failed to consider the effects of their actions on climate change or the effects of climate change on agency actions subject to NEPA.").

211. Massachusetts v. EPA, 549 U.S. 497, 517 (2007) (emphasis added) (quoting *Lujan* 504 U.S. at 572, n.7).

212. *Id.* at 518 (citing *Lujan*, 504 U.S. at 572, n.7).

213. *Id.* at 522-23.

214. *Id.* at 522 (citing Fed. Election Comm'n v. Akins, 524 U.S. 11, 24 (1998)).

215. *See* MANDELKER ET AL., *supra* note 77, at § 8:56, n. 3 (listing NEPA cases wherein courts found standing).

216. Juliana v. United States, 947 F.3d 1159, 1168 (9th Cir. 2020). Plaintiffs were requesting a nationwide injunction of the government's climate policies (or lack thereof) since they "deprived them of a substantive constitutional right to a 'climate system capable of sustaining human life." *Id.* at 1169.

217. *Id.* at 1168.

218. *Id.* (quoting Massachusetts v. EPA, 549 U.S. 497, 517 (2007)).

or hypothetical."[219] Courts have grappled with the test for establishing "imminence."[220]

The Supreme Court has never articulated a specific numerical requirement to establish "imminence," and, as noted by commentators, the Court has "sent conflicting signals regarding the problem of probabilistic injury."[221] That said, the Court has signaled that, "threatened injury must be certainly impending to constitute injury in fact."[222] And "[a]llegations of possible future injury are not sufficient."[223]Although this language suggests that plaintiffs must demonstrate a certainly impending injury, the Court, in the same opinion, noted, "[o]ur cases do not uniformly require plaintiffs to demonstrate that it is literally certain that the harms they identify will come about. In some instances, we have found standing based on a 'substantial risk' that the harm will occur, which may prompt plaintiffs to reasonably incur costs to mitigate or avoid that harm."[224]

Thus, there appear to be two separate tests for establishing imminence. The D.C. Circuit has distilled these different tests and states plaintiffs "can establish standing by satisfying *either* 'the certainly impending' test *or* the 'substantial risk' test."[225] Under the "substantial risk" test, plaintiffs must demonstrate (1) a substantially increased risk of harm AND (2) a substantial probability of harm with that increase taken into account."[226]

Ultimately, the Supreme Court seems to examine the nature of an injury and whether it hinges on significant speculation or an attenuated causal chain and applies one of the two aforementioned tests depending on the nature of the case.[227] This "imminence" requirement is also significantly lowered when plaintiffs are asserting a procedural claim, such as a violation of NEPA, as noted in *Owens Corning* and *Massachusetts v. EPA*.[228]

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219. Lujan v. Defs. of Wildlife, 504 U.S. 555, 560 (1992).

220. *E.g.*, Pub. Citizen, Inc. v. Nat'l Highway Traffic Safety Admin., 489 F.3d 1279, 1295 (D.C. Cir. 2007) ("What increase in the risk of harm and what level of ultimate risk are high enough to be 'substantial'—and thus render the harm sufficiently 'imminent'?").

221. RICHARD MURPHY, 33 FED. PRAC. & PROC. JUDICIAL REVIEW § 8337 (2d ed. 2022).

222. Clapper v. Amnesty Int'l, 568 U.S. 348, 409 (2013) (citing Whitmore v. Arkansas, 495 U.S. 149, 158 (1990)).

223. *Id.* (quoting *Whitmore*, 495 U.S. 149 at 158 (internal quotation marks omitted)).

224. MURPHY, *supra* note 221, at § 8337.

225. New Jersey v. EPA, 989 F.3d 1038, 1047 (D.C. Cir. 2021) (citing Attias v. Carefirst, Inc., 865 F.3d 620, 626-27 (D.C. Cir. 2017)).

226. *Id.* (emphasis added) (citing Food & Water Watch, Inc. v. Vilsack, 808 F.3d 905, 914 (D.C. Cir. 2015)).

227. MURPHY, *supra* note 221, at § 8337 (outlining the Supreme Court's inconsistent rulings on imminence).

228. Nw. Env't Def. Ctr. v. Owens Corning Corp., 434 F. Supp. 2d 957, 964 (D. Or. 2006); *Massachusetts*, 549 U.S. at 517.

B. ESTABLISHING CAUSATION FOR ATTENUATED CHAINS

To establish standing, plaintiffs must also demonstrate that the defendant's actions caused their alleged injury. This "causation" prong requires plaintiffs to demonstrate that their injury is "fairly . . . trace[able] to the challenged action of the defendant."[229]

Generally, establishing causation is not an issue when the challenged action is specifically directed at the alleged wrongdoer.[230] Meeting this prong, however, is more difficult when plaintiffs are challenging the failure of an agency to regulate a third party (e.g., when the FCC issues licenses to commercial entities to operate satellites). In this scenario, plaintiffs have to demonstrate multiple links in the causation chain. That is, the failure of an agency to conduct X action led party Y to commit a certain action, which, in turn, harmed the plaintiff. With each additional link in the chain, the causation becomes more attenuated and more difficult to prove.

This type of causal chain was addressed in *WildEarth Guardians v. Jewell* where the D.C. Circuit held that to meet causation in NEPA suits plaintiffs must show a "causal chain . . . [with] at least two links: one connecting the omitted EIS to some substantive government decision that may have been wrongly decided because of the lack of an EIS and one connecting that substantive decision to the plaintiff's particularized injury."[231] To establish this first "link," plaintiffs must simply demonstrate that the "procedural step was connected to the substantive result."[232]

Environmental plaintiffs have faced additional challenges when arguing that an agency's action (or inaction) contributed to widespread environmental harm (e.g., climate change).[233] This is the second link required in the causal chain. Plaintiffs must demonstrate that the alleged injury from this widespread harm is "fairly traceable" to defendant's actions and, in the case of agencies, the specific action "created a demonstrable risk, or caused a demonstrable increase in an existing injury."[234] For example, in the aforementioned *WildEarth Guardians* case, plaintiffs were challenging a Bureau of Land Management ("BLM") lease

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229. Lujan v. Defs. of Wildlife, 504 U.S. 555, 560 (1992); *See also* MANDELKER ET AL., *supra* note 77, at § 4:22.

230. MANDELKER ET AL., *supra* note 77, at § 4:22.

231. WildEarth Guardians v. Jewell, 738 F.3d 298, 306 (D.C. Cir. 2013) (quoting Fla. Audubon Soc'y v. Bentsen, 94 F.3d 658, 668 (D.C. Cir. 1996)); *see also* Sierra Club v. FERC, 827 F.3d 36, 47 (D.C. Cir. 2016) ("NEPA thus requires a reasonably close causal relationship between the environmental effect and the alleged cause, which is analogous to the familiar doctrine of proximate cause from tort law.") (internal citations omitted).

232. *WildEarth Guardians*, 738 F.3d at 306 (citing *Massachusetts*, 549 U.S. at 518).

233. *See*, *e.g.,* Ctr. for Biological Diversity v. U.S. Dep't of Interior, 563 F.3d 466, 478 (D.C. Cir. 2009) (finding the causal link between the Department of Interior's leasing program and plaintiffs' climate-related injuries too tenuous).

234. MANDELKER ET AL., *supra* note 77, at § 4.22 (citing *Audubon Soc'y*, 94 F.3d 658).

that authorized coal mining operations on public lands.[235] The D.C. Circuit found that, although plaintiffs established standing as it relates to local pollution, plaintiffs could not establish standing based on the project's contribution to global climate change.[236]

The case of *Florida Audubon Society v. Bentsen* also demonstrates the difficulty of establishing causation for attenuated causal chains. In *Florida Audubon Society*, plaintiffs filed suit pursuant to NEPA arguing that the Internal Revenue Service ("IRS") failed to prepare an EIS for the authorization of a tax credit promoting the use of an ethanol-based fuel.[237] Plaintiffs, in effect, argued that the tax credit would lead to increased production of corn and other crops, which, in turn, would cause environmental harms associated with agricultural pollution.[238] The agricultural pollution would then impact wildlife areas bordering agricultural areas that plaintiffs visited.[239] The court held that this "protracted chain of causation" fails due to the "uncertainty of several individual links and because of the number of speculative links that must hold for the chain to connect the challenged acts to the asserted particularized injury."[240] The court also noted that this chain of causation required a number of independent actions by third parties (e.g., ethanol producers, distributors, and farmers throughout various states).[241]

Conversely, the *Owens Corning* case demonstrates how environmental plaintiffs can demonstrate "causation." The court found that the "fairly traceable" element of causation "does not require that a plaintiff show to a scientific certainty that defendant's emissions, and only the defendant's emissions are the source of the threatened harm."[242] Instead, the court held that "[i]t is sufficient for Plaintiffs to assert that emissions from Defendant's facility will contribute to the pollution that threatens Plaintiffs' interests."[243] In the aforementioned *Juliana* case, the Ninth Circuit also found that "[c]ausation can be established 'even if there are multiple links in the chain'"[244] and ultimately found that "the alleged injuries [were] caused by carbon emissions from fossil fuel production, extraction, and transportation."[245]

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235. *WildEarth Guardians,* 738 F.3d at 313.

236. *Id*. at 318.

237. Fla. Audubon Soc'y v. Bentsen, 94 F.3d 658, 662 (D.C. Cir. 1996).

238. *Id*. at 666.

239. *Id*. ("Appellants in this case premise their claims of particularized injury and causation on a lengthy chain of conjecture. In brief, appellants contend that the tax credit will cause more ETBE production, which in turn will cause more ethanol production, which consequently will cause more production of the corn and sugar necessary for ethanol, which will then cause more agricultural pollution.").

240. *Id*. at 670.

241. *Id.*

242. Nw. Env't. Def. Ctr. v. Owens Corning Corp., 434 F. Supp. 2d 957, 967 (D. Or. 2006) (citing Sierra Club, Lone Star Chapter v. Cedar Point Oil Co. Inc., 73 F.3d 546, 558 (5th. Cir. 1996)).

243. *Id.*

244. Juliana v. United States, 947 F.3d 1159, 1169 (9th Cir. 2020) (quoting Mendia v. Garcia, 768 F.3d 1009, 1012 (9th Cir. 2014)).

245. *Id.*

C. REDRESSABILITY STANDARD IS RELAXED FOR PROCEDURAL HARMS

The last prong in a standing analysis is determining whether the claim is "redressable." To meet the redressability prong, plaintiffs must demonstrate that their requested relief is (1) substantially likely to redress their alleged injuries and (2) within the power of the court to award.[246] Procedural claims, such as NEPA, "loosen the strictures of the redressability prong."[247] Redressability is typically not disputed in NEPA suits since courts have the ability to simply enjoin the completion of a project until the agency properly satisfies NEPA.[248] For example, in *WildEarth Guardians v. Jewell*, the court held that vacatur of a BLM order would meet the redressability prong because the agency could change its mind about issuing the order if it properly conducted an analysis under NEPA and adequately considered the alleged environmental impacts.[249]

Although procedural claims relax the standard of redressability, they do not wholly eliminate the plaintiff's requirement to show imminence and redressability.[250] Courts have denied standing under the redressability prong when, for example, the suit involves a political question or the relief sought is beyond the authority of a court to grant (i.e., it is non-justiciable).[251] Courts have also dismissed suits on redressability grounds when the disputed action is within the agency's discretion,[252] the conduct causing the alleged injury was the result of a third-party,[253] the agency action would not actually redress the injury,[254] or when relief depends on uncertain third-party actions.[255]

Claims based on diffuse harms, such as atmospheric damage, are unique in that multiple entities may be responsible for the harm. Courts, however, have found that plaintiffs can satisfy the redressability requirement even when a defendant's actions are not solely responsible for a specific injury. The *Owens Corning* court held:

> Plaintiffs *need not* show that the entire problem (for instance, global warming) will be cured if the Plaintiffs prevail in this action, or that the challenged action is the exclusive source of that harm. Particularly in environmental and land

246. Lujan v. Defs. of Wildlife, 504 U.S. 555, 561 (1992).

247. Summers v. Earth Island Inst., 555 U.S. 488, 497 (2009).

248. MANDELKER ET AL., *supra* note 77, at § 4.23, n.1 (cataloging dozens of NEPA suits wherein courts found the plaintiffs established redressability).

249. WildEarth Guardians v. Jewell, 738 F.3d 298, 307 (D.C. Cir. 2013).

250. Ctr. for L. & Educ. v. Dep't of Educ., 396 F.3d 1152, 1157 (D.C. Cir. 2005).

251. *See, e.g.,* Rucho v. Common Cause, 139 S. Ct. 2484, 2506-07 (2019) (holding that partisan gerrymandering claims were political questions beyond the scope of Article III courts); Tinian Women Ass'n v. U.S. Dep't of the Navy, 2017 WL 4564188 at *19-20 (D. N. Mariana Islands 2017), *aff'd*, 976 F.3d 832 (9th Cir. 2020) (holding that plaintiffs lacked standing to pursue NEPA claims regarding troop movements since the movement was based on a treaty between the U.S. and Japan).

252. MANDELKER ET AL., *supra* note 77, at § 4.23, n.11 (listing cases).

253. *Id.* at § 4.23, n.13 (listing cases).

254. *Id.* at § 4.23, n.14 (listing cases).

255. *Id.* at § 4.23, n.16 (listing cases).

> use cases, the challenged harm often results from the cumulative effects of many separate actions that, taken together, threaten the plaintiff's interests. The relief sought in the Complaint need not promise to solve the entire problem, any more than a legislative body is forbidden to enact a law addressing a discrete part of a problem rather than the entire problem.[256]

The Supreme Court embraced this same reasoning in *Massachusetts v. EPA*, holding that regulating greenhouse gas emissions from U.S. motor-vehicles may not wholly solve climate change but it may nevertheless "*slow* or *reduce* it."[257]

That said, the redressability prong must still be met for suits targeting atmospheric harms—particularly if the suit is based on substantive claims (rather than procedural). For example, in *Juliana,* the Ninth Circuit ultimately held that plaintiffs' unique constitutional claims were not redressable by an Article III court.[258] The court described plaintiffs' requested remedy as "an injunction requiring the government not only to cease permitting, authorizing, and subsidizing fossil fuel use, but also to prepare a plan subject to judicial approval to draw down harmful emissions."[259] The court also determined that the type of declaration plaintiffs were seeking (i.e., that the government's policies were violating the Constitution) "is not substantially likely to mitigate the plaintiffs' asserted concrete injuries."[260] The court added, "[plaintiffs] do not show that even the total elimination of the challenged programs would halt the growth of carbon dioxide levels in the atmosphere, let alone decrease that growth."[261] Plaintiffs, nevertheless, argued that even if their requested relief does not halt global climate change, their "injuries would be to some extent ameliorated." [262] Citing *Massachusetts v. EPA*, plaintiffs argued that the requested relief would likely slow or reduce emissions.[263] The Ninth Circuit, however, noted that *Massachusetts* "involved a *procedural right* that the State of Massachusetts was allowed to assert 'without meeting all the normal standards for redressability.'"[264] In short, the Ninth Circuit held that plaintiff's substantive due process claims faced a higher burden than the type of procedural right at issue in *Massachusetts*.[265] This distinction is key when analyzing standing issues under NEPA for satellite constellations.

Finally, the *Juliana* court concluded that even if the requested relief would substantially redress the plaintiffs' injuries, it was not within the power of an Article III court to grant such relief. The Ninth Circuit held, "it is beyond the power of an

256. Nw. Env't. Def. Ctr. v. Owens Corning Corp., 434 F. Supp. 2d 957, 968 (emphasis added).
257. Massachusetts v. EPA, 549 U.S. 497, 525 (emphasis in original).
258. Juliana v. United States, 947 F.3d 1159, 1175 (9th Cir. 2020).
259. *Id.* at 1170.
260. *Id.*
261. *Id.*
262. *Id.* at 1171.
263. *Id.* (citing Massachusetts v. EPA, 549 U.S. 497, 525-26 (2007)).
264. *Id.* (citing Massachusetts v. EPA, 549 U.S. at 517-18, 525-26) (emphasis added).
265. *Id.*

Article III court to order, design, supervise, or implement the plaintiffs' requested remedial plan."[266] The court added, "as the opinions of [plaintiffs'] experts make plain, any effective plan would necessarily require a host of complex policy decisions entrusted, for better or worse, to the wisdom and discretion of the executive and legislative branches."[267]

In sum, the Ninth Circuit held that broad, climate change related claims can satisfy the injury-in-fact and causation prongs for Article III standing, but the type of substantive relief the plaintiffs in *Juliana* sought was not redressable by an Article III court. This holding, however, leaves open the possibility for procedural-type claims, such as NEPA, since these claims have a lower redressability bar.

IV. SPACEX'S STARLINK: A CASE STUDY IN NEPA'S EXTRATERRESTRIAL SCOPE

In 2018, the FCC granted authorization for SpaceX to launch and operate its Gen1 Starlink system.[268] Since its initial approval, the FCC has granted SpaceX numerous modifications for its Gen1 permit and recently approved the launch of SpaceX's Gen2 system.[269] Following the modification of its Gen1 permit, multiple parties challenged the FCC's authorization on a number of grounds.[270] For the purpose of this Article, the most important challenges came from two parties, Viasat, Inc. and the Balance Group ("environmental plaintiffs"), who contested the FCC's order based on the Commission's failure to conduct a proper NEPA review relating to the satellites' impacts on Earth and in outer space.[271]

An important question that courts have never addressed is whether NEPA applies extraterrestrially. The FCC also sidestepped this question in its authorization, noting it would not rule on the "novel question" of whether NEPA extended to space.[272] Instead, the Commission rejected the environmental claims on the merits, finding SpaceX's proposal would not significantly affect the environment.[273] The environmental plaintiffs appealed the order, but the D.C. Circuit dismissed the claims on standing grounds, leaving NEPA's extraterrestrial scope unanswered.[274] Although neither the Commission nor the D.C. Circuit answered this question, a number of commentators published articles advocating for and against NEPA's extraterrestrial application.[275]

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266. *Id.*
267. *Id.* at 1171-72 (citing *Miss. v. Brown*, 902 F.3d at 1086).
268. Space Exploration Holdings, LLC, 33 FCC Rcd 3391 (2018) [hereinafter Initial Gen1 Order].
269. Final Gen2 Order, *supra* note 10, para. 2, 4.
270. Final Gen1 Order, *supra* note 10, at 7998.
271. *Id.* at 8036-37.
272. *Id.* at 8037.
273. *Id.* at 8039.
274. Viasat, Inc. v. FCC, 47 F.4th 769, 779 (D.C. Cir. 2022).
275. *See*, *e.g.*, Runnels, *supra* note 7.

On December 1, 2022, the FCC partially granted SpaceX's Gen2 permit, authorizing 7,500 satellites and setting aside the company's request for an additional 22,500 satellites, pending additional investigation.[276] Following approval, the International Dark-Sky Association ("IDA") appealed the FCC's decision to the D.C. Circuit arguing the order violates the APA and NEPA.[277] In July 2024, the D.C. Circuit found IDA satsified standing; however, the Court held IDA failed to demonstrate that the agency's actions were arbitrary, capricious, or otherwise contrary to law.[278] The court, like other tribunals before it, did not specifically rule on NEPA's applicability to space, thus (again) leaving the question unresolved.

A. THE FCC GRANTS SPACEX A LICENSE FOR ITS GEN1 SYSTEM AND THE FAA ISSUES A FONSI

On March 28, 2018, the FCC approved a permit for SpaceX to deploy and operate its Gen1 Starlink system, a satellite constellation consisting of thousands of satellites orbiting in NGSO.[279] SpaceX describes Starlink as a "high-speed, low-latency service [that] is made possible via the world's largest constellation of highly advanced satellites operating in a low orbit around Earth."[280]

Deploying satellites requires approval from, at minimum, the FAA and FCC.[281] Both agencies approved SpaceX's application and subsequent modifications with limited review of environmental effects above 3,000 feet.[282] The FAA determined that SpaceX's proposal to launch Starlink's satellites constituted a "major federal action," pursuant to NEPA.[283] After conducting an EA, the agency issued a FONSI, determining that the proposed action would not significantly affect the quality of the human environment.[284] As part of its EA, the FAA analyzed several environmental categories, including biological resources, climate impacts, coastal resources, and air quality—among others.[285] In assessing air quality, the agency limited its analysis to emissions below 3,000 feet and determined that emissions "would be of short duration (a matter of seconds) during

276. Final Gen2 Order *supra* note 10, para. 1.

277. The Int'l Dark-Sky Ass'n, Inc.'s Notice of Appeal at 3, Int'l Dark-Sky Ass'n v. FCC, No. 22-1337 (Dec. 29, 2022).

278. Initial Gen1 Order, *supra* note 268.

279. *See How Starlink Works*, STARLINK, https://perma.cc/5QL9-5THV (last visited Mar. 12, 2023).

280. Int'l Dark-Sky Ass'n v. FCC, 106 F.4th 1206, 1217 (D.C. Cir. 2024).

281. 47 U.S.C. §§ 308-309 (FCC Requirements for a License); 51 U.S.C. § 50131 (FAA Authorities).

282. *See* FED. AVIATION ADMIN, FINAL ENVIRONMENTAL ASSESSMENT AND FINDING OF NO SIGNIFICANT IMPACT FOR SPACEX FALCON LAUNCHES AT KENNEDY SPACE CENTER AND CAPE CANAVERAL AIR FORCE STATION 33 (July 2020) [hereinafter FAA EA], *available at* https://www.faa.gov/space/environmental/nepa_docs/media/SpaceX_Falcon_Program_Final_EA_and_ FONSI.pdf.

283. *Id.*

284. *Id.* at Summary.

285. *Id.* at 29.

launches . . . [and] [a]ir pollutant emissions would not result in violations of any air quality standards [under the Clean Air Act]."[286]

The EA noted that Earth's atmosphere is composed of five layers (in ascending order): the troposphere, stratosphere, mesosphere, ionosphere, and exosphere.[287] But the agency only examined launch impacts below 3,000 feet (the lower troposphere) since 3,000 feet is the "nominal height of the atmosphere mixing layers in assessing contributions of emissions to ground-level ambient air quality under the Clean Air Act."[288] The agency recognized that emissions would occur above 3,000 feet, but found that these emissions would not result in appreciable *ground-level* concentrations.[289]

The FCC approved SpaceX's permit without conducting an EA. Instead, the agency relied on a longstanding CATEX that has been in place since 1986.[290] Following the FCC's initial approval, SpaceX submitted a number of modifications to its license to modify the operational altitude for their satellites.[291] Viasat and the Balance Group filed objections, arguing the FCC was required to prepare an EA pursuant to NEPA prior to granting the modification.[292] In total, the parties made five environmental claims: the impact of launching and reentering satellites on the Earth's atmosphere, the risk of satellites causing damage on Earth, increased light pollution, impacts to the orbital environmental (i.e., orbital collisions), and the impact on radiofrequency.[293]

In its order, the Commission stated that "it is not clear that all of the issues raised by these parties are within the scope of NEPA or related to [the Commission's] action in approving SpaceX's Third Modification application" and these issues present "novel questions about the scope of NEPA."[294] The Commission nevertheless assumed the statute applied "out of an abundance of caution."[295]

Even assuming NEPA applied, the Commission still rejected Viasat and the Balance Group's environmental claims.[296] The Commission held that the record was insufficient to determine whether satellite reentry would have a significant

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286. *Id*. at 70.

287. *Id*. at 33.

288. *Id*.; During a 2022 GAO audit, the FAA reiterated that the agency only examines rocket launch emissions up to 3,000 feet during license reviews to determine whether there would be any Clean Air Act violations. U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-23-105005, SATELLITE LICENSING: FCC SHOULD REEXAMINE ITS ENVIRONMENTAL REVIEW PROCESS FOR LARGE CONSTELLATIONS OF SATELLITES 13 (2022), https://perma.cc/HV9G-Z2PC.

289. FAA EA, *supra* note 281, at 33.

290. *See* Final Gen1 Order, *supra* note 10, at 8034-35.

291. *Id*. at 7996-99.

292. *See id*. at 8036. DISH Network also objected to the modification, arguing the lowering of the satellites would interfere with their satellite television service. This claim is beyond the scope of this Article.

293. *Id*. at 8036.

294. *Id*. at 8037.

295. *Id*.

296. *Id*. at 8045 ("[W]ith respect to NEPA, we conclude that the record before us does not support a need for further environmental review.").

impact on the atmosphere or ozone layer.[297] The FCC also relied on the FAA's FONSI and found that the FAA had "assumed responsibility" for reviewing the environmental effects of launches and "no additional consideration of potential impacts associated with those launches is required."[298]

B. THE D.C. CIRCUIT DISMISSES ENVIRONMENTAL PLAINTIFFS' CLAIMS

Following the Commission's denial, Viasat and the Balance Group appealed the decision to the D.C. Circuit.[299] In the environmental plaintiffs' view, the Commission "inexplicably concluded that an environmental assessment was unnecessary . . . because the Commission was *uncertain* as to the environmental impacts of its authorization.[300] The Commission's Order, plaintiffs argued, "risks multiple tragedies of the commons, including tragedies to ground-based astronomy, Earth orbit, and Earth's upper atmosphere."[301]

Environmental plaintiffs heavily relied on the D.C. Circuit's opinion in *American Bird Conservancy v. FCC*.[302] In *American Bird Conservancy*, the plaintiffs challenged an FCC order that declined to review the environmental effects of communication towers on migratory birds.[303] The FCC declined to conduct a review in that case because (1) there was a lack of specific evidence regarding the impact of these communication towers on the human environment, and (2) there was debate among scientists regarding their impact on migratory birds.[304] The D.C. Circuit rejected the Commission's reasoning and vacated the decision, holding that the FCC misunderstood NEPA's obligations.[305] The court noted that the FCC's "demand for definitive evidence of significant effects, and specifically for a scientific showing that the population of any specific bird species had decreased, plainly contravened the 'may' standard in the Commission's own regulations."[306] The *American Bird* court noted that adopting the FCC's approach would "jeopardize NEPA's purpose to ensure that agencies consider environmental impacts before they act rather than wait until it is too late."[307] Environmental plaintiffs argued that the FCC engaged in the same mistaken analysis when reviewing Starlink's environmental effects. That is, the Commission used uncertainty "about the extent of the impact and because SpaceX purportedly [is] trying to mitigate certain harms" as a reason *not* to conduct an EA.[308]

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297. *Id*. at 8040.
298. *See id*.
299. Final Brief of Appellants Viasat, Inc. and the Balance Group, Viasat, Inc. v. FCC, 47 F.4th 769 (D.C. Cir. 2022) (Nos. 21-1125, 21-1123, & 21-1128).
300. *Id*. at 1-2.
301. *Id*. at 2 (quoting Boley & Byers, *supra* note 6, at 1).
302. *Id*. at 3 (citing American Bird Conservancy v. FCC, 516 F.3d 1027 (D.C. Cir. 2008)).
303. *Id*. (citing *American Bird*, 516 F.3d at 1033-34).
304. *Id*.
305. *Id*. at 23-24 (citing *American Bird*, 516 F.3d at 1033).
306. *Id*. at 24 (citing *American Bird*, 516 F.3d at 1033).
307. *Id*.
308. *Id*. at 3.

The FCC, SpaceX, and TechFreedom (an amicus party) presented three key defenses before the D.C. Circuit: standing, the uncertainty surrounding the alleged impacts from satellite operations, and NEPA's applicability to space (or lack thereof). TechFreedom solely briefed the issue of NEPA's extraterrestrial application, which is addressed in more detail in Part IV(D).

The FCC asserted two primary defenses against Viasat and the Balance Groups' environmental claims. First, the Commission argued that environmental plaintiffs lacked standing since neither party allegedly met the requirements for Article III standing (injury, causation, and redressability) and their claims were not within NEPA's zone of interests.[309] Although the FCC recognized that courts relax issues of imminence and redressability for procedural injuries, the Commission argued that Viasat did not demonstrate an actual injury resulting from the Commission's approval of the SpaceX license.[310] Viasat, according to the FCC, simply demonstrated a "skewed playing field," which the D.C. Circuit court has rejected in the past as insufficient grounds to support standing.[311] Likewise, the Commission argued that the Balance Group lacked Article III standing as an association or organization.[312] This particular argument is beyond the scope of this Article.[313]

The FCC argued in the alternative that even if standing was met, the record did not otherwise demonstrate a need for an EA.[314] The Commission determined that environmental plaintiffs merely pointed to generalized evidence regarding alumina released from satellite launches and reentries, and that this generalized evidence fell short of the "significance" threshold.[315] This was especially true, according to the FCC, since the order in dispute simply authorized a change in the orbital altitude of SpaceX's satellites.[316] The FCC added that even if there are *some effects,* these effects must still rise to the level of a *significant* effect on the environment.[317] The Commission provided an analogy to support its point: "In the same way that a $500 car repair may have a significant effect on one person's monthly budget but not another's, significance depends on context."[318]

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309. Final Brief of Appellee/Respondent at 37, Viasat, Inc. v. FCC, 47 F.4th 769 (D.C. Cir. 2022) (Nos. 21-1125, 21-1123, 21-1127, & 21-1128).

310. *Id*. at 67-68.

311. *Id*. at 68.

312. *Id*. at 73.

313. The Commission argued the Balance Group did not demonstrate a "traditional membership association" or functional equivalent, and the organization was merely a "forum for balanced research and advocacy" and its members played no role in selecting the organization leadership, guiding its activities, or financing those activities. *Id*. at 73-74.

314. *Id*. at 77.

315. *Id*. at 80-81.

316. *Id*. at 4.

317. *Id*. at 78-79.

318. *Id*. at 79.

In its briefing, SpaceX argued that the plaintiffs were relying on a "poster presented at a conference" for the impact of satellite reentry on the atmosphere.[319] SpaceX also noted, "the poster's analysis is pegged to multiple large constellations in the aggregate . . . [a]nd even then, the figures used for Starlink refer to a '12,000-42,000' satellite constellation, not the much smaller subset of satellites at issue [in this order]." SpaceX, in effect, argued that the scope of review was much more limited at this stage.[320]

The D.C. Circuit ultimately dismissed Viasat and the Balance Group's environmental claims on standing grounds without reaching the novel question of whether NEPA applies to space.[321] The court concluded that the Balance Group's standing affidavit was too conclusory to establish organizational standing.[322] Additionally, the court held that the Balance Group did not establish associational standing, which requires "indicia of a traditional membership association."[323] The full scope of Viasat's claims are beyond the scope of this Article, but the court concluded that the type of injuries asserted by Viasat (e.g., orbital debris, increased operational costs, etc.) are primarily economic in nature and beyond the purview of NEPA.[324] Dismissing the claims on standing grounds leaves NEPA's applicability to satellite operations and the scope of "human environment" under NEPA unresolved.[325]

C. THE FCC PARTIALLY GRANTS SPACEX'S GEN2 SYSTEM

While SpaceX's permit for its Gen1 Starlink was still pending before the FCC (and subsequently the D.C. Circuit), SpaceX filed another permit application for a second-generation non-geostationary satellite system.[326] If fully approved, this Gen2 system would add an additional 30,000 NGSO satellites to low-earth orbit.[327] Following SpaceX's submission of its Gen2 permit, a number of parties submitted petitions renewing many of the alleged environmental impacts from the Gen1 permit and requesting that the agency conduct a more thorough NEPA review.[328]

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319. Space Exploration Holdings, LLC Final Response Brief as Intervenor for Respondent at 45, Viasat, Inc. v. FCC, 47 F.4th 769 (D.C. Cir. 2022) (Nos. 21-1125, 21-1123, 21-1127, & 21-1128).

320. *Id.*

321. Viasat, Inc. v. FCC, 47 F.4th 769, 774 (D.C. Cir. 2022).

322. *Id.* at 781 (internal citations omitted).

323. *Id.* (citing Sorenson Commc'ns v. FCC, 897 F.3d 214, 225 (D.C. Cir. 2018)).

324. *Id.* at 779-80 (discussing Viasat's argument that it would be more technically complex and expensive to launch their satellites given the FCC's approval of SpaceX's constellation).

325. *Id.* at 774 ("We decline to consider [the claims under NEPA] because the environmental group lacks Article III standing, and the competitor's asserted injury does not fall within the zone of interests protected by NEPA.").

326. Final Gen2 Order, *supra* note 10.

327. Final Gen2 Order, *supra* note 10, para 1.

328. Many other parties filed comments that are beyond the scope of this Article. For example, the Broadband International Legal Action Network ("BBILAN") filed a comment seeking the removal of the FCC's "categorical exclusion from NEPA for satellite licensing." Final Gen2 Order *supra* note 10,

The Natural Resources Defense Council ("NRDC") and IDA petitioned the Commission alleging that approval of the Gen2 permit "would have a significant environmental effect."[329] Specifically, they asserted that the Gen2 system "will dump millions of pounds of pollution into the atmosphere causing significant environmental impacts both in space and on the ground" because the satellites are designed to operate for a few years before burning up and reentering the atmosphere.[330] The NRDC and IDA made three core environmental claims regarding SpaceX's Gen2 permit:

1. [The] increased alumina in the atmosphere will contribute to catastrophic climate change and destructive heat waves, floods, hurricanes and wildfires;
2. [O]zone depletion will increase the risk of cancer and other negative health effects; and
3. [L]ight pollution will have negative impacts on the health and quality of life of NRDC and IDA members as well as on the plants and animals such members value.[331]

NRDC and IDA asserted that these three effects trigger environmental review under NEPA beyond a categorical exclusion.[332] Additionally, they asserted that the FCC should *not* rely on the recent D.C. Circuit case since that decision was solely based on the petitioners' lack of standing and failure to demonstrate that their interests fall within the zone of interests protected by NEPA.[333]

NRDC and IDA noted that even if NEPA does not apply to space, it applies to the Gen2 permit since the 30,000 satellites will have an impact on the ground and "will increase the amount of aluminum oxide (or alumina) as well as soot in the atmosphere."[334] They added that this type of atmospheric pollution contributes to climate change, which, in turn, leads to an increase in the frequency and intensity of various natural disasters, loss of property, and damage to flora and fauna.[335] NRDC and IDA also maintained that the rocket launches required to deploy the satellites will contribute to stratospheric ozone depletion and these same ozone-

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para. 107. The Commission rejected BBILAN's comments since they "effectively seek a broader rulemaking proceeding, which is an individualized decision under our generally applicable rules as they currently exist." Final Gen2 Order *supra* note 10, para. 107.

329. Letter from the Nat. Res. Def. Council, Inc. & Int'l Dark-Sky Ass'n, Inc. to Marlene H. Dortch, Sec., Fed. Commc'n Comm. 7, (Sept. 7, 2022) [hereinafter NRDC/IDA Gen2 Comments] (IBFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105).

330. *Id*. at 2.

331. *Id*. at 3.

332. *Id*.

333. *Id*. at 3.

334. *Id*. at 5.

335. *Id*.

depleting chemicals also act as "powerful heat-trapping gasses accelerating the dangerous weather extremes of climate change."[336]

Viasat also submitted a petition opposing SpaceX's Gen2 Starlink system, echoing many of NRDC and IDA's concerns.[337] Viasat cited to scholarship that specifically examined Starlink's Gen1 System and its impact on the atmosphere: "[D]epending on the atmospheric residence time of material from reentered satellites, each mega-constellation will produce fine particulates that could greatly exceed natural forms of high-altitude atmospheric aluminum deposition, particularly if the full numbers of envisaged satellites are launched."[338] Viasat noted that this study examined the technical aspects of the satellites for SpaceX's Gen1 system, but SpaceX has since "increased the size and mass of its Starlink satellites—and there is every likelihood that SpaceX will do so again in the future."[339] Full approval of Space's Gen2 Starlink system would result in an additional deployment of 89,964 satellites over fifteen years based on SpaceX's five-year design life, according to Viasat.[340] This exponential increase, Viasat argued, is sufficient to demonstrate that the permit "*may* have a significant environmental impact," and this necessitates, at a minimum, an EA.[341]

SpaceX submitted a response to the FCC addressing these comments.[342] SpaceX contended that the alleged environmental concerns raised by NRDC and IDA were moot since NEPA "does not apply to activities in space[,]" and SpaceX highlighted that NRDC and IDA failed to cite any authority that NEPA applies outside the jurisdiction of the United States, including space.[343] Instead, SpaceX asserted NRDC and IDA "seek to goad the Commission into exceeding its authority under NEPA by interpreting the term 'environment' to include 'the space environment' and making unsubstantiated claims about the impact of satellites on ground activities."[344]

Although a number of parties filed comments concerning the potential environmental impacts of launching an additional 30,000 satellites, the FCC ultimately concluded that the increased number of satellites did not trigger additional review

336. *Id*. at 7.

337. Petition to Deny or Hold in Abeyance of Viasat, Inc, to Fed. Commc'n Comm. (Feb. 8, 2022) [hereinafter Viasat Gen2 Comments]. (In the Matter of Space Exploration Holdings, LLC, Application for Approval of Orbital Deployment and Operating Authority for an Additional 29,998 Operating NGSO Satellites) (IBFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105).

338. *Id*. at 60 (citing Boley & Byers, *supra* note 6, at 4).

339. *Id*. at 61.

340. *Id*. at 54.

341. *Id*. at 54-55.

342. Letter from SpaceX to Marlene H. Dortch, Sec., Fed. Commc'n Comm. (Sept. 21, 2022) [hereinafter SpaceX Response to NRDC/IDA Comments] (IBFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105).

343. *Id*. at 1.

344. *Id*. at 1-2.

under NEPA.[345] The FCC determined, without deciding the novel issue of NEPA's applicability to space activities, that it would follow its approach in the Third Modification Order for the Gen1 system wherein the Commission concluded that an EIS was not required for the specific licensing decision (i.e., Gen2 permit) since the action constituted a CATEX.[346] The FCC again declined to review any harms associated with increased rocket launches.[347] The Commission stated that requiring SpaceX to conduct an additional NEPA review "would simply duplicate the FAA's review."[348]

The Commission also rejected NRDC, IDA, and Viasat's concerns regarding satellite reentry and the deposition of alumina into the atmosphere.[349] The Commission considered the studies the petitioners cited, including the GAO Technology Assessment, but "conclude[d] that the ESA assessment regarding atmospheric impact of spacecraft reentries appears to be the most relevant evidence in the record, focusing specifically on atmospheric effects of reentering spacecrafts."[350] Interestingly, the Commission noted that the ESA studies clarified that additional data was needed, but the Commission noted "that most scientific studies could benefit from additional data."[351] The FCC conditioned its partial approval on "SpaceX's commitment to work with the scientific community on this issue to explore methods to collect observational data on formation of alumina from satellite reentry."[352]

On December 1, 2022, the FCC partially granted SpaceX's request to launch a portion of its Gen2 satellite installation.[353] The Commission approved the launch of 7,500 satellites but set aside the request for the additional 22,500 satellites, citing concerns regarding potential interference, space debris, and orbital crashes.[354] On December 29, 2022, IDA appealed the FCC's decision to the U.S. Court of Appeals for the District of Columbia arguing the order was arbitrary and capricious under the APA and violates NEPA.[355] The court recently issued its opinion,

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345. *E.g., Letter from Jameson Dempsey, Principal, Satellite Policy, to Marlene H. Dortch, Sec., Fed. Commc'n Comm. 3-4 (Oct. 20, 2022)* [hereinafter SpaceX October 2022 Letter] (IBFS File Nos. SAT-LOA20200526-00055 and SAT-AMD-20210818-00105) (noting the "lack of observational data" about satellite reentry and uncertainty surrounding alumina's impact on the atmosphere); Final Gen2 Order, *supra* note 10, para. 122.

346. Final Gen2 Order, *supra* note 10, para. 103.

347. Final Gen2 Order, *supra* note 10, para. 103.

348. Final Gen2 Order, *supra* note 10, para. 115.

349. Final Gen2 Order, *supra* note 10, para. 116-19.

350. Final Gen2 Order, *supra* note 10, para. 118.

351. Final Gen2 Order, *supra* note 10, para. 118.

352. Final Gen2 Order, *supra* note 10, para. 118.

353. Final Gen2 Order, *supra* note 10, para. 1.

354. Final Gen2 Order, *supra* note 10, para. 1.

355. The Int'l Dark-Sky Ass'n, Inc.'s Notice of Appeal at 3, Int'l Dark-Sky Ass'n v. FCC, *appeal docketed* No. 22-1337 (D.C. Cir. Dec. 29, 2022).

upholding the Commission's determination.[356] Specifically, the court held SpaceX's license falls within the FCC's CATEX and IDA did not otherwise demonstrate that the license and additional launches of satellites would have a signficant environmental impact.[357] The court found the FCC's reliance on the previously cited ESA studies as reasonable and not in violation of the APA.[358]

D. NAVIGATING DIVERGENT PATHS: OUTER SPACE AS A "HUMAN ENVIRONMENT"

SpaceX's Starlink system and similar mega-constellations have sparked furious debate about the sustainability of space operations. Much of the debate has centered around NEPA's applicability to the "final frontier," and what, if any, role the FCC should play in regulating satellite operations.

Federal courts will most likely provide the most immediate answer as to NEPA's role in satellite operations unless the FCC or Congress acts to broaden NEPA's scope either via regulatory or statutory changes. Opponents of a broader, extraterrestrial scope argue that the text of NEPA is Earth-bound because the statute specifically refers to "man's environment," "the human environment," and the "biosphere."[359] That is, NEPA refers to the "worldwide . . . character of environmental problems" and NEPA's focus is to "prevent or eliminate damage to the environment and biosphere."[360]

Even if NEPA's language is not clear, opponents argue that the legislative history limits an extraterrestrial application. For example, the conference report drafted by NEPA's sponsor "spoke of the need to preserve and enhance our *air, aquatic*, and *terrestrial* environments," and the desire for the statute to protect "actions which do irreparable damage to the *air*, *land* and *water* which support life on Earth."[361] Moreover, at the time of NEPA's passage, "the space age [was] barely a decade old, [and] identified environmental problems were generally limited to those on earth . . . [including] human interactions with air, water, wildlife, and resource management, to name a few."[362] NEPA's omission of space is even more telling since Congress passed the law a few months prior to the Apollo 11 moon landing and "[a]t no time in American history has Congress been more aware of outer space . . . [and thus Congress] could easily have expressed a desire for NEPA to apply there."[363]

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356. Brief of Amicus Curiae TechFreedom in Support of Appellee/Respondent and Affirmance at 4-5, Viasat, Inc. v. FCC, 47 F.4th 769 (D.C. Cir. 2022) (Nos. 21-1125, 21-1123, 21-1127, & 21-1128) [hereinafter TechFreedom Brief]; Ellis, *supra* note 7, at 4.

357. Ellis, *supra* note 7, at 4.

358. *Id*. (citing 115 Cong. Rec. 40,416 (1969) (Statement of Senator Henry M. Jackson)).

359. Gilbert & Vidaurri, *supra* note 7, at 243.

360. Intl' Dark-Sky Ass'n v. FCC, 106 F.4th 1206, 1218 (D.C. Cir. 2024).

361. *Id*.

362. *Id*. at 1218-19.

363. TechFreedom Brief, *supra* note 356, at 10.

Conversely, proponents of an extraterrestrial scope cite the same plain language and legislative history to support their position.[364] NEPA's use of the phrase "human environment," under a strict textualist approach, would simply mean "the human environment is that which surrounds humans . . . [and thus] would include all of Earth as well as outer space, or at least the portions in which humans are present."[365] NEPA's reference to the "natural and physical environment" could be interpreted to cover not just Earth but also its orbital environment since Earth's orbital environment only exists due to Earth's mass and gravity.[366] That is, Earth's orbital environment is "a mere physical manifestation of Earth's mass, as is the Earth's atmosphere."[367] The CEQ definition of "human environment" is also broad and incorporates the "natural and physical environment and can evolve as the relationship of future Americans with the environment changes following technological and scientific advancements."[368] The mere presence of humans in space suggests that space is now part of the "human environment."[369] Moreover, the benefits derived from satellites operating in LEO are ubiquitous and, as noted by one commentator, "failure to mitigate orbital debris risks to Earth's orbital environment could imperil the functioning of Earth's information infrastructure."[370] That is, the presence of humans and human technologies in space turns outer space into a "human environment."

Proponents also assert that legislative intent favors their broad reading.[371] In their view, the Congressional Declaration of Purpose "does not contain language that limits the idea of the environment to the world or Earth. Nor does it contain language that limits the purpose of the statute only to the national environment."[372]

Opponents, of course, argue that the presumption against extraterritoriality applies to NEPA.[373] For example, for a law to apply to the high seas, a well-recognized "global common," a law generally must use the words "high seas."[374] Likewise, to apply in space, a law generally must announce that it applies "in space."[375] And since NEPA says nothing of applying outside of the U.S., it would not extend to space.[376] Even if NEPA's text *could* indicate an extraterritorial

364. *See, e.g.*, Gilbert & Vidaurri, *supra* note 7, at 244-45.
365. *Id.* at 233.
366. Runnels, *supra* note 7, at 191.
367. *Id.*
368. Gilbert & Vidaurri, *supra* note 7, at 245.
369. Runnels, *supra* note 7, at 195 ("LEO may be considered a 'human environment,' as it houses the International Space Station, which has maintained a constant human presence for over twenty years.") (internal citation omitted).
370. *Id.* at 192 (citations omitted).
371. *See, e.g.*, Gilbert & Vidaurri, *supra* note 7, at 234.
372. *Id.* at 245.
373. TechFreedom Brief, *supra* note 356, at 4.
374. *Id.* at 8.
375. *Id.* at 4; Ellis, *supra* note 7, at 3 (noting congress has in the past extended specific statutes and regulations to govern activities in outer spaces, similar to the high seas, and failed to do so for NEPA).
376. TechFreedom Brief, *supra* note 356, at 8-9.

scope, outer space differs significantly from Antarctica since the U.S. has a great measure of legislative control over Antarctica, which is not true of outer space.[377] The presumption against extraterritoriality, thus, "should carry special weight . . . [since], [l]ike the high seas outer space is an area outside of the control of any sovereign state."[378] Moreover, some commentators argue that NEPA is not a domestic statute and that the location of the agency action is the area where the impact would occur (i.e., space).[379] And "[w]ithout any relevant conduct inside of the United States, NEPA would not extend to outer space."[380]

NEPA proponents, on the other hand, argue that the relevant conduct is the domestic decision making process and that outer space is akin to a global common, so the presumption against extraterritoriality would not apply.[381] Most commentators agree that the relevant conduct in any NEPA suit generally occurs within the U.S. since the agency action is the decision making process itself, as NEPA is merely a procedural statute.[382] This is known as the "headquarters theory," since the decision making process is occurring within a U.S. territory at a given agency's headquarters.[383] The triggering action, thus, would be in the United States. Proponents also argue that NEPA applies to outer space as a global common since, like Antarctica, the U.S. retains a measure of legislative control in outer space, for example by retaining national jurisdiction of U.S. spacecraft and remaining liable for its space objects under international law.[384]

Opponents also cite negative policy implications of broadening NEPA's scope. For example, if courts or the FCC were to block the launching of satellites from the U.S., companies would simply launch them beyond American jurisdiction at, for example, the Baikonur Cosmodrome in Kazakhstan, the Vostochny Cosmodrome in Russia, or the Guiana Space Centre in French Guiana.[385] That is, "NEPA should not apply abroad when, regardless whether it is so applied, the challenged action will happen anyway."[386]

Ultimately, federal courts will likely have to determine the scope of NEPA and whether the "human environment" extends to outer space. That said, a number of commentators have published proposals and recommendations for addressing

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377. *Id*. at 21-22. (citing Env't Def. Fund, Inc. v. Massey, 986 F.2d 528, 529 (D.C. Cir. 1993)).

378. Ellis, *supra* note 7, at 3.

379. Ellis, *supra* note 7, at 4; *but see* TechFreedom Brief, *supra* note 356, at 21-22 (recognizing that the conduct in question, i.e. the FCC's decision making, was domestic in nature).

380. Ellis, *supra* note 7, at 4.

381. *See* Gilbert & Viadurri, *supra* note 7, at 254, 261-62.

382. *See id*. at 262.

383. *Id*.

384. *Id*. at 266-67 ("Recent legislative action only underscores this control . . . the Commercial Space Launch Competitiveness Act . . . grant[s] jurisdiction to U.S. courts to regulate conduct by U.S.-launched space objects and codified property rights for U.S. Citizens for resources retracted in outer space.").

385. TechFreedom Brief, *supra* note 356, at 29 (citations omitted).

386. *Id*. at 22. (citing Env't Def. Fund, Inc. v. Massey, 986 F.2d 528, 529 (D.C. Cir. 1993)).

this issue. For example, some (including another federal agency) have advocated for eliminating or amending the FCC's CATEX for satellite constellations,[387] amending NEPA's definition of natural environment to include Earth's orbital environment,[388] drafting a programmatic agreement for all satellite operations,[389] amending EO 12,114 to include outer space as a global common,[390] or simply relying on current international agreements.[391] These recommendations could ensure closer review of mega-constellations, but there is another route that may achieve some level of review without relying on congressional action or broad rulings from federal courts.

V. CHALLENGING FCC LICENSING OF MEGA-CONSTELLATIONS

Although procedural in nature, NEPA has played a significant role in shaping the environment in America today. As mankind extends its reach into space and the orbital environment, the question remains whether NEPA applies to this "final frontier." The exponential growth of satellites will impact not only space itself—for example, in the form of more debris—but also life on Earth, the stratosphere, and the greater human environment.

Given the uncertainty of NEPA's extraterrestrial scope and the current trend of federal courts restraining broad agency interpretations,[392] it seems unlikely that proponents of tighter regulation of satellite operations will prevail if the issue is framed as whether NEPA applies to outer space. Additionally, given the state of Congress, it seems unlikely both the House and Senate will pass any amendments to NEPA to expand its scope, especially given that Congress has recently narrowed certain provisions of the statute.[393]

Ensuring proper oversight of certain aspects of satellite operations, however, can be achieved if the issue is framed properly. Plaintiffs can avoid an unfavorable ruling limiting NEPA's extraterritorial scope to Earth by narrowing their claims to those effects directly impacting Earth's atmosphere, such as ozone depletion and climate change stemming from the effects from increased launches

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387. Runnels, *supra* note 7, at 204; Comments of Broadband International Legal Action Network, IBFS File No. SAT-LOA-20200526-00055 (filed Feb. 8, 2022); GAO SATELLITE RECOMMENDATION, *supra* note 94 at 28.

388. Runnels, *supra* note 7, at 205; Gilbert & Viadurri, *supra* note 7, at 271.

389. Comments of the Natural Resources Defense Counsel and International Dark Sky Association, IBFS File Nos. SAT-LOA-20200526-00055 and SATAMD-20210818-00105 n.61 (filed Sept. 7, 2022); *see also* Ryan, *supra* note 7, at 948 ("[T]he FCC could conduct an EA similar to NASA's routine payloads EA that would review the most commonly used components in commercial-satellite projects.").

390. *See* Gilbert & Viadurri, *supra* note 7, at 271.

391. Ellis, *supra* note 7, at 8-9.

392. *See, e.g.*, Blake Emerson, *The Binary Executive*, 132 YALE L.J. F. 756 (2022) (highlighting the Supreme Court's greater willingness in probing executive and agency actions).

393. In fact, the Fiscal Responsibility Act of 2023 (known as the 2023 Debt Ceiling Bill) narrowed NEPA's scope in a number of ways. Edward Boling, Thomas Jensen, & Kerensa Gimre, *Substantive NEPA Amendments in the Debt Ceiling Bill* (June 8, 2023), https://perma.cc/X2PS-3ZFG (last visited July 21, 2023).

and satellite reentries.[394] This approach ensures that federal decision makers are considering at least some of the adverse impacts of these operations.

There is growing evidence that mega-satellite constellations, led by SpaceX's Starlink, will impact Earth's stratosphere. This layer of atmosphere can be characterized as part of the "human environment," as it is crucial to life on Earth, and, therefore, would fall under NEPA's purview. The application of NEPA to the stratosphere does not trigger the presumption against extraterritoriality since NEPA contains multiple clear statements of its extraterritorial scope. Moreover, the application of NEPA to FCC satellite licensing decisions is a permissible domestic application of the law. Additionally, a plaintiff can likely satisfy constitutional standing requirements by narrowly tailoring any suit to impacts to the stratosphere. Finally, NEPA's extension to the stratosphere (1) aligns with the precautionary principle and ensures that the United States' expansion into the final frontier does not trigger any unintended consequences, (2) supports DoD policy, and (3) adheres to the United States' international obligations under the Outer Space Treaty.

A. NEPA EXTENDS TO STRATOSPHERIC IMPACTS FROM SATELLITE OPERATIONS

NEPA applies to any "major Federal actions significantly affecting the quality of the *human environment*."[395] This "human environment" should include the stratosphere, as this atmospheric layer is crucial to life on Earth. NEPA's application to the stratosphere is a logical extension from its current application to the troposphere. Moreover, NEPA is not barred by the presumption against extraterritoriality since the statute's application to FCC licensing actions is a permissible domestic application of the law.

1. The Stratosphere is Part of the Human Environment

Whether the definition of "human environment" extends to space will ultimately fall on the federal courts to resolve, absent an action from Congress.[396] The "human environment," however, should include Earth's atmosphere. As depicted in Figure 1, Earth's atmosphere consists of five layers, including the thermosphere, which is where SpaceX operates Starlink and where the majority of these mega-constellations orbit.[397] Opponents of a broader extraterrestrial scope of NEPA, such as SpaceX, TechFreedom, and the Heritage Foundation, in effect, argue that the thermosphere, which includes LEO, constitutes outer space and thus is beyond NEPA's reach.

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394. Light pollution and increased casualty risk from reentering satellites likely fit within this narrower scope without triggering the question of whether NEPA applies extraterrestrially.

395. 42 U.S.C. § 4332(1)(C) (emphasis added).

396. See *supra* Part IV(D).

397. *See supra* Part I(A) for discussion of atmospheric layers.

The scientific community and federal courts are in consensus that the troposphere, the lowest of Earth's atmospheric layers, is part of the "human environment." Nearly all greenhouse gasses circulate in this layer,[398] and, although no Supreme Court decision has affirmatively demarcated the upper bounds of the atmosphere, climate-change related impacts to the troposphere can, and in many instances must, be considered in NEPA analyses.[399] In fact, President Trump's rescission of Obama-era CEQ regulations requiring agencies to calculate carbon pollution in NEPA analyses led to a wave of defeats in federal courts.[400] For example, the D.C. District Court held in *WildEarth Guardians v. Zinke* that the Bureau of Land Management ("BLM") violated NEPA when it authorized oil and gas leases on federal lands without sufficiently considering the impacts on climate change.[401] Notably, the BLM did not argue that they were not required to evaluate climate impacts; the agency merely argued that quantifying emissions at the leasing stage would be too speculative.[402] The court, however, held "NEPA required that BLM reasonably quantify the GHG emissions resulting from oil and gas development on the leased parcels in the aggregate."[403]

Moreover, the CEQ has published guidance on incorporating climate change into NEPA analyses since 2010.[404] Recent interim guidance, published January 9, 2023, reiterates that "[c]limate change is a fundamental environmental issue, and its effects on the human environment fall squarely within NEPA's purview."[405] The guidance even states that "[f]ederal agencies have been analyzing climate change impacts and GHG emissions in NEPA documents for many years."[406] Thus, there appears little debate that the "human environment" extends to the troposphere (i.e., the atmospheric layer where GHGs circulate).

Above the troposphere lies the stratosphere, which extends roughly from 12-50 kilometers.[407] No reported cases have concluded that the stratosphere is part of the "human environment," but a plain reading of this term dictates that

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398. V. Ramaswamy, et. al., *Radiative Forcing of Climate Change*, TAR CLIMATE CHANGE 2001: THE SCIENTIFIC BASIS 356 (2001) ("The well-mixed greenhouse gasses have lifetimes long enough to be relatively homogeneously mixed in the troposphere.")

399. Gilbert & Vidaurri, *supra* note 7, at 264 ("[C]urrent jurisprudence holds that major federal actions that cause domestic GHG emissions with domestic and global climate impacts via the atmosphere must be considered under NEPA.").

400. Christy Goldfuss, Sally Hardin, & Marc Rehmann, *12 Climate Wins from the National Environmental Policy Act*, THE CENTER FOR AMERICAN PROGRESS (May 29, 2019), https://perma.cc/32TT-5LWV ("NEPA has upheld the federal requirement to consider climate—specifically greenhouse gas emissions—at various levels in courts across the country at least 12 times.").

401. WildEarth Guardians v. Zinke, 368 F. Supp. 3d 41, 51 (D.D.C. 2019).

402. *Id*. at 69.

403. *Id*. at 70.

404. Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions, 75 Fed. Reg. 8046-01 (proposed Feb. 18, 2010).

405. 2023 Proposed Climate Change NEPA Guidance, *supra* note 175, at 1197.

406. *Id*. at 1198.

407. GAO ASSESSMENT, *supra* note 5, at 11.

the stratosphere falls within "human environment." NEPA itself does not define "human environment," but the implementing CEQ regulations state that "human environment" is "comprehensively the natural and physical environment and the relationship of present and future generations of Americans with that environment."[408] Even if NEPA is an "Earth-bound statute," as opponents to NEPA's extraterrestrial application have argued, it is difficult to argue that the stratosphere, which is crucial to the survival of the human race on Earth, falls outside of this definition. The EPA's web page even notes that, "[t]he stratospheric ozone layer is Earth's 'sunscreen' – protecting living things from too much ultraviolet radiation from the sun."[409]

The arguments raised by opponents of NEPA's application to outer space, in effect, support NEPA's application to the stratosphere. For example, Michael Ellis of the Heritage Foundation argues the NEPA conference report "spoke of the need to preserve and enhance our *air, aquatic*, and *terrestrial* environments," and the desire for the statute to protect "actions which do irreparable damage to the *air*, *land* and *water* on which support life on Earth."[410] This language may suggest NEPA's Earth-bound scope, but it also implies that the statute would undoubtedly extend to the upper reaches of the stratosphere since impacts to it would "do irreparable damage . . . [to] life on Earth."

Textualist arguments also fall flat since the stratosphere should be considered part of "man's environment," "the human environment," and the "biosphere," all of which are terms that opponents have cited as to why NEPA should not extend to space. That is, even a strict textualist approach weighs in favor of including the stratosphere as part of the "human environment." Merriam-Webster Dictionary defines "biosphere" as "the part of the world in which life can exist."[411] Interestingly, although studies are limited, astrobiologists have determined that extremophile microbes (aka, living organisms) live in the stratosphere.[412] Applying NEPA to the stratosphere, as opposed to the orbital environment, undercuts this key objection by opponents. For example, TechFreedom argued in their amicus brief in *IDA v. FCC*:

> True enough, Earth and its orbital space share a connection. The same could be said of Earth and the surface of the Sun. Space is not part of the biosphere—i.e., the places on Earth that can sustain life. NEPA must be given a constrained territorial scope—not one expanded by inventive inferences.[413]

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408. 40 C.F.R. § 1508.1(m) (2023).

409. EPA, *supra* note 25.

410. Ellis, *supra* note 7, at 4 (citing 115 Cong. Rec. 40,416 (1969) (Statement of Senator Henry M. Jackson)).

411. *Biosphere*, MERRIAM-WEBSTER (2023).

412. Starre Vartan, *How Stratospheric Life is Teaching Us About the Possibility of Extreme Life on Other Worlds,* ASTROBIOLOGY AT NASA (May 30, 2018), https://perma.cc/8T5Y-X8RX.

413. TechFreedom Brief, *supra* note 356, at 10, Int'l Dark-Sky Ass'n v. FCC, No. 22-1337 (June 20, 2023) (internal citation omitted).

Assuming *arguendo* the connection between the "human environment" and orbital space is too tenuous, the stratosphere is a "place[] on Earth that can sustain life." This is not an inventive inference.

Moreover, the generally understood boundary between Earth's atmosphere and "outer space," known as the Kármán Line, lies 100 km above Earth's mean sea level, which includes the entirety of the stratosphere (12 -50 km).[414] Thus, it appears the scientific community would also support the contention that the stratosphere falls within the "biosphere" and "man's environment."

Taken together, all evidence points to treating the stratosphere as part of the "human environment." This application is the logical extension of finding the troposphere is part of the "biosphere," and thus subject to NEPA. By narrowly tailoring a complaint against the FCC to stratospheric impacts from satellites, plaintiffs should be able to establish that the agency action affects the "human environment," thus defeating a core argument by opponents to NEPA's applicability to satellite constellations. However, the presumption against extraterritoriality is always lurking in NEPA suits involving worldwide harm.

2. NEPA's Application to the Stratosphere Does Not Violate the Presumption Against Extraterritoriality

The application of NEPA to Earth's stratosphere likely will not trigger the presumption against extraterritoriality because NEPA's text, legislative history, and case law confirm congressional intent regarding its extraterritorial scope. More pointedly, NEPA's "focus" is informed decision making, which is a purely domestic exercise. Although the effects of satellite operations are diffuse and global in nature, all of the concrete actions relating to the licensing and launching of satellites occur on U.S. soil. Therefore, NEPA's application to satellite operations, specifically impacts to the atmosphere, is not barred by the presumption against extraterritoriality. Moreover, NEPA's application to the stratosphere aligns with district and appellate court decisions regarding NEPA's applicability to the global commons.

NEPA's application to the stratosphere satisfies both parts of the two-step test articulated in *RJR Nabisco*.[415] First, the statutory text of NEPA contains multiple clear indications that it applies extraterritorially. Briefly reexamining NEPA's text and purpose is useful. The Congressional Declaration in NEPA states that Congress recognizes "the profound impact of man's activity on the interrelations of all components of the natural environment."[416] Section 102 further declares that "Congress authorizes and directs, *to the fullest extent possible* . . . all agencies of the Federal Government shall . . . recognize the *worldwide and long-range*

414. Eric Betz, *The Karman Line: Where Does Space Begin*, ASTRONOMY (Mar. 5, 2021), https://perma.cc/L3YD-8HKN.

415. *See* discussion *supra* Part II(C)(4) for explanation of the two-step test.

416. 42 U.S.C. § 4331(a) (2024).

character of environmental problems."[417] Both statutory declarations support an extraterritorial application.

Moreover, although the legislative history may not explicitly support extraterrestrial application, it highlights the need to protect our atmosphere and life on Earth, which would require extraterritorial application. The Conference Committee Report states "we will not intentionally initiate actions *which will do irreparable damage to the air* . . . which supports life on Earth."[418] The House Report notes that "implicit in [NEPA] is the understanding that the international implications of our current activities will also be considered, inseparable as they are from the purely national consequences of our actions."[419] And the Congressional White Paper jointly drafted by the Senate and House recognized the interconnectedness of the world environment and assumed that NEPA would apply extraterritorially.[420] Although the legislative history on NEPA is somewhat sparse, the lack of debate also highlights the strong consensus in the statute's provisions, including those that reference extraterritorial application.[421]

Assuming *arguendo* that NEPA's text and legislative history do not contain a "clear indication of extraterritorial effect"[422] (i.e., step-one of the *RJR Nabisco* test), the "focus" of the statute undoubtedly supports its extraterritorial application to the stratosphere, meeting step two of the *RJR Nabisco* test. The agency action here (i.e., the licensing process) occurs within the U.S. and the launches themselves occur on U.S. soil. CEQ guidance requires agencies to consider reasonably foreseeable effects of a proposed action, regardless of where those impacts actually occur, another signal that the focus of NEPA is the domestic decision making process—not necessarily the site of impact.[423] Although CEQ guidance confirms that it does not (and cannot) apply to "U.S. actions that t*ake place in another country* or otherwise outside the jurisdiction

417. *Id*. at § 4332 (emphasis added).

418. 115 Cong. Rec. 40,416 (1969) (Statement of Senator Henry M. Jackson) (emphasis added); *see also* Enewetak v. Laird, 353 F. Supp. 811, 817 (D. Haw. 1973) ("The remarks of Senator Jackson, NEPA's principal sponsor, in submitting the Conference Committee's Report to the Senate are representative [of NEPA's broad scope].").

419. H. REP. NO. 91-378, at 9 (1969).

420. Goldfarb, *supra* note 101, at 556.

421. Both houses passed NEPA overwhelmingly with little to no debate. The Senate passed its version with no amendments offered and no debate. CRS NEPA BACKGROUND, *supra* note 95, at 4. And the House passed its version in a landslide vote of 372 to 15. *Id.*

422. RJR Nabisco, Inc. v. Eur. Cmty., 579 U.S. 325, 337 (2016).

423. *See also* Council on Environmental Quality, Memorandum to Heads of Agencies on the Application of the National Environmental Policy Act to Proposed Federal Actions in the United States with Transboundary Effects (July 1, 1997), *available at* https://perma.cc/4SRE-RF27 ("NEPA requires agencies to include analysis of reasonably foreseeable transboundary effects of proposed actions in their analysis of proposed actions in the United States."); *see also* MANDELKER ET AL., *supra* note 77, at § 5.21 (noting cases wherein courts have found that NEPA is required for transboundary effects).

of the United States," the guidance states that "agencies must include analysis of reasonably foreseeable transboundary effects of proposed actions."[424]

Some commentators have argued that the relevant conduct in an extraterritoriality analysis is the location of the impact, which, in this case, would be the stratosphere and greater atmosphere.[425] That is, the emissions impacting the stratosphere are, in part, occurring abroad since satellite reentry and disintegration are occurring in the upper reaches of the atmosphere worldwide. An opponent, thus, may argue that *Massey,* and its progeny regarding NEPA's extension to the global commons, was overruled with the Supreme Court's line of cases finding that the presumption still applies in sovereignless areas.[426] The stratosphere as a sovereignless area would not fall within NEPA's purview, the argument goes.

This argument, however, stretches the basic structure of NEPA. The Supreme Court has held that in determining the focus of a statute courts should examine "the object of [the statute's] solicitude, which can include the conduct it seeks to regulate, as well as the parties and interest it seeks to protect or vindicate."[427] Here, the object of NEPA's solicitude is informed decision making. The Supreme Court has noted that NEPA merely requires agencies to take a "hard look" at the environmental impacts of their actions.[428] The purpose of this statute is to require agencies to "identify and develop methods and procedures . . . which will ensure that presently unquantified environmental amenities and values may be given appropriate consideration in decision-making along with economic and technical considerations."[429]

Moreover, NEPA seeks to regulate federal agencies, not necessarily third-party actions. As long as the federal agency takes a "hard look" at its action and complies with NEPA's procedural requirements, the third party (e.g., a satellite operator that receives a license from the FCC) may carry out their actions despite any adverse environmental impacts. Returning to the two-step test in *RJR Nabisco*, the Supreme Court explicitly noted that "if the conduct relevant to the statute's focus occurred in the United States, then the case involves a permissible domestic application *even if other conduct occurred abroad*."[430] That is exactly the case here. The federal action takes place in the United States with transboundary effects worldwide. The argument that the relevant conduct in a NEPA suit is the

424. *Id.*

425. See *supra* Part IV(D) for discussion.

426. *See supra* Part II(C)(4)-(5).

427. WesternGeco LLC v. ION Geophysical Corp., 585 U.S. 407, 414 (2018) (internal citations omitted) (citing Morrison v. Nat'l Australia Bank Ltd., 561 U.S. 247, 267 (2010)).

428. Kleppe v. Sierra Club, 427 U.S. 390, 410 n.21 (1976) ("The only role for a court is to ensure that the agency has taken a 'hard look' at environmental consequences.").

429. 42 U.S.C. § 4332(2)(B).

430. RJR Nabisco, Inc. v. Eur. Cmty., 579 U.S. 325, 337 (2016).

location of the environmental harm misinterprets the very core of NEPA's solicitude.

Additionally, twisting the nexus of the agency action to the site of the impact (i.e., worldwide stratospheric harm) would essentially overturn dozens, if not hundreds, of cases holding that agencies are required to consider the impacts of climate change in their NEPA analyses. This argument would also essentially nullify any NEPA suit regarding transboundary harm generally (i.e., cases with a nexus in the U.S. that have environmental effects in other countries).[431]

The application of NEPA to the stratosphere also aligns with current district court and appellate court precedent regarding NEPA's extraterritorial application—although the Supreme Court has yet to specifically address NEPA's extraterritorial status following *Smith*[432] and *Haitian Centers*.[433] For example, the *Massey* decision extending NEPA to Antarctica is nearly analogous to NEPA's application to the stratosphere. Both cases involve the failure to conduct a proper NEPA review for actions occurring in a global common (Antarctica and the stratosphere). As the *Massey* court noted, the federal government's failure to comply with NEPA in this case would never require enforcement in a foreign forum or involve a choice of law dilemma.[434] Finally, the U.S. maintains some measure of legislative control in each area. Although opponents may argue that the U.S. has more legislative control over Antarctica than the stratosphere,[435] the test is not whether the U.S. has more legislative control in area X or Y but rather whether the U.S. maintains "some measure" of control.[436] And if anything, the U.S. may have more legislative control over satellite operations' impacts on the stratosphere than the incineration of toxic pollutants *on a different continent*.[437] Here, the FCC is not only conducting its NEPA analysis in the U.S., but the rocket launches deploying the satellites are likewise occurring on U.S. soil. The only non-U.S. nexus is the impacts of these launches and reentries, which will be felt worldwide, including within the U.S. Additionally, the U.S. retains legislative control over its satellites entering the stratosphere, as evidenced by international

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431. MANDELKER ET AL., *supra* note 77, at § 5.21 (noting cases wherein courts have found that NEPA is required for transboundary effects); Backcountry Against Dumps v. Chu, 215 F. Supp. 3d. 966, 981 (S.D. Cal 2015) ("[R]efusing to apply NEPA to actions with extraterritorial effects would create a situation where agencies are required to assiduously consider effects of a proposed action right up until the border fence, but effects a few yards away in [another country] are immaterial.").

432. Smith v. United States, 507 U.S. 197 (1993).

433. Sale v. Haitian Ctrs. Council, Inc., 509 U.S. 155 (1993).

434. Env't Def. Fund, Inc. v. Massey, 986 F.2d 528, 533 (D.C. Cir. 1993).

435. TechFreedom argued in its amicus brief in *Viasat v. FCC* that the U.S. has more legislative control in Antarctica than outer space, which is an interesting position given the *Massey* court itself analogized Antarctica to outer space. TechFreedom Brief, *supra* note 356, at 23. (citing Env't Def. Fund, Inc. v. Massey, 986 F.2d 528, 534 (D.C. Cir. 1993)). Regardless, it is foreseeable that opponents would rely on this same argument in a suit based on stratospheric harms.

436. *Id* at 529-30 (citing Foley Bros v. Filardo, 336 U.S. 281, 282 (1949)).

437. *Id*. at 529-30.

law,[438] which is akin to the U.S. control over certain research stations in Antarctica, a fact the *Massey* court cited in its opinion.[439]

Moreover, at least one district court has held that NEPA may apply "where United States agency action abroad has direct environmental impacts within this country, or where there has been an absence of environmental assessment by the federal agency or foreign country involved."[440] Assuming *arguendo* that the agency action is the disintegration of satellites above foreign airspace (as some commentators have argued), the action would nevertheless have direct environmental impacts within this country by harming the ozone layer. And, as discussed above, there has been no environmental assessment of stratospheric harms because the only review was conducted by the FAA and limited to emissions below 3,000 feet.[441] Both of these facts weigh in favor of NEPA's extraterritorial application to the stratosphere.

NEPA's application to commercial satellite launches also does not implicate the same foreign policy matters at issue in other NEPA extraterritorial cases. For example, in *Greenpeace*, the court declined to extend NEPA to shipments of munitions across the Pacific because the specific agreement to remove munitions from Germany was negotiated and approved by the President.[442] Starlink's operation does not implicate foreign policy matters such as executive agreements with foreign nations.

NEPA's application to the stratosphere does not even rise to the level of foreign policy considerations at issue in *NRDC v. Navy*. There, the district court found the Navy's use of sonar via their littoral warfare advanced development program did not trigger the foreign policy exception.[443] Here, although SpaceX is a DoD contractor,[444] it is difficult to foresee the actions of a DoD contractor rising to this level when a federal court would not grant the Navy the exception for testing its own advanced warfare systems.[445]

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438. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, art. VII. Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N. T.S. 2015 [hereinafter Outer Space Treaty] ("Each State Party to the Treaty that launches or procures the launching of an object into outer space . . . is internationally liable for damage to another State Party . . . in air or in outer space.").

439. Env't Def. Fund, Inc. v. Massey, 986 F.2d 528, 534 (D.C. Cir. 1993).

440. Consejo de Desarrollo Económico de Mexicali, AC v. United States, 438 F. Supp. 2d 1207, 1235 (D. Nev. 2006) (citing *Greenpeace*, 748 F. Supp. at 761), *vacated on other grounds by* Consejo de Desarrollo Económico de Mexicali, A.C. v. United States, 482 F.3d 1157 (9th Cir. 2007).

441. FAA EA, *supra* note 282, at 70.

442. Greenpeace USA v. Stone, 748 F. Supp. 749, 763 (D. Haw. 1990).

443. Nat. Res. Def. Council v. U.S. Dep't Navy, No. CV-01-07781 CAS(RZX), 2002 WL 32095131, at *10 (C.D. Cal. Sept. 17, 2002) ("[T]he foreign policy implications of applying NEPA in this case are minimal.").

444. *E.g.*, Watts, *supra* note 12 (SpaceX launch of GPS satellite on behalf of U.S. military).

445. *See* Part V(C)(2) for a broader discussion of options available to the DoD in the event the application of NEPA to a specific satellite raises national security concerns.

In sum, the stratosphere is part of the "human environment," as life on Earth depends on its existence. NEPA's text, purpose, and legislative history support extraterritorial application; however, even if a court finds that this extraterritorial reach is not sufficiently clear, the "focus" of the statute is domestic decision making, which allows NEPA's application to Earth's stratosphere. The limited case law on NEPA's extraterritorial reach is also consistent with the statute's application to the stratosphere.

B. STANDING FOR STRATOSPHERIC HARMS CAN BE ESTABLISHED

One potential hurdle to establishing that NEPA extends to the stratosphere is standing. The court in *Viasat v. FCC* declined to reach the broader question of whether NEPA applies to space and instead dismissed the environmental plaintiffs' claims on standing grounds.[446] Viasat and the Balance Group, in effect, were the wrong parties to bring the suit. The same court, however, found that the environmental plaintiffs in *IDA v. FCC* established standing, yet the court ruled against the plaintiffs on the merits, holding that the FCC did not abuse its discretion when it found the effects of satellite launches and reentries did not warrant NEPA review beyond the agency's CATEX.[447] Nevertheless, satisfying standing will likely continue to serve as a hurdle for any future parties seeking to challenge the licensing of mega-constellations.

Although the scientific community's full understanding of the impacts from alumina and increased launches is still in its infancy, there is sufficient evidence to demonstrate that these mega-constellations may damage the stratosphere, which, in turn, may cause concrete, particularized harms. The fact that the harms may be diffuse does not defeat standing. Moreover, plaintiffs challenging the FCC pursuant to NEPA are not required to meet the more stringent standards for redressability and imminence that would apply in a claim based on substantive, rather than procedural, harms.

1. Increased Reentries and Satellite Launches May Lead to Concrete, Particularized, and Imminent Harms

To challenge Starlink or another satellite mega-constellation on NEPA grounds, plaintiffs must first demonstrate there is an injury-in-fact. There is no debate regarding the impact of ozone depletion on human health. The ozone layer in the upper stratosphere protects humans from dangerous ultraviolet rays, which can cause a myriad of health issues including skin cancer and cataracts.[448] These

446. Viasat, Inc. v. FCC, 47 F.4th 769, 779 (D.C. Cir. 2022).

447. *See Health and Environmental Effects of Ozone Layer Depletion,* EPA (Sep. 27, 2022), https://perma.cc/4VB9-A3UZ (EPA summary of the connection between ozone layer depletion and the effects of UVB radiation); Final Gen2 Order, *supra* note 10, para. 113.

448. Montreal Protocol on Substances that Deplete the Ozone Layer, Sept. 16, 1987, S. Treaty Doc. No. 100-10, 1522 U.N.T.S. 3.

dangers, in fact, were the impetus of the 1987 Montreal Protocol, the multilateral treaty banning the use of ozone-depleting substances.[449] There is also growing evidence of alumina's role in ozone depletion,[450] although, as illustrated by the pleadings before the FCC and D.C. Circuit, there is a debate as to the amount of alumina that will be deposited into the stratosphere.[451]

Plaintiffs, however, do not have to demonstrate with certainty that the FCC's licensing decision will lead to an injury. Rather, plaintiffs must show that the risk is substantial and the challenged action increases the risk.[452] Moreover, as noted by the *Owens Corning* court, a plaintiff's fear that they may be harmed, as opposed to "will" be harmed, is sufficient to satisfy the injury-in-fact requirement.[453] The *Owens Corning* court also noted that Congress specifically passed laws and ratified the Montreal Protocol, banning the types of ozone-depleting substances at issue in that case.[454] Alumina, likewise, falls within this same category as a type of ozone-depleting substance, which, "weigh[s] against any suggestion that the threatened harm is entirely chimerical."[455]

Moreover, plaintiffs likely exist that have suffered (and will continue to suffer) injuries associated with ozone depletion, whether health-related (like skin cancer or cataracts) or harms to their recreational and aesthetic interests (for example, by harming terrestrial and marine ecosystems).[456] In *Juliana*, the court found that the threat of coastal flooding caused by climate change was sufficient to establish a concrete harm.[457] Here, a future plaintiff need only demonstrate that their injuries are real and not abstract.

Additionally, harms associated with atmospheric and stratospheric damage (like ozone depletion) differ from the injuries asserted by Viasat in the first suit challenging SpaceX's Gen1 Starlink. Viasat argued, in part, that SpaceX's satellites may cause debris to collide with its own satellites.[458] The court rejected this argument on the grounds that the injury was too speculative (i.e., not concrete), finding that Viasat relied on too many unlikely contingencies that required a SpaceX satellite to suffer a collision which, in turn, would create a debris field, and then a debris particle large enough and traceable to a SpaceX satellite would

449. *See* GAO ASSESSMENT, *supra* note 5, at 13.

450. See Part IV(A)-(C).

451. Int'l Dark-Sky Ass'n v. FCC, 106 F.4th 1206, 1219 (D.C. Cir. 2024).

452. *Viasat*, 47 F.4th at 779 (citing Food & Water Watch, Inc. v. Vilsack, 808 F.3d 905, 914 (D.C. Cir. 2015)).

453. Nw. Env't. Def. Ctr. v. Owens Corning Corp., 434 F. Supp. 2d 957, 963 (D. Or. 2006).

454. *Id*. at 963-64.

455. *Id*. at 964.

456. EPA, *Ozone Layer Protection: Health and Environmental Effects of Ozone Layer Depletion* (2023) https://perma.cc/6G3V-5CKJ; *Friends of the Earth,* 528 U.S. at 183 ("[E]nvironmental plaintiffs adequately allege injury in fact when they aver that they use the affected area and are persons for whom the aesthetic and recreational values of the area will be lessened by the challenged activity.").

457. Juliana v. United States, 947 F.3d 1159, 1168 (9th Cir. 2020).

458. *Viasat*, 47 F.4th at 779.

have to remain undetected and strike a Viasat satellite.[459] In short, "Viasat's theory of space-debris collision [did] not cross the line from speculative to certainly impending."[460]

Viasat's alleged injuries would require a number of low-probability, intervening factors. That is not the case here. The FCC's decision to license tens of thousands of satellites would directly impact the atmosphere and increase risks associated with ozone depletion due, in part, to the deposition of alumina into the upper atmosphere. There is a predictable, increased risk of atmospheric harm (for example, deposition of alumina into the stratosphere) if the FCC grants licenses to these mega-constellations (i.e., a concrete harm).

The government and any intervenors will likely assert that any harms from increased launches and reentering satellites are too diffuse in nature to establish a concrete harm. Defendants in both *Owens Corning* and *Juliana* asserted these arguments.[461] But, in both cases, the courts rejected these arguments, noting that "the notion that 'injury to all is injury to none' does not correctly reflect the current doctrine."[462] The same principle applies here.

Turning to the second requirement of establishing an injury-in-fact, plaintiffs must show that the alleged harm may impact them "in a personal and individual way."[463] This requirement also should not be a significant hurdle when challenging an agency's authorization of satellite constellations. Although plaintiffs must show that their injuries are distinct from the public, these harms can stem from widespread atmospheric-type injuries. The requirement that an injury be distinct from the general public simply serves as a check to ensure plaintiffs do not use the courts to file generalized grievances about the actions and policies of the federal government. For example, the Supreme Court has repeatedly dismissed suits wherein the plaintiffs asserted "taxpayer standing" because "it is a complete fiction to argue that an unconstitutional federal expenditure causes an individual federal taxpayer any measurable economic harm."[464] In other words, taxpayers do not suffer "particularized" harm. This is distinct from situations wherein an action generally harms the public but where plaintiffs also suffer specific harms. For example, in *Owens Corning*, the court held that the increased risk of skin cancer and Lupus from the release of HCFC-142b (an ozone depleting substance) were sufficiently particularized harms.[465]

Likewise, the harms from increased satellite launches and reentries will not target specific individuals, but the increased risks are not diminished simply because

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459. *Id.*

460. *Id.*

461. Juliana, 947 F.3d at 1169; Nw. Env't. Def. Ctr. v. Owens Corning Corp., 434 F. Supp. 2d 957, 966 (D. Or. 2006).

462. *Juliana*, 947 F.3d at 1168; *Owens Corning*, 434 F. Supp. 2d at 965-66.

463. Lujan v. Defs. of Wildlife, 504 U.S. 555, 560 n.1 (1992).

464. Hein v. Freedom From Religion Found., Inc., 551 U.S. 587, 593 (2007); *see also* Massachusetts v. Mellon, 262 U.S. 447, 487 (1923) ("The administration of any statute, likely to produce additional taxation to be imposed upon a vast number of taxpayers, the extent of whose several liability is indefinite and constantly changing, is essentially a matter of public and not of individual concern.").

465. *Owens Corning*, 434 F. Supp. 2d at 963-64.

the harms may be widespread. The NRDC submitted a petition to the Commission regarding SpaceX's Gen2 Starlink system noting, "the various rocket launches required to deploy the 30,000 satellites that SpaceX proposes can contribute to the problem of stratospheric ozone depletion … stratospheric ozone protects humans from dangerous ultraviolet radiation. Loss of it increases rates of skin cancer, cataracts and other illnesses. Many ozone-depleting chemicals can also act as powerful heat-trapping gasses accelerating the dangerous weather extremes of climate change."[466] These types of injuries are likely sufficient for establishing "particularized" harm.

The final element of establishing an injury-in-fact is demonstrating its "imminence." Although there is no clear, single test for establishing imminence (i.e., substantial harm test or the certainly impending test),[467] plaintiffs in a suit challenging the FCC (or FAA) for their failure to conduct an EA or EIS will face lower "imminence" requirements because NEPA is a procedural statute.[468]

Moreover, the nature of harms associated with increased launches and satellite reentries does not hinge on speculation, and the causal chain between agency action (i.e., permit approval) and the harm is short. The FAA is the sole agency for authorizing the launch of commercial satellites from U.S. territory, and the FCC is the sole agency responsible for authorizing a satellite's orbital path.[469] There is growing scientific literature suggesting that ozone depletion from launch events *alone* may reach nearly six percent of annual global impacts within a decade,[470] and at least one federal agency has recognized that increased launches and reentries could "change the temperature of the stratosphere and deplete the ozone layer, which could increase the amount of harmful ultraviolet solar radiation reaching Earth."[471] These types of harms are beyond mere conjecture or hypotheticals and likely satisfy the imminence requirement.

2. A Mega-Constellation's Contributions to Stratospheric Harms is Sufficient to Satisfy Causation

Establishing causation will likely be the determinative factor in a standing analysis—specifically demonstrating the link between a given plaintiff's injury and a licensee's actions. To satisfy the causation prong in NEPA suits, plaintiffs must (1) connect the faulty EA/EIS to a specific, substantive government decision, and (2) demonstrate that the substantive decision (i.e., the issuance of a license without performing a proper review under NEPA) is linked to the plaintiff's particularized injury.[472]

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466. Final Gen2 Order, *supra* note 10, para. 113.
467. See discussion in Part III(A).
468. *Lujan*, 504 U.S. at 572, n.7.
469. 47 U.S.C. §§ 308-309 (FCC Requirements for a License); 51 U.S.C. § 50131 (FAA Authorities).
470. Miraux et al., supra note 30, at 329.
471. GAO ASSESSMENT, *supra* note 5, at 12.
472. WildEarth Guardians v. Jewell, 738 F.3d 298, 306 (D.C. Cir. 2013) (quoting Audubon Soc'y v. Bensten, 94 F.3d 658, 668 (D.C. Cir. 1996)).

This first prong is not an issue. The causal chain is short and differs significantly from the harms in, for example, *Florida Audubon Society v. Bentsen* wherein the court found that the government was not required to prepare an EIS for a tax credit program because the causal chain between the tax credit and pollution was too attenuated.[473] Here, the FAA is solely responsible for authorizing the launch vehicles, and the FCC is the exclusive agency for authorizing a given constellation's orbital path.[474] The FCC's decision to issue a CATEX and their determination that satellite constellations do not merit, at minimum, an EA is directly connected to a substantive result (for example, the full deployment of SpaceX's Gen1 Starlink and partial approval for Gen2).

The more difficult issue is demonstrating that the launch and reentry of any given satellite constellation is linked to a plaintiff's particularized injuries because SpaceX does not operate in this arena alone. That said, a particularized injury "does not fail simply because it has several links, provided those links are not hypothetical or tenuous and remain plausible."[475]

As of July 2023, SpaceX has launched 4,837 satellites as part of its Gen1 and Gen2 systems. The company is authorized to launch 7,500 satellites as part of its Gen2 system and is seeking approval to launch an additional 29,988 satellites.[476] In total, SpaceX is currently authorized to launch approximately 12,000 satellites.[477] These satellites, however, are not permanent. They have a shelf-life of approximately five years and require replacement, adding thousands of additional satellites into Earth's atmosphere.[478] Although SpaceX will be deploying more satellites than any other commercial entity, there are other players in this space, ranging from the DoD to other commercial satellite operators within and outside of the United States.[479] Moreover, any impacts stemming from satellite launches or reentries exist in a broader landscape where other anthropogenic and naturally occurring activities (e.g., meteorite entries) are impacting the stratosphere and atmosphere.[480]

However, contribution to a worldwide problem that results in diffuse harms does not, in and of itself, defeat causation. Diffuse harms can still result in particularized injuries, and standing does not require scientific certainty. For example, the *Owens Corning* court held that plaintiffs need only assert "that emission from Defendant's facility will contribute to the pollution that threatens Plaintiff's interests."[481]

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473. Fla. Audubon Soc'y v. Bentsen, 94 F.3d 658, 670 (D.C. Cir. 1996)

474. 47 U.S.C. §§ 308-309 (FCC Requirements for a License); 51 U.S.C. § 50131 (FAA Authorities).

475. Washington Env't Council v. Bellon, 732 F.3d 1131, 1141–42 (9th Cir. 2013) (quoting Native Vill. of Kivalina v. ExxonMobil Corp., 696 F.3d 849, 867 (9th Cir. 2012) (Pro., J., concurring)).

476. Final Gen2 Order, *supra* note 10, para. 1.

477. Final Gen2 Order, *supra* note 10, para. 1.

478. *See* Boley & Byers, *supra* note 6, at 4.

479. Miraux et al., *supra* note 30, at 334, tbl. 5.

480. See Section IV(A)-(C).

481. *Owens Corning,* 434 F. Supp. 2d at 967.

This question, thus, hinges on whether there is a "reasonably close" causal relationship between increased satellite deployments and atmospheric harm—specifically harm to the stratosphere and ozone layer.[482] In *Washington Environmental Council v. Bellon*, a key case the government relied on in *Juliana*, the government successfully argued that the failure to regulate five oil refineries was too tenuous to demonstrate causation because the refineries had a "scientifically indiscernible" impact on climate change.[483] The plaintiffs in *Juliana* successfully distinguished their case from *Bellon* because the *Juliana* plaintiffs were seeking an injunction that impacted a number of broad-reaching federal policies—not the regulation of five specific oil refineries.[484] The *Juliana* court noted that there was "at least a genuine factual dispute as to whether those policies were a 'substantial factor' in causing plaintiffs' injuries."[485]

A challenge to the FCC's approval of a satellite mega-constellation aligns more with *Juliana* than *Bellon*. Although plaintiffs would be challenging a single decision from the FAA/FCC (i.e., approving a license after failure to prepare an EA), this one licensing decision may play a substantial factor in impacting the stratosphere. That is, the FAA's and FCC's decisions have a more direct and concrete impact on ozone harm than suits based on climate grievances, which involve billions of emissions sources from automobiles to stationary sources.

Satellite operators may contest the severity of the effects from increased launches and reentries on the stratosphere, but, at minimum, there is a genuine factual dispute, which, generally, is sufficient for establishing causation for the purposes of standing.[486] In fact, SpaceX has already signaled that it will rely on the uncertainty surrounding the science of alumina in any litigation.[487] However, the science on alumina's impact is growing and even the federal government recognizes its potential effects. The GAO Assessment specifically highlights the harms of alumina, noting "[a]lumina particles emitted from rocket launches could accumulate in the stratosphere, causing both stratospheric warming and ozone depletion . . . Alumina particles can also enhance ozone depletion by creating a surface for ozone depleting chemical reactions to occur."[488]

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482. Sierra Club v. FERC, 827 F.3d 36, 47 (D.C. Cir. 2016) ("NEPA thus requires a reasonably close causal relationship between the environmental effect and the alleged cause, which is analogous to the familiar doctrine of proximate cause from tort law.") (internal citations omitted).

483. Washington Env't Council v. Bellon, 732 F.3d 1131, 1141 (9th Cir. 2013).

484. Juliana v. United States, 947 F.3d 1159, 1169 (9th Cir. 2020).

485. *Id.* (citing Mendia v. Garcia, 768 F.3d 1009, 1013 (9th Cir. 2014)).

486. *Id.*

487. SpaceX October 2022 Letter, *supra* note 345, at 5. ("It would be arbitrary to assume that alumina potentially produced by reentering satellites presents a significant environmental issue when it remains a minute fraction of the metals and other chemical compounds introduced each year from natural sources (to say nothing of man-made resources)—a fact that remains true of both SpaceX's Gen1 and Gen2 systems.").

488. GAO ASSESSMENT, *supra* note 5, at 13.

The GAO Assessment is not a one-off. A recent quantitative assessment conducted by a group of European scientists, discussed above, concluded that launch events alone from increased satellite deployments could reach 6% of annual global impacts to the atmosphere.[489] Moreover, this 6% estimate was solely based on increased *launch* activity. This number will undoubtedly be higher when accounting for satellite reentries.[490]

This 6% estimate is a useful benchmark. In *Center for Biological Diversity v. National Highway Traffic Safety Administration*, eleven states and a group of other plaintiffs challenged the NHTSA's promulgation of new corporate average fuel economy ("CAFE") standards for light trucks.[491] The petitioners successfully argued that the agency's failure to account for greenhouse gas emissions' impacts on global warming during a NEPA review was arbitrary and capricious.[492] The court specifically cited that "light trucks account for a significant percentage of the U.S. transportation sector[] [and] that the U.S. transportation sector accounts for about six percent of the world's greenhouse gasses . . . ."[493] Although there is no numerical threshold for demonstrating causation, at least one court of appeals has held that contributing "a significant percentage" towards 6% of the world's greenhouse gases was sufficient to affect climate change.

Thus, even if SpaceX (or other constellation operators) challenges the underlying science behind stratospheric and atmospheric impacts from launches and reentries, there nevertheless appears to be "at least a genuine factual dispute as to whether [these actions are] a 'substantial factor' in causing plaintiffs' injuries."[494] This is sufficient for purposes of establishing causation.

3. Redressability is Easily Met Given NEPA's Procedural Nature

The last prong in a standing analysis is determining whether a plaintiff's claims are "redressable." This "redressability" requirement, however, is lowered for procedural claims such as NEPA.[495] Although courts have been reluctant to find that climate change-related injuries can be redressed by Article III courts, the calculation is significantly different when claims are brought under NEPA as opposed to a substantive claim, such as *Juliana*. Courts have repeatedly held that the very nature of NEPA (i.e., simply requiring federal agencies to take a "hard look" at the environmental impacts of its action) means that an agency could change its mind about taking a particular action if it properly conducted an analysis under

489. Miraux et al. *supra* note 30, at 329.

490. *Id*.

491. Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin., 538 F.3d 1172, 1180 (9th Cir. 2008) (emphasis added).

492. *Id*. at 1200.

493. *Id*. at 1214.

494. Juliana v. United States, 947 F.3d 1009, 1169 (9th Cir. 20120) (citing Mendia v. Garcia, 768 F.3d 1009, 1013 (9th Cir. 2014)).

495. Lujan v. Defs. of Wildlife, 504 U.S. 555, 572, n.7 (1992).

NEPA.[496] This alone is enough to meet the redressability prong. As noted by the Supreme Court, "[w]hen a litigant is vested with a procedural right, that litigant has standing if there is some possibility that the requested relief will prompt the injury-causing party to reconsider the decision that allegedly harmed the litigant."[497]

Moreover, many of the lawsuits targeting agency (in)action on climate change hinge on whether the scope of the agency review was sufficient (for example, whether they properly examined the downstream or upstream impacts of the proposal).[498] Here, the FCC is refusing to even prepare an EA—instead relying on CATEXs. In fact, the FCC has granted a CATEX for *every* large satellite constellation it has reviewed since 2016 (24 in total).[499]

Finally, a court has the power to order the FCC to complete a NEPA review. This does not involve a political question that is beyond the authority of the court to answer. Likewise, the disputed action (NEPA review) is not within the Commission's discretion, the conduct causing the injury is a direct result of the Commission (not caused by a third-party), and proper agency action (completing a properly scoped NEPA review) would redress the injury.

Thus, plaintiffs will likely be able to demonstrate that a court can redress their alleged injuries by simply ordering the FCC to comply with NEPA, and ordering the FCC to complete said review is within the power of a court to award. Both elements of redressability, therefore, can be met.

Taken together, plaintiffs will likely be able to satisfy the Article III constitutional requirements of standing. And, in fact, as noted above, the environmental plaintiffs in *IDA v. FCC* were able to sufficiently establish standing. There, the court held plaintiffs (1) alleged a sufficient injury in fact since their aesthetic and recreational activities would be inhibited by light pollution and (2) causation and redressability were met since the case merely involved a procedural harm (failure to conduct an EA) and the FCC could switch courses upon performing an environmental review.[500] This model can be replicated in future suits addressing stratospheric harms from satellite operations — although light pollution from satellites, of course, differs from stratospheric harms from alumina and other particles.

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496. *See, e.g.,* WildEarth Guardians v. Jewell, 738 F.3d 298, 306 (D.C. Cir. 2013) (holding that vacatur of a BLM order would meet redressability because the agency could change its mind) (citing Lemon v. Geren, 514 F.3d 1312, 1315 (D.C. Cir. 2008)).

497. Massachusetts v. EPA, 549 U.S. 497, 518 (citing *Lujan*, 504 U.S. at 572, n.7).

498. MANDELKER ET AL., *supra* note 77, at Ch. 9 (Scope of the Environmental Impact Statement).

499. GAO SATELLITE RECOMMENDATION, *supra* note 94, at 26 ("According to FCC officials, as of October 2021, none of the 24 applications for large constellations of satellites received since 2016 was determined to need an environmental assessment.").

500. Stephen G. Wood et al., *Whither the Precautionary Principle? An American Assessment from an Administrative Law Perspective*, 54 AM. J. COMP. L. 581, 581 (2006).

Growing evidence suggests that increased launch activities and the disintegration of thousands, if not tens of thousands, of satellites into our upper atmosphere will harm our stratosphere and ozone layer. The FCC's licensing of mega-constellations, thus, will result in concrete, particularized, and imminent harms—for example, in the form of increased skin cancer or cataracts. Although the harms may be diffuse, an individual's injuries are not diminished simply because others may also suffer harm from the FCCs' licensing decisions. Although causation will likely be the hardest hurdle for any plaintiff, there is a reasonably close causal relationship between the FCC's decision to license thousands of satellites and potential harm to the stratosphere, ozone layer, and greater atmosphere. Finally, given the FCC's sole authority to license orbital paths for satellites, a court could adequately redress claims under NEPA by simply ordering the Commission to properly comply with the statute (for example, preparing an EA).

C. NEPA'S APPLICATION TO THE STRATOSPHERE PROVIDES FAR-REACHING BENEFITS

Conducting a properly scoped NEPA analysis by considering satellites' impacts on the atmosphere offers significant policy benefits. First, if the FCC prepared an EA, it would be able to more readily identify, and perhaps reduce, adverse impacts associated with satellite constellations via the precautionary principle. Second, a more thorough review would strengthen our national security and align with DoD policy. Third, a properly scoped review is consistent with the United States' obligations under the Outer Space Treaty.

1. Preventing Unintended Consequences via NEPA's Precautionary Principle

The precautionary principle advocates for "decision makers to avoid or minimize risks whose consequences are uncertain but potentially serious by taking anticipatory action,"[501] and should be utilized "[w]here risks of serious or irreversible damages are identified but conclusive evidence is not available."[502] This principle should play an outsized role when mankind is conducting activities at a scale yet to be seen in human history. The FCC's approval of SpaceX's Gen1 Starlink, and partial approval of Gen2 Starlink, marks the early stages of the commercial use of mega-constellations. The scale and speed at which thousands of satellites are being deployed should be undertaken with adequate precautions. In addition to the likely harmful impacts on the stratosphere and the greater atmosphere, these mega-constellations may also create a myriad of other problems mentioned throughout this Article, including orbital debris fields, casualty risk, and light pollution.

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501. *Id.* (quoting Jutta Brunnee, *The Precautionary Principle And International Law: The Challenge of Implementation*, 91 AM. J. INT'L L. 210, 210 (1997) (book review)).

502. *See id.* at 585-86.

Adhering to the precautionary principle provides decision makers the ability to identify and analyze the potential environmental harms. Decision makers need to have a better understanding of the impacts of these mega-constellations on Earth's atmosphere so that mankind does not have long-standing, unintended impacts on the ozone layer, the Earth's "protective sunscreen."

The precautionary principle is the subject of much academic literature. As scholars have noted, its exact role in American jurisprudence is murky.[503] On one hand, the principle is not enshrined in the Constitution and appears minimally in federal regulations and statutes.[504] There are also very few reported cases discussing this principle.[505] On the other hand, although this principle is not mentioned in many laws, regulations, and cases, its concept underpins some U.S. laws—none more than NEPA.[506] The Supreme Court has described NEPA as the requirement to take a "hard look."[507] The statute itself requires agencies to "identify and develop methods and procedures … which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations."[508] As noted by the D.C. Circuit, "NEPA's purpose [is] to ensure that agencies consider environmental impacts before they act rather than wait until it is too late."[509]

Properly scoping the impacts of satellite constellations under NEPA, at a minimum, will facilitate identification of problems at the onset, which, in turn, will not only reduce adverse impacts but also likely reduce costs associated with satellite constellations. A concrete example illustrates why decision makers should proceed with caution and ensure they fully understand the adverse risks associated with wide-scale, mass deployment of these mega-constellations. The World Meteorological Organization ("WMO") released its quadrennial scientific assessment of ozone depletion on January 9, 2023.[510] The report has already attracted significant media attention and a few outlets have also made the connection

503. *Id*. at 583.

504. Int'l Dark-Sky Ass'n v. FCC, 106 F.4th 1206, 1217-18 (D.C. Cir. 2024).

505. *See id*. at 583-85.

506. The ESA and the Montreal Protocol are two other significant examples. Under the ESA, the federal government must take certain actions to protect species before they face extinction. 16 U.S.C. § 1533(a); Phillip M. Kannan, *The Precautionary Principle: More Than A Cameo Appearance in United States Environmental Law?*, 31 WM. & MARY ENVTL. L. & POL'Y REV. 409, 435 (2007) ("The fact that protection is to begin before a species is actually endangered demonstrates that the ESA is designed to prevent harm, and is thus inherently precautionary."). Likewise, the signatories to the Montreal Protocol, including the U.S., adopted a precautionary approach by banning the use of certain ozone-depleting substances prior to causing additional damage. Montreal Protocol on Substances that Deplete the Ozone Layer, *supra* note 448.

507. Kleppe v. Sierra Club, 427 U.S. 390, 410 n. 21 (1976).

508. 42 U.S.C. § 4332(2)(B).

509. Am. Bird Conservancy v. FCC, 516 F.3d 1027, 1033 (D.C. Cir. 2008).

510. WORLD METEOROLOGICAL ORGANIZATION, SCIENTIFIC ASSESSMENT OF OZONE DEPLETION: 2022 EXECUTIVE SUMMARY (Oct. 2022) [hereinafter WMO Report], https://perma.cc/7M93-D6QN.

between the ozone layer and satellite mega-constellations.[511] The report makes a number of important findings that are relevant when considering the impact of satellite constellations on our stratosphere and ozone layer. The report noted that "[a]ctions taken under the Montreal Protocol continued to decrease atmospheric abundances of controlled ozone-depleting substances (ODSs) and advance the recovery of the stratospheric ozone layer."[512]

Due to these actions, the ozone layer is expected to return to 1980 levels by 2040, although the recovery in the polar regions will likely lag a few decades.[513] The report also lists a number of ongoing scientific and policy challenges, which includes "increased frequency of civilian rocket launches."[514] The report notes that "the planned development of massive low-Earth orbit satellite constellations (mega-constellations) could cause particulates resulting from space debris reentry to become comparable to that from launch emissions," but the report adds that "little is known about the impacts of reentry particles, and their accumulation in the stratosphere has not been modeled."[515] The GAO report on mega-constellations recognizes this risk as well and recommends regulations dictating the composition of the satellites to prevent greater impacts on the atmosphere.[516]

In short, the ozone layer continues to recover due to proactive steps taken by nations to limit their emissions of ozone-depleting substances, but challenges still remain, and increased rocket launches and satellite reentries have the potential to reverse these gains. Adopting a precautionary approach would allow decision makers to more fully understand the adverse impacts of these mega-constellations, rather than indiscriminately approving them and risking unknown damage to our ozone layer, stratosphere, and greater atmosphere.

2. Strengthening National Security via Informed Decision Making

NEPA plays a crucial role in risk analysis and aligns with DoD policy. Although the exponential growth in satellites is primarily driven by private companies, there is also potential for the DoD to expand its satellite footprint.[517] In fact, the DoD Space Development Agency has proposed its own large satellite constellation for communications and data collection.[518] SpaceX also supports and contracts with the DoD to launch the department's satellites.[519]

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511. *E.g.*, Tereza Pultarova, *Supersonic Planes, Rockets and Megacontellations Could Thwart Ozone Layer's Recovery,* SPACE (Jan. 23, 2023), https://perma.cc/2LX4-6FUY.
512. WMO Report, *supra* note 510, at Highlights.
513. *Id.*
514. *Id.*
515. *Id.* at 43.
516. GAO ASSESSMENT, *supra* note 5, at 17.
517. *Id.* at 6.
518. *Id.*
519. *E.g.*, Watts, *supra* note 12 (SpaceX launch of GPS satellite on behalf of U.S. military).

In the last decade, the federal government has begun to recognize the risks of climate change on national security.[520] In January 2021, President Biden issued an executive order titled, "Tackling the Climate Crisis at Home and Abroad."[521] This E.O. recognized that climate analysis and considerations must be "an essential element of United States foreign policy and national security."[522] The executive is not alone in this determination.

The DoD extolls the virtues of informed decision making and recognizes the risks of climate change. In fact, the Department has been developing plans to manage the effects of climate change on its operations since 2010.[523] The National Defense Authorization Act ("NDAA") of 2018 further recognized that "climate change is a direct threat to the national security of the United States and is impacting stability in areas of the world both where the United States Armed Forces are operating today, and where strategic implications for future conflict exists."[524] The statute further states that the DoD "must ensure that it is prepared to conduct operations both today and in the future and that it is prepared to address the effects of a changing climate on *threat assessments,* resources, and readiness."[525]

The DoD's most recent Climate Risk Analysis, published in October 2021, further notes:

> Climate change is reshaping the geostrategic, operational, and tactical environments with significant implications for U.S. national security and defense. Increasing temperatures; changing precipitation patterns; and more frequent, intense, and unpredictable extreme weather conditions caused by climate change are exacerbating existing risks and creating new security challenges for U.S. interests.[526]

The DoD also published a Climate Adaptation Plan in 2021 containing five lines of efforts ("LOEs"). The first LOE is ensuring "climate-informed decision-making on climate assessments."[527] The Plan further notes, "[c]limate considerations must continue progress toward becoming an integral element of DOD's

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520. *See* Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions, 75 Fed. Reg. 8046-01 (proposed Feb. 18, 2010).

521. Exec. Order No. 14008, 88 Fed. Reg. 7619 (Jan. 27, 2021).

522. *Id.* at § 101.

523. DEP'T OF DEFENSE, CLIMATE RISK ANALYSIS 7 (2021), *available* at https://perma.cc/G7NU-ADU6 [hereinafter DOD: CLIMATE RISK ANALYSIS]. As early as 2004, the DoD began recognizing the potential catastrophic implications of climate change on national security. PETER SCHWARTZ & DOUG RANDALL, AN ABRUPT CLIMATE CHANGE SCENARIO AND ITS IMPLICATIONS FOR UNITED STATES NATIONAL SECURITY 3 (2003) ("This report suggests that, because of the potentially dire consequences, the risk of abrupt climate change, although uncertain and quite possibly small, should be elevated beyond a scientific debate to a U.S. national security concern.").

524. *Id.* at 7.

525. *Id.* (emphasis added).

526. *Id.* at 2.

527. DEP'T OF DEFENSE, CLIMATE ADAPTATION PLAN 6 (2021), *available* at https://perma.cc/TH8U-58JF.

enterprise-wide resource allocation and operational decision-making processes . . . [and] must be based on the best available, validated, and actionable climate science that informs the most likely climate change outcomes."[528]

NEPA, in a sense, is nothing more than a threat assessment. It is a statute designed to ensure our decision makers, whether in the Pentagon, halls of Congress, or FCC headquarters, take a "hard look" at environmental consequences before taking a particular action. More importantly, harms to the stratosphere fit within the same type of climate harms the DoD is concerned about. For example, the analysis specifically recognizes the threats to the Arctic as a growing concern: "In the Arctic, climate change is dramatically altering the natural environment and creating a new frontier of geostrategic competition."[529] Any damage to the stratosphere and ozone layer due to increased launches and satellite reentries will likely be felt most prevalently in the polar regions.[530] The DoD also recognizes that climate change "demand[s] on-going analysis of evolving risks as well as investments in resilience, international development, and governance."[531]

Moreover, although DoD NEPA regulations do not specifically discuss the stratosphere or outer space, the department's NEPA reviews account for certain impacts to the space environment (like orbital debris).[532] Thus, although critics are quick to argue that NEPA curbs the United States' ability to strategically compete with China,[533] DoD policy seems to indicate otherwise.

The federal government also has a number of avenues for avoiding NEPA review if a particular satellite constellation has national security implications.[534] Courts have generally permitted projects with foreign policy implications to proceed without a full NEPA analysis. For example, in *NEPA Coalition of Japan v. Aspin*, the District Court of D.C. rejected claims under NEPA related to U.S. military operations in Japan because "U.S. foreign policy interests outweigh the benefits from preparing an EIS."[535] And the court in *Greenpeace v. Stone* rejected a lawsuit challenging the Army's decision not to prepare an EIS for the transportation of munitions across the Pacific Ocean from West Germany to the Johnston Atoll.[536] The court noted that NEPA "clearly recognizes . . . that actions should be taken 'consistent with the foreign policy of the United States.'"[537] The court

528. *Id.*

529. DOD: CLIMATE RISK ANALYSIS, *supra* note 523, at 6.

530. Delaval, *supra* note 43.

531. DOD: CLIMATE RISK ANALYSIS, *supra* note 523, at 6.

532. Gilbert & Vidaurri, *supra* note 7, at 257 ("Although DOD NEPA regulations do not mention the outer space environment, their EIAs occasionally include elements of the space environment, such as orbital space debris.").

533. *See, e.g.*, Ellis, *supra* note 7, at 2.

534. *See* Winter v. NRDC, 555 U.S. 555 U.S. 7, 48-49 (2008) (Ginsburg, J., dissenting) (discussing the Navy's options for bypassing NEPA review).

535. NEPA Coal. of Japan v. Aspin, 837 F. Supp. 466, 468 (D.D.C. 1993).

536. Greenpeace USA v. Stone, 748 F. Supp. 749, 753 (D. Haw. 1990).

537. *Id.* at 759 (quoting 42 U.S.C. § 4332(f)).

held that the Army was not required to prepare the EIS because it would "result in grave policy implications and would substantially interfere with a decision of the President and a foreign sovereign in a manner not intended or anticipated by Congress."[538]

Moreover, even if a given satellite constellation does not implicate foreign policy, E.O. 12,114 specifically exempts certain actions from NEPA review if they are "taken by or pursuant to the direction of the President or Cabinet officer when the *national security* or interest is involved."[539] Additionally, the DoD has sought to assert a "national security" exemption separate from the authority contained in E.O. 12,114. While courts have been reluctant to read this exemption into the statute, if the right facts are presented, the DoD has been able to bypass NEPA review if, for example, the NEPA review would release state secrets.[540] If all of these options fail, the federal government can always seek congressional authorization to proceed with certain satellite launches and operations without complying with NEPA's full requirements—for example via an annual National Defense Authorization Act.[541]

3. Consistency with International Obligations under the Outer Space Treaty

As a party to the Outer Space Treaty ("OST") of 1966, the U.S. is obligated to ensure that its use of space is for the benefit of all mankind and that its outer space activities do not adversely impact life on Earth.[542] The potential impacts from launching tens of thousands of satellites may, arguably, violate at least two of the treaty's articles.

Article I states, "[t]he exploration and use of outer space . . . shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind."[543] While Starlink and other mega-constellations may "bring next

538. *Id.* at 761.

539. Exec. Order No. 12,114 at § 2-5(iii) (emphasis added).

540. MANDELKER ET AL., *supra* note 77, at § 5:15 ("The exemption has not been generally recognized, but the federal government has invoked secrecy provisions in the Freedom of Information Act to shield national defense activities from judicial review for NEPA compliance." (citations omitted)); *Compare* Weinberger v. Catholic Action of Hawaii/Peace Educ. Project, 454 U.S. 139, 145 (1981) (holding FOIA's national security exemption shields judicial review pursuant to NEPA to the extent the NEPA process would violate FOIA's secrecy exemption) *with* Citizens for Reid State Park v. Laird, 336 F. Supp. 783, 788 (D. Me. 1972) ("There can be little doubt that NEPA is a clear mandate to all federal agencies to give careful and informed consideration to environmental values in their decisionmaking process.") *and* Concerned About Trident v. Rumsfeld, 555 F.2d 817, 823 (D.C. Cir. 1976) ("There is no support in either the statute or the cases for implying a 'national defense' exemption from NEPA.").

541. *See* Winter v. NRDC, 555 U.S. 555 U.S. 7, 48-49 (2008) (Ginsburg, J., dissenting) (noting specific instances when the government has obtained congressional authorization to proceed with activities without completing NEPA's requirements).

542. Outer Space Treaty, *supra* note 438.

543. *Id.* at art. I.

generation satellite broadband to Americans nationwide, including those living and working in areas traditionally unserved or underserved by terrestrial systems . . . [and] help[] to close the digital divide on a global scale,"[544] this new technology must also be for the province of all mankind, "irrespective of their degree of economic or scientific development." Here, the FCC seems to be concerned more with the economic benefits of mega-constellations than ensuring the technology is for the benefit of all mankind.

More pointedly, Article IX states, "[p]arties to this Treaty shall pursue studies of outer space, including the Moon and other celestial bodies, and conduct exploration of them *so as to avoid their harmful contamination and also adverse changes in the environment of the Earth* resulting from the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose."[545] Although Article IX appears to be concerned with the introduction of extraterrestrial matter, the underlying principle supports and aligns with a fully scoped NEPA review (i.e., the U.S. "shall pursue studies . . . so as to avoid . . . adverse changes in the environment of Earth.").

The science *at minimum* suggests these constellations may impact Earth's atmosphere and climate. The FCC itself recognizes the potential effects of alumina from satellite reentry, and, in fact, conditioned its partial grant of SpaceX's Gen2 system on the assurance that SpaceX will continue to work with the scientific community to explore methods of data collection and report to the FCC annually.[546] The Commission's decision to allow the regulated industry to conduct its own scientific review of this nascent technology not only undermines NEPA's purpose of ensuring a "hard look," but also undermines the U.S.'s commitments in the OST. The OST obligates states to pursue studies so as to avoid adverse changes in Earth's environment. The OST does not permit commercial entities to act in lieu of the state parties, which, in essence, allows parties to avoid the thorny question of whether a given activity is being carried out for the province of all mankind, as opposed to commercial interests. In fact, the OST explicitly declares that state parties "*shall* bear international responsibility for national activities in space . . . whether such activities are carried on by governmental agencies or non-governmental entities."[547]

NEPA's application to the stratosphere is not only consistent with text, purpose, and legislative history of the statute, but is also beneficial for mankind. This application is consistent with the precautionary principle and ensures decision makers have a better understanding of mega-constellations' impacts on Earth's atmosphere (for example, ensuring we do not undo the recent gains made in healing the ozone layer). A properly scoped NEPA review is also consistent with

544. Final Gen2 Order, *supra* note 10, para. 1.
545. Outer Space Treaty, *supra* note 438, at art. IX (emphasis added).
546. Final Gen2 Order, *supra* note 10, para. 118.
547. Outer Space Treaty, *supra* note 438, at art. VI. (emphasis added).

DoD policy, national security interests, and the United States' obligations under the Outer Space Treaty.

CONCLUSION

The commercialization of space, led by SpaceX's Starlink system, has led to calls for further environmental regulation of space. There is growing scientific evidence that increased launches and satellite reentries will adversely affect the stratosphere, which plays an outsized role in protecting life on Earth as the planet's "sunscreen." The deposition of alumina is particularly concerning.

The D.C. Circuit recently had the opportunity to determine whether NEPA applied to activities in outer space, but the court ultimately dismissed the suit on standing grounds, leaving NEPA's extraterrestrial reach uncertain. Even if NEPA does not apply to space, it should apply to the stratosphere, which is a logical extension of the troposphere and part of the "human environment." NEPA's application to the stratosphere also does not trigger the presumption against extraterritoriality because NEPA itself contains multiple, clear indications that it applies extraterritorially. Additionally, NEPA is a procedural statute and its application to FCC licensing actions is a permissible domestic application of the statute. The only nexus between satellite mega-constellations and extraterritorial considerations is the fact that the harms associated with these operations are diffuse and felt globally. Thus, plaintiffs may have more success challenging FCC licensing decisions by narrowing the scope of their claims to those injuries caused by atmospheric harms because NEPA's extraterrestrial scope remains uncertain. Utilizing narrowly-tailored litigation to obtain a properly scoped NEPA review is also more likely than congressional action expanding NEPA or federal courts upholding broad agency interpretations of the statute's extraterrestrial scope.

Plaintiffs also have a viable path to satisfying standing requirements, as recently demonstrated in *IDA v. FCC*. The unchecked growth of the commercial satellite industry will likely lead to concrete, particularized, and imminent harms, by, for example, degrading Earth's stratosphere, which, in turn, may lead to increased rates of skin cancer. Although the harms may be diffuse, an individual's injuries are not diminished simply because others may also suffer harm from these operations. There is also growing evidence to establish at least a genuine factual dispute as to whether these mega-constellations contribute to a given injury. And, given NEPA's procedural nature, redressability likely will not serve as a barrier.

NEPA's logical extension to the stratosphere has a number of other policy benefits. Utilizing NEPA aligns with the precautionary principle, ensuring decision makers comprehend the potential impacts from mega-satellite constellations. DoD policy also appears to support NEPA's application to the stratosphere in order to ensure the U.S. military is properly conducting risk analyses. Finally,

conducting a broader NEPA review is consistent with the U.S.'s obligations in the Outer Space Treaty.

The procedural safeguards of NEPA simply ensure our decision makers are properly balancing competing interests. Considering the environmental impacts of space operations to life on Earth is crucial to ensuring our expanded footprint, which is increasingly taking the form of commercial mega-satellite constellations, is for the benefit and interests of all. By ignoring the purpose and scope of NEPA, the FCC is, in effect, allowing private parties to access and consume a global common resource, and, in turn, externalizing the costs of these mega-constellations to all life on Earth in the form of increased atmospheric pollution and ozone damage. At minimum, NEPA's application to the stratosphere ensures decision makers are taking a "hard look" before authorizing the deployment of tens of thousands of satellites into the night skies.