USING INSTITUTIONAL CONTROLS IN ANTICIPATION OF SUPERFUND SITE DISASTERS

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About 73 million people live within three miles of a Superfund site.[1] Compared to the general population, the population within this range is lower-income, has more Indigenous people and people of color, and is more burdened by other environmental stressors (e.g., poor air quality, lead paint, etc.).[2] When natural disasters occur around toxic sites, the results can be catastrophic. For example, dioxins—chemicals that can cause cancer and liver and nerve damage—were dumped in and around the San Jacinto River near Houston by paper mills in the 1960s.[3] Though the responsible parties installed a temporary cap over the waste in 2011, during Hurricane Harvey in 2017, heavy damage to the cap resulted in high levels of dioxins detected in the area.[4]

Natural hazards caused approximately 17,000 toxic material releases between 1990 and 2010.[5] Flooding events (inland and coastal) were most numerous and caused about 26% of the total number of releases. Similarly, another 20% were the result of hurricane exposure, many resulting from major episodes in 2005 and 2008.[6] Storms, wind events, wildfires, earthquakes, and temperature-related events were responsible for releases of toxic materials.[7]

Overall, the number of contaminant releases resulting from natural hazard exposures has increased over the past three decades, co-occurring with enhanced potential for serious human and environmental impacts.[8] These impacts are not limited to the immediate area around a site, as downwind and downstream communities are also at risk. For example, there is a three-mile stretch of the Black River in New York contaminated with polychlorinated biphenyls (PCBs).[9] The site includes wastewater discharge from the Carthage and West Carthage Water Pollution Control Facilities, which are upstream from the contamination.[10]

Understanding the nearly impossible task of containing contaminants from Superfund sites, it is imperative to find solutions in anticipation of disasters that scientists project will only increase in magnitude and frequency.[11] This Comment proceeds in six parts. Part I identifies the challenge of increasing natural disasters and their impact at Superfund sites, which are toxic havens. Part II identifies efforts that the U.S. Environmental Protection Agency (EPA) and other federal agencies have taken to make Superfund sites more climate-resilient.

Part III identifies and explains institutional controls (ICs) as a potentially underutilized tool for making Superfund sites more climate-resilient. Part IV identifies specific land use policies that municipalities and site managers can implement as ICs to achieve climate resilience at and around Superfund sites. Part V provides recommendations for implementing ICs throughout different stages of the cleanup process. Part VI concludes.

I. Natural Disasters Near Superfund Sites

Natural disasters and the consequences thereof will only increase in frequency and intensity in the coming years. Over the past five years, the United States has experienced an average of 18 billion-dollar climate disasters each year.[12] In 2024 (as of September 10), there were 20 confirmed weather/climate disaster events, with losses exceeding $1

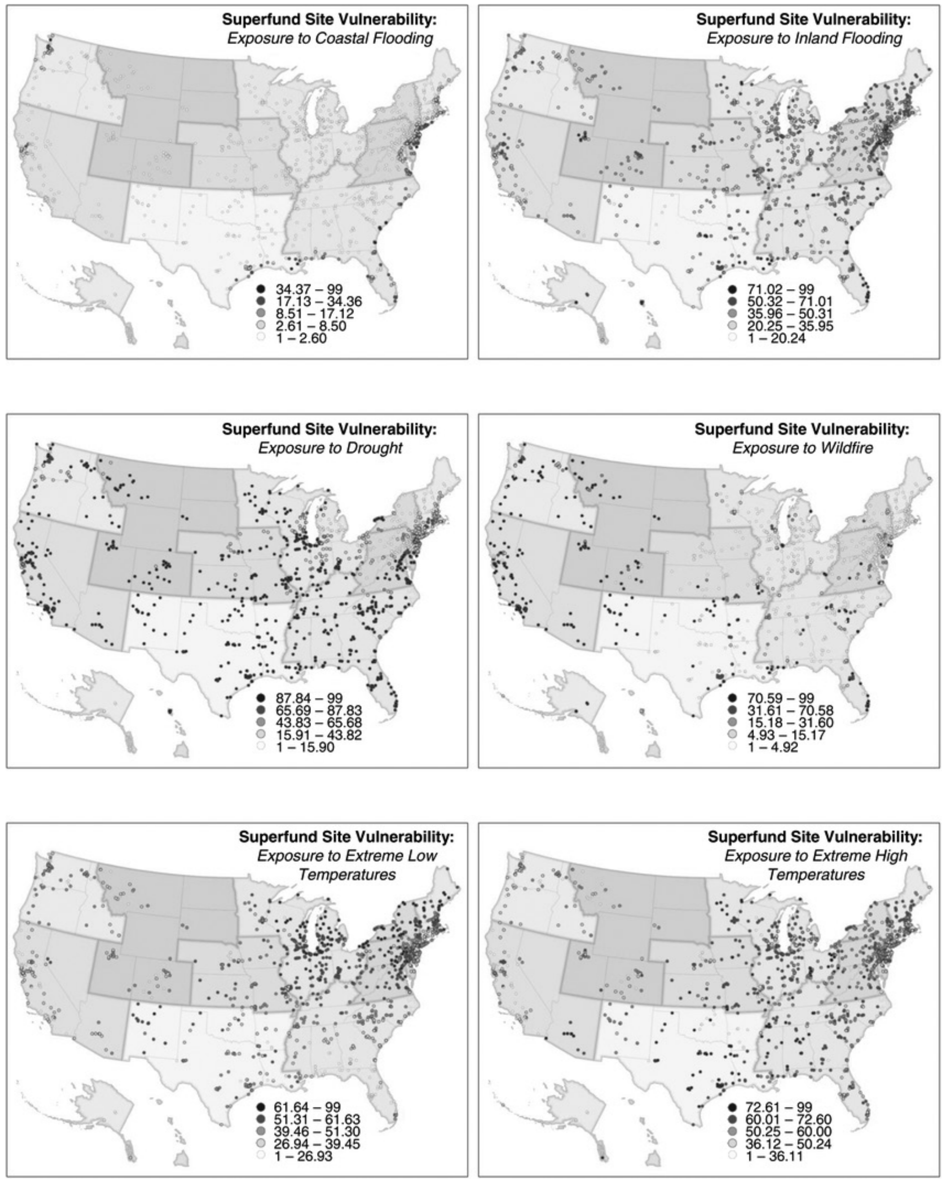
1. U.S. Environmental Protection Agency (EPA), *Supporting Environmental Justice at Superfund Sites*, https://www.epa.gov/superfund/supporting-environmental-justice-superfund-sites (last updated Feb. 6, 2025); Environmental Law Institute (ELI), Institutional Controls in Use (1995), https://www.eli.org/sites/default/files/eli-pubs/d7.02.pdf; ELI, Protecting Public Health at Superfund Sites: Can Institutional Controls Meet the Challenge? (1999), https://www.eli.org/sites/default/files/eli-pubs/d10.01.pdf; Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. §§9601-9675. This Comment uses the terms "CERCLA" and "Superfund" interchangeably.
2. U.S. EPA, *supra* note 1; Chloe Reichel, *Toxic Waste Sites and Environmental Justice: Research Roundup*, Journalist's Res. (Sept. 24, 2018), https://journalistsresource.org/environment/superfund-toxic-waste-race-research/.
3. *Climate Change Could Spell Disaster for Superfund Sites*, Climate Reality Project (Feb. 17, 2022), https://www.climaterealityproject.org/blog/climate-change-could-spell-disaster-superfund-sites.
4. *Id.*
5. Hatice Sengul et al., *Analysis of Hazardous Material Releases Due to Natural Hazards in the United States*, 36 Disasters 723 (2012).
6. *Id.* at 723.
7. *Id.*
8. Kevin Summers et al., *National Hazards Vulnerability and the Remediation, Restoration, and Revitalization of Contaminated Sites*, 67 Env't Mgmt. 1029 (2021).
9. U.S. EPA, *Superfund Site: Black River PCBs Town of Champion, NY*, https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0206296 (last visited Feb. 10, 2025).
10. *Id.*
11. Sonia I. Seneviratne et al., *Weather and Climate Extreme Events in a Changing Climate*, *in* Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change 1513 (V. Masson-Delmotte et al. eds., Cambridge Univ. Press 2021), https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter11.pdf.
12. Penny Gusner, *Natural Disaster Facts and Statistics 2025*, Forbes (Jan. 3, 2025), https://www.forbes.com/advisor/homeowners-insurance/natural-disaster-statistics/.

billion each, that affected the United States.[13] These events included 16 severe storm events, 1 tropical cyclone event, 1 wildfire event, and 2 winter storm events.[14] Overall, these events resulted in the deaths of 149 people and had significant economic effects on the areas impacted.[15]

These events present particular concern because they can move large amounts of sediment; "[u]nder certain conditions, such as high winds, strong currents, or changes in ambient chemistry, accumulated contaminants are released, resuspended, or dispersed in the water."[16] As such, natural disasters can compound the likelihood of releases from contaminated sites.[17]

Scholars have increasingly noted the risk of natural disasters at Superfund sites. Figure 1 demonstrates Superfund site vulnerabilities to six natural disasters: coastal flooding, inland flooding, drought, wildfires, extreme low temperatures, and extreme high temperatures. As the maps indicate, many sites are quite vulnerable to inland flooding while coastal flooding dominates the East Coast, and wildfires dominate the West Coast. This Comment will explore IC measures for both wildfires and flooding. Further research is necessary to determine the appropriate ICs for sites vulnerable to extreme temperatures and drought.

Figure 1. Natural Hazard Vulnerability at Superfund Sites



Source: Kevin Summers et al., *National Hazards Vulnerability and the Remediation, Restoration and Revitalization of Contaminated Sites—1. Superfund*, 67 Env't Mgmt. 1029 fig. 1 (2021).

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) established the "Superfund," which allows EPA to clean up contaminated sites. It also forces the parties responsible for contamination to either perform cleanups or reimburse the government for EPA-led cleanup work. Toxins at these sites range from PCBs to petroleum from eroding propane tanks, and can inflict a variety of illnesses when ingested by the proximate population. Many of the toxins at Superfund sites are confirmed carcinogens while others are "probable human carcinogens."[18] Natural disasters disrupt the containment of toxins at Superfund sites, spreading these toxins into neighboring communities. This spread, in turn, can exacerbate the health inequities faced by communities residing near Superfund sites.

EPA has acknowledged that increased rainfall, storms, and flooding can contaminate water resources with viruses and bacteria, causing gastrointestinal and other illnesses.[19]

13. National Oceanic and Atmospheric Administration National Centers for Environmental Information, *Billion-Dollar Weather and Climate Disasters*, https://www.ncei.noaa.gov/access/billions/ (last visited Feb. 10, 2025).
14. *Id*.
15. *Id*.
16. Katrina Fischer Kuh, *Climate Change and CERCLA Remedies: Adaption Strategies for Contaminated Sediment Sites*, 2 Seattle J. Env't L. 61 (2012).
17. *Id*.
18. *See* U.S. EPA, *Risk Assessment for Carcinogenic Effects*, https://www.epa.gov/fera/risk-assessment-carcinogenic-effects (last updated Oct. 23, 2024). Whereas known or confirmed carcinogens (group A) refer to those agents with adequate data to demonstrate the causal association of the agent with human cancer, probable carcinogens (group B) refer to those agents with sufficient evidence from animal bioassay data, but either limited human evidence or with little to no human data.
19. U.S. EPA, *Climate Change Impacts on Health*, https://www.epa.gov/climateimpacts/climate-change-impacts-health (last updated Jan. 30, 2025).

Understanding that Superfund sites can contain many harmful chemicals, it is imperative that EPA seek to prevent the spread of toxins with the inevitable increase of weather events that will cause these toxins to travel outside the bounds of the Superfund site.

Superfund sites are uniquely positioned as some of the most climate-vulnerable areas across our country. Federal data suggest that about 60% of Superfund sites overseen by EPA are in areas that may be impacted by wildfires and different types of flooding—natural hazards that may be exacerbated by climate change.[20] Climate change conditions also alter the movement, bioavailability, and toxicity of hazardous substances in the environment, and thus people's exposure to these substances.[21] For example, higher temperatures may alter the biotransformation of contaminants into more biologically active metabolites; and areas experiencing less rainfall may contribute to higher volatilization of contaminants, while areas receiving greater precipitation may experience more contaminant runoff or deposition of airborne contaminants.[22]

Releases of hazardous materials from contaminated sites have been documented after earthquakes, floods, hurricanes, and wildfires.[23] Natural hazards caused approximately 17,000 toxic material releases between 1990 and 2010.[24] Flooding events (inland and coastal) were most numerous, and caused about 26% of the total number of releases.[25] Similarly, another 20% were the result of hurricane exposure, many resulting from major episodes in 2005 and 2008.[26] Overall, the number of contaminant releases resulting from natural hazard exposures has increased over the past three decades, co-occurring with enhanced potential for serious human and environmental impacts.[27]

When natural disasters occur in areas of high chemical composition, those toxins may spread to the surrounding community. For example, in Bridgewater, New Jersey, one site contained "contaminated soil and groundwater from 27 unlined chemical waste lagoons stemming from more than 90 years of chemical and pharmaceutical manufacturing."[28] In 2011, the floodwaters from Hurricane Irene submerged the Cytec chemical dump in the area, causing balls of tar to go beyond the protective barriers of the waste site.[29] Bridgewater is not alone—studies document that this is a recurring issue.[30]

Because natural disasters have grown—and will continue to grow—in strength and frequency, Superfund cleanup plans cannot afford to abide by the status quo. To prevent the future sprawl of toxins, mere containment of Superfund sites is no longer sufficient. EPA, as part of its cleanup plans, must consider stronger, lasting controls that account for the imminence of natural disasters. This Comment posits that disaster mitigation land use solutions—implemented as ICs—should be part of the solution. This Comment will survey flooding and wildfire strategies that municipalities are undertaking.

II. Superfund and Climate Adaptation

A. *Background*

The CERCLA regulatory framework to protect human health from releases of toxic chemicals has been in place for 34 years.[31] Both the explicit language and the underlying policies of CERCLA require that climate change analysis be incorporated into the remediation and management of new and existing Superfund sites.[32] CERCLA provides legal options to EPA, concerned citizens, and state governments to secure Superfund sites against the threats of increased precipitation, flooding, and stronger, more frequent storms.[33]

In 2019, the U.S. Government Accountability Office (GAO) produced a report indicating that EPA's climate-resilient measures are insufficient. The GAO found that EPA's actions to manage risks to human health and the environment from potential impacts of climate change effects at nonfederal national priorities list (NPL) sites did not measure up to the standards established by enterprise risk management.[34] The report recommends that EPA integrate climate information into the site-level decisionmaking to ensure long-term protection of human health and the environment. In short, the GAO report tells us that we need to turn to local solutions.[35]

EPA has several types of remedies from which to choose. Often, the selected remedies result in contaminations left in

20. U.S. Government Accountability Office (GAO), GAO-20-73, Superfund: EPA Should Take Additional Actions to Manage Risks From Climate Change (2019), https://www.gao.gov/assets/gao-20-73.pdf.
21. Sara M. Amolegbe et al., *Adapting to Climate Change: Leveraging Systems-Focused Multidisciplinary Research to Promote Resilience*, 19 Int'l J. Env't Rsch. & Pub. Health 14674 (2022).
22. *Id.*
23. Summers et al., *supra* note 8.
24. Sengul et al., *supra* note 5; Summers et al., *supra* note 8.
25. Sengul et al., *supra* note 5, at 723.
26. *Id.*
27. *Id.*
28. New Jersey Department of Environmental Protection, American Cyanamid Superfund Site Fact Sheet 1 (2011), https://www.nj.gov/dep/srp/community/sites/pi/american_cyanamid_fs.pdf; *Climate Change Could Spell Disaster for Superfund Sites*, *supra* note 3.
29. New Jersey Department of Environmental Protection, *supra* note 28.
30. Emily Russell, *Superfund and Climate Change: Lessons From Hurricane Sandy*, NR&E, Winter 2014, at 3, https://www.law.uh.edu/faculty/thester/courses/Climate%20Intervention%20Law%202019/Superfund%20and%20Climate%20Change%20by%20Russell.pdf.
31. *Id.*
32. *Id.*
33. *Id.*
34. *See* U.S. EPA, *Superfund: National Priorities List (NPL)*, https://www.epa.gov/superfund/superfund-national-priorities-list-npl (last updated Oct. 9, 2024) (noting that the NPL is the list of sites of national priority among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States). Enterprise risk management is a framework GAO uses to help agencies assess threats that can affect the achievement of their goals. The elements of enterprise risk management include aligning the enterprise risk management process with goals and objectives; identifying risks; assessing risks; responding to risks; monitoring risks; and communicating about and reporting on risks. GAO, *supra* note 20.
35. *See* GAO, *supra* note 20.

situ, or in place.[36] In these circumstances, EPA will require a cap or sediment cap, which critics have denounced as mere band-aid solutions.[37] In the context of natural disasters, these remedies are often insufficient, as they can erode or disintegrate.

B. The Superfund Vulnerability Assessment

EPA notes that "consideration of climate change implications in cleanup projects is most effective through use of a place-based strategy, due to variations in the geophysical characteristics of contaminated sites, the nature of remedial actions, and local or regional climate and weather regimes."[38] To support this notion, EPA uses high-level climate screening to evaluate the site remedy's exposure to climate or weather hazards of concern and the remedy's sensitivity to the hazards of concern.[39]

In June 2021, the Office of Superfund Remediation and Technology Innovation issued a memorandum titled Consideration of Climate Resilience in the Superfund Cleanup Process for Non-Federal NPL Sites.[40] Consistent with CERCLA, the national oil and hazardous substances pollution contingency plan (NCP), and associated EPA Superfund guidance, the memo recommends the following approach for EPA regions to consider when evaluating climate resilience during the remedy selection and implementation process: (1) assess the vulnerability of a remedial action's components and evaluate the impact of climate change on the long-term protectiveness of a selected remedy; (2) identify and evaluate adaptation measures that increase the system's resilience; and (3) implement adaptation measures necessary to ensure the long-term protectiveness of CERCLA remedial actions.[41]

Where necessary after climate screenings, a project team may choose to conduct a detailed climate vulnerability assessment.[42] These vulnerability assessments look at variables like temperature, precipitation, wind, sea-level rise, and wildfires. Vulnerability is a function of exposure, sensitivity, and adaptive capacity.[43]

EPA provides detailed information on which climate hazards correspond with different site locations, noting, for example, that while coastal sites are at risk of storm surge and sea-level rise, all sites are vulnerable to temperature, precipitation and drought, and inland flooding.[44] EPA also provides metrics for how to determine the vulnerability of each hazard. For example, to determine whether a site is at risk of extreme temperatures, experts and site managers should analyze data such as the number of days above 95 degrees and the one-in-10-year temperature.[45]

In short, several tools exist for aiding site managers and site administrative staff in determining whether their sites may be vulnerable to climate hazards. These tools can inform whether site managers should include proactive ICs to prevent such hazards.

III. Why and How of Institutional Controls

A. ICs Generally

Superfund waste sites fall into two categories: remedial and removal. Sites are identified either by the state where the site is located, or by a citizen who alerts EPA to the problem.[46] While remedial sites—like landfills, dumps, and abandoned chemical plants—are scheduled for long-term cleanups, removal sites are sudden environmental emergencies that are not on the NPL, including mercury spills, oil tanker spills, and factory fires.[47]

In conducting remediations at Superfund sites, EPA has several tools to help it minimize the potential for human exposure to contamination and protect the integrity of the remedy. Such solutions fall into one of two categories: treatment/engineering controls and ICs. While site managers use engineering/treatment controls to address the principal threat wastes, ICs aim to reduce the exposure to contamination by limiting land or resource use and guiding human behavior.[48] The NCP emphasizes that ICs are meant to supplement, rather than subvert, engineering controls during all phases of cleanup, but may be a necessary component of the completed remedy.[49]

EPA normally uses ICs when waste is left on-site and when there is a limit to the activities that can safely take place at the site (i.e., the site cannot support unlimited use and unrestricted exposure) and/or when cleanup equipment remains on-site.[50] Site managers often utilize ICs

36. In situ remediation techniques are used at Superfund sites to clean up hazardous materials without excavating or pumping groundwater. Degradation occurs when reactive materials or microbes cause chemical and biological reactions that change the contaminants.
37. David Hasemyer & Lise Olsen, *Battered, Flooded, and Submerged: Many Superfund Sites Are Dangerously Threatened by Climate Change*, Inside Climate News (Sept. 24, 2020), https://insideclimatenews.org/news/24092020/climate-change-epa-superfund-sites-hurricanes-floods-fires-sea-level-rise/.
38. U.S. EPA, *Superfund Climate Resilience: Vulnerability Assessment*, https://www.epa.gov/superfund/superfund-climate-resilience-vulnerability-assessment (last updated Feb. 5, 2025).
39. *Id.*
40. U.S. EPA, Conducting Climate Vulnerability Assessments at Superfund Sites (2023), https://www.epa.gov/system/files/documents/2023-11/cva_issuepaper_nov2023_508c.pdf.
41. *Id.*
42. *Id.*
43. *Id.* "Exposure" is defined as whether a site could experience a climate hazard; "sensitivity" is the degree to which a climate hazard impacts remedy protectiveness; and "adaptive capacity" is the ability of a system to adjust to climate change, adjust to moderate potential damages, take advantage of opportunities, or cope with the consequences.
44. *See* U.S. EPA, *supra* note 40.
45. *Id.*
46. *See* Mary Schons, *Superfund*, Nat'l Geographic (Oct. 19, 2023), https://education.nationalgeographic.org/resource/superfund/.
47. *Id.*
48. *See* U.S. EPA, *Institutional and Engineering Controls Data*, https://rcrapublic.epa.gov/rcrainfoweb/action/modules/cor/caindex (last updated Jan. 2021).
49. *Id.*
50. Memorandum from Michael B. Cook, Director, EPA Office of Superfund Remediation and Technology Innovation et al., to Superfund National Policy Managers et al., re: Institutional Controls: A Citizen's Guide to Understanding Institutional Controls at Superfund, Brownfields, Federal Facilities, Underground Storage Tanks, and Resource Conservation and Recovery

throughout a site cleanup, including when the contamination is first discovered; cleanup work is ongoing; and some amount of contamination remains on-site as part of a cleanup remedy. EPA encourages the use of ICs in layers. Layering ICs means using more than one IC at the same time, all with the same goal.[51] A common use of this method includes layering an informational device and an enforcement tool.

There are four general categories of ICs: proprietary controls, enforcement and permit tools with IC components, informational devices, and governmental controls.[52] Proprietary controls include property use restrictions based on private-property law like easements or covenants.[53] Enforcement and permit tools include documents that require individuals or companies to conduct or prohibit specific actions.[54] Informational devices include deed notices or public advisories that alert and educate people about a site.[55]

Finally, governmental controls include local laws or permits that typically rely on the locality's zoning system.[56] This Comment focuses on governmental controls because they allow the broadest reach of regulation. It uses "governmental controls" and "land use controls" interchangeably.

Typically, state or local governments implement and enforce governmental controls. These controls can include zoning restrictions, building codes, or other provisions that restrict land or resource use at the site.[57] Local governments have legal authority to impose a variety of land use controls, from simple use restrictions to more sophisticated measures such as planned unit development zoning districts and overlay zones.

When implementing zoning codes as ICs, EPA encourages the site managers to work with the local municipality's planning staff to determine whether any anticipated changes to the ordinance are likely and what procedures for assuring zoning compliance exist. Final approval or denial of the zoning application will generally come from the governing body of the local jurisdiction.[58] Any building on the site must comply with such land use restrictions.

B. *Why ICs on Land Use?*

While the obligation to create land use controls may be contained in a federal consent decree, EPA must rely on actions under state property law or the general police power of local governments to create and maintain the controls.[59] The United States' dual system of federalism reserves to the states the powers that are not specifically delegated to the federal government by the U.S. Constitution. The Tenth Amendment acknowledges the Constitution's reservation of powers.[60] The police power and other powers reserved to the states are not powers conferred upon the states, but ones that have always resided within their dominion.

Although difficulties in defining the police power have plagued both courts and scholars, the term has come to be understood as the power to protect the health, safety, and welfare, closely tied to land use and natural resource protection. The delegation of power to control and tax local development explains why state legislatures have not vested their state agencies with land use control so as not to compete with or hinder this traditional local jurisdiction.[61] It also demonstrates why the opportunity—or responsibility—rests with local governments to fill the significant gaps left by federal and state authorities.[62]

Involving the local government has potential to boost the relationship between site managers and the locals impacted by a cleanup.[63] Many populations—particularly disenfranchised communities living near Superfund sites—may have reservations about interacting with the federal government. By integrating the local government as a conduit for and representative of the community, the site managers and agency staff can better understand the community's needs and goals for the site going forward.

Further, natural disaster impacts are typically site-specific. While a particular state may be prone to certain natural disasters, there is little recourse for state-level solutions that can effectuate the necessary level of detail when adapting to these disasters. Natural hazards can interact with toxic contaminant sites in many ways. Mine drainage sites can release contaminants to adjacent ecosystems via flooding.[64] Hurricanes can redistribute toxic contaminants through coastal flooding, high wind, and excessive rain.[65] Finally, earthquakes can breach contained systems, distributing contaminants.[66] Therefore, site managers ought

Act Cleanups (Mar. 1, 2005), https://www.epa.gov/sites/default/files/documents/ic_ctzns_guide.pdf.

51. *Id.*; U.S. EPA, Institutional Controls: A Site Manager's Guide to Identifying, Evaluating, and Selecting Institutional Controls at Superfund and RCRA Corrective Action Cleanups (2000), https://www.epa.gov/sites/default/files/2016-01/documents/icfactfinal.pdf (noting that to restrict land use, the site manager may issue an enforcement tool such as a unilateral administrative order, obtain an easement, initiate discussions with local governments about a zoning change, and enhance future awareness of restrictions by recording them in a deed notice and in a state registry of contaminated sites).
52. Memorandum from Michael B. Cook, *supra* note 50.
53. *Id.* at 6.
54. *Id.*
55. *Id.*
56. *Id.*
57. U.S. EPA, Institutional Controls: A Guide to Planning, Implementing, Maintaining, and Enforcing Institutional Controls at Contaminated Sites (2012), https://www.epa.gov/sites/default/files/documents/final_pime_guidance_december_2012.pdf.
58. *Id.*
59. Maureen Hartwell, *Strengthening Superfund Cleanups With Land Use Institutional Controls*, 54 ELR 10548 (July 2024), https://www.elr.info/articles/elr-articles/strengthening-superfund-cleanups-land-use-institutional-controls.
60. U.S. Const. amend. X.
61. *See* Richard C. Schragger, *Federalism, Metropolitanism, and the Problem of States*, 105 Va. L. Rev. 1, 29 (2019).
62. *See id.*
63. Hartwell, *supra* note 59.
64. Summers et al., *supra* note 8.
65. Gopal Bera et al., *Baseline Data for Distribution of Contaminants by Natural Disasters: Results From a Residential Houston Neighborhood During Hurricane Harvey Flooding*, 5 Heliyon e02860 (2019).
66. Hiroaki Kato et al., *Depth Distribution of ^{137}Cs, ^{134}Cs, and ^{131}I in Soil Profile After Fukushima Dai-ichi Nuclear Power Plant Accident*, 111 J. Env't Radioactivity 59 (2012).

to examine site conditions by considering local topography and the likelihood of exposures.

By drawing on ICs, the Superfund program can tap into typically inaccessible local land use powers to direct the cleanup measures. The convergence of federal and local powers is already accounted for in the law with ICs—municipalities and site managers just need to take advantage of them.[67] This Comment posits that local governments are best positioned to implement climate-resilient strategies ahead of natural disasters for two reasons: local governments are the first line of defense and zoning solutions—like those described later—are more cost-effective than federal response measures.

C. Local Governments Are the First Line of Defense

Most state legislatures have delegated local governments extensive legal authority to determine what type of development may be built within their jurisdictions, including disaster-prone areas and vulnerable coastal areas.[68] This authority is found in state constitutions, planning enabling acts, zoning enabling acts, home rule authority, and additional state laws that permit localities to protect health and safety, to preserve the local physical environment, and to mitigate disaster damage.[69] Traditional local land use laws can be used to create disaster-resilient communities as a key objective of a community's land use regime.[70]

First, the zoning enabling act adopted in most states generally makes it clear that one of its purposes is to encourage "the most appropriate use of land throughout the municipality."[71] Laws that lessen the prospect of damage from natural disasters certainly encourage the most appropriate use of land. Further, the statutes delegating power to localities to adopt subdivision and site plan regulations make it clear that standards may be included in such regulations that prevent and control the impacts of storms and other calamities.[72]

Local governments are the first line of defense against emergencies and disasters, and are primarily responsible for managing the response to and recovery from those events.[73] Officials have distinct roles before, during, and after disasters.[74] Pre-disaster, they advocate risk reduction through codes and planning.[75] During disasters, they rely on emergency managers' expertise, empowering them to make decisions and foster communication.[76] After disasters, officials focus on resilience through investments and assistance programs.[77]

Many local governments have become adept at managing natural weather-related disasters, as severe winter weather, hurricanes, and flooding become more frequent occurrences that instigate a network of emergency response and recovery efforts.[78] In the case of these types of disasters, the intergovernmental system approach in the United States is federal support, state coordination, and local response in the aftermath of an event.[79]

Regardless of community size or the nature of the disaster, local government leaders are responsible for overseeing all four phases of emergency management—preparedness, response, recovery, and mitigation.[80] Federal and state governments play a supporting role in the immediate aftermath, and in providing funding and guidance for long-term recovery and mitigation.[81]

State and local governments—including special districts and utilities—hold more decisionmaking power on disaster mitigation investments than the federal government through routine public infrastructure updates, operation, and maintenance.[82] Historically, local governments are the biggest funders of infrastructure, financed through municipal bonds and tax revenues.[83] Municipal and county governments also have control over the nature of local land development that may affect hazard exposure; for example, allowing development close to forested areas at risk of wildfires or along threatened coastlines.[84] Thus, allowing local governments to control more of the disaster preparation, rather than solely the response, could potentially prevent the catastrophic impacts of disasters in the first place.

D. Fronting the Costs of Risk Reduction

The public sector spends far less on risk reduction than on recovery, and it fails to target scarce risk-reduction dollars to the highest-need and highest-risk areas.[85] Historically, investments in risk reduction have paled in comparison to spending on disaster recovery. The Federal Emergency Management Agency's (FEMA's) pre-disaster mitigation spending has been minimal, and spending from the U.S. Army Corps of Engineers for flood mitigation has

67. *See* 40 C.F.R. §§264.118, 265.118; NCP, *id*. §300.430(a)(1)(iii)(D).
68. John R. Nolon, Protecting the Environment Through Land Use Law: Standing Ground 5 (2014).
69. *Id*.
70. *Id*. at 6.
71. *Id*.
72. *Id*.
73. *How Communities Deal With Emergencies and Disasters*, *in* A Citizen's Guide to Disaster Assistance 2-1 (Federal Emergency Management Agency 2003), https://training.fema.gov/emiweb/downloads/is7unit_2.pdf.
74. Yucel Ors, *Local Leaders' Role Before, During, and After Disasters*, Nat'l League Cities (Sept. 1, 2023), https://www.nlc.org/article/2023/09/01/local-leaders-role-before-during-and-after-disasters/.
75. *Id*.
76. *Id*.
77. *Id*.
78. Komla D. Dzigbede et al., *Disaster Resiliency of U.S. Local Governments: Insights to Strengthen Local Response and Recovery From the COVID-19 Pandemic*, 80 Pub. Admin. Rev. 634 (2020), https://pmc.ncbi.nlm.nih.gov/articles/PMC7300832/.
79. *Id*. at 635.
80. Christine Becker, *Disaster Recovery: A Local Government Responsibility*, Pub. Mgmt., Mar. 2009, at 6, https://icma.org/documents/disaster-recovery-local-government-responsibility.
81. *Id*.
82. Carolyn Kousky et al., *As Disasters Become More Costly, the US Needs a Better Way to Distribute the Burden*, Brookings (Sept. 13, 2023), https://www.brookings.edu/articles/as-disasters-become-more-costly-the-us-needs-a-better-way-to-distribute-the-burden/.
83. *Id*.
84. *Id*.
85. *Id*.

focused on a limited number of flood control projects around the country.[86]

A 2019 study from the National Institute of Building Sciences found that every dollar invested in disaster mitigation saves six dollars.[87] Indeed, more recent data indicate that mitigation can save up to 13 dollars per dollar invested.[88] Until recently, most federal funding to help states manage costs became available only after an incident.[89] However, in April 2024, recognizing the importance of inviting local efforts, FEMA unveiled its guidance for emergency managers, Climate Adaptation Planning.[90] The guide states that it is intended "to help state, local, tribal, and territorial (SLTT) emergency managers incorporate climate adaptation into emergency planning efforts."[91]

This comprehensive guide includes several "climate adaptation planning principles."[92] One such principle is the "link to community planning processes."[93] In explaining this principle, the guide notes:

> Most communities have well-established planning processes that provide the infrastructure, services, land use, economic development, and public health foundations for a community to thrive and prosper over time. Effective climate planning can be integrated into these planning efforts so that strategies are put into place to adapt existing services, infrastructure, and capabilities to withstand future climate-related challenges.[94]

Among other accomplishments, this document outlines several different measures for financing climate adaptation and mitigation. Namely, the Building Resilient Infrastructure and Communities (BRIC) program funds capability and capacity-building activities such as mitigation planning and mitigation projects that directly impact the natural and built environment.[95] Further, FEMA has stated that BRIC aims to deliver 40% of its overall benefits to disadvantaged communities.[96] Thus, if properly taken advantage of, climate disaster anticipation—rather than mere response—can save costs in the long term.

E. The Challenges of ICs

Before delving into examples of climate-protective land use measures, it is important to acknowledge some of the shortcomings of ICs. Namely, ICs are not a sustainable solution because they ask local governments to sacrifice flexibility and creativity with land uses in response to improper containment. Put differently, ICs ask local governments to deal with the fallout of contamination that EPA failed to deal with the first time around.

Scholars have criticized solutions like ICs as relying on risk avoidance—strategies that call upon risk bearers to alter their practices and ways of living to avoid exposure to contaminants left unabated.[97] For example, asthmatics might be advised to refrain from going outside on "ozone alert" days to avoid the risks of ground-level ozone pollution; and parents may be instructed to keep their children from making mud pies to avoid the risks of lead and other heavy metal contamination.[98]

ICs may indeed be a form of risk avoidance. Since 1982, 167 Superfund sites have used solidification/stabilization (S/S), including both in situ and ex situ projects.[99] S/S is a treatment technology used at these sites to prevent or slow the release of harmful chemicals from contaminated materials.[100] Solidification binds waste into a solid block using a binding agent like cement, asphalt, fly ash, or clay.[101] Stabilization causes a chemical reaction that makes contaminants less likely to be leached into the environment.[102] Historically, S/S has been one of the top five source control treatment technologies used at Superfund remedial sites. Critics have argued that S/S is not an effective means of containment at Superfund sites because the processes do not actually remove the contaminants from the land.[103]

Understanding the potential dangers of S/S methods, this Comment recognizes that the best, most durable solution would be more complete remediations at the outset of a cleanup.[104] However, given that a large-scale overhaul of treatments does not seem feasible at this time, the Comment instead offers ICs as a short-term solution to shielding

86. *Id.*
87. National Institute of Building Sciences, Mitigation Saves: Federal Grants Provide a $6 Benefit for Each $1 Invested (2019), https://www.nibs.org/files/pdfs/ms_v3_federalgrants.pdf.
88. Thaddeus Swanek, *Being Prepared for the Next Disaster Pays Off, New Study Shows*, U.S. Chamber Com. (June 25, 2024), https://www.uschamber.com/security/being-prepared-for-the-next-disaster-pays-off-new-study-shows.
89. Pew Charitable Trusts, Natural Disaster Mitigation Spending Not Comprehensively Tracked (2018), https://www.pewtrusts.org/-/media/assets/2018/09/fiscal_federalism_federal_and_state_funding_issue_brief_v1.pdf.
90. FEMA, Climate Adaptation Planning: Guidance for Emergency Managers (2024), https://www.fema.gov/sites/default/files/documents/fema_climate-adaptation-planning-guide_2024.pdf.
91. *Id.* at 1.
92. *Id.* at 23.
93. *Id.*
94. *Id.*
95. *Id.* at 25.
96. *Id.* at 65.
97. Catherine O'Neill, *No Mud Pies: Risk Avoidance as Risk Regulation*, 31 Vt. L. Rev. 273 (2007), https://digitalcommons.law.seattleu.edu/faculty/440.
98. *Id.* at 273.
99. Office of Solid Waste and Emergency Response (OSWER), U.S. EPA, Use of Bioremediation at Superfund Sites (2001) (EPA-542-R-01-0190).
100. OSWER, U.S. EPA, Solidification/Stabilization Use at Superfund Sites (2000) (EPA-542-R-00-010).
101. *Id.*
102. *Id.*
103. OSWER, U.S. EPA, Cost and Performance Report: Solidification/Stabilization at the New Bedford Harbor Superfund Site, New Bedford, Massachusetts (2000). For example, S/S was determined not to be effective in treating PCBs in the hot spot sediments and did not appreciably reduce the leachability of semi-volatile organic compounds in the hot-spot sediments in a 2000 study of the New Bedford Harbor Superfund site.
104. Scholars and policymakers have debated for decades on what constitutes the most health-protective Superfund site remedy. Importantly, it depends on several factors like topography, the type of contaminant, and whether the site is on the NPL. Ultimately, the remedy is contingent on sufficient funding; however, the most health-protective Superfund remediation is to remove the source of toxins and remove the toxins themselves entirely.

the public from contaminants spread via natural disasters around Superfund sites.[105]

IV. Case Studies

Understanding that land use ICs present a viable solution for climate preparedness at and around Superfund sites, this Comment reviews how vulnerable communities are taking note of climate disasters and implementing creative strategies in preparation. Most ICs across the country regulate groundwater, restrict land use, or require soil testing for new developments near Superfund sites. This Comment proposes reimagining ICs as a tool for disaster mitigation and preparedness.

A. Flooding Solutions

EPA has determined that more than 300 Superfund sites are at risk of flooding.[106] More than 700 of the 945 sites vulnerable to climate change are in 100-year floodplains, meaning they have a chance of 1% or more of flooding in any given year, and more than 80 regularly flood at high tide or are already permanently submerged.[107] Forty-nine of the sites face triple threats—they are in 100-year floodplains, regularly flood, and are vulnerable to hurricanes, according to EPA and GAO data.[108] To prevent complete destruction to communities and landscapes, site managers and local governments should work together to institute robust ICs.

In 2021, repeated flooding from Hurricane Henri disturbed old contaminants and sent them flowing downstream to Little Thunder Brook—a small tributary with high concentrations of PCBs in the sediment from the nearby Dewey Loeffel Landfill Superfund site.[109] This tributary experienced flooding and shifts in flow, washing away sections of the stream bank with contaminated soil and sending them downstream toward the Valatie Kill, which flows into Nassau Lake and eventually the Hudson River.[110] According to EPA, the toxins disturbed by the storm were produced in the 1950s and 1960s by General Electric and SI Group, who contracted with Dewey Loeffel to dump more than 46,000 tons of industrial hazardous wastes, carcinogens, and PCBs into a natural lagoon-turned-dumping ground.[111] The total amount of hazardous waste at the Dewey Loeffel site was twice the volume of what was buried at the infamous Love Canal site.[112]

In the decades since dumping stopped at Dewey Loeffel, the contaminants have migrated out and traveled deep in the soil on the banks of the brook and are still found today.[113] Under the oversight of EPA, General Electric and SI Group are now conducting a remedial investigation and feasibility study (RI/FS) for Little Thunder Brook, the landfill, groundwater, and other water bodies connected to the site.[114] The companies are paying for EPA's costs to oversee the current cleanup. Along with PCBs, metals, pesticides, and semi-volatile and volatile organic compounds, additional toxins are still being discovered.[115] In 2014, the cleanup discovered 1,4-dioxane at the site, a chemical considered by EPA to be a "likely human carcinogen."[116]

In 2017, the Rensselaer County Legislature passed a county law limiting the discharge of 1,4-dioxane from Superfund site properties that are owned by the county to a maximum level of 0.35 parts per billion.[117] While there is no federal maximum contaminant level, EPA has a nonbinding health advisory level for screening 1,4-dioxane in drinking wells and groundwater.[118] According to the local law, if a person or entity violates any rule or regulation promulgated pursuant to it relating to a temporary or permanent source or act of contamination, the Rensselaer County Department of Health may impose a civil penalty for the violation thereof or the noncompliance therewith, not exceeding $1,000 for every such violation or noncompliance.[119]

While there is limited data on the effectiveness of this specific law, flood-vulnerable towns—or managers of sites vulnerable to flooding—can mimic these tactics by adopting their own laws limiting the discharge toxins from Superfund site properties that are owned by the municipality to a maximum level where an EPA maximum does not exist. In similar sites, EPA can—and should—limit the discharge toxins via an IC or otherwise include more stringent restrictions in the record of decision (ROD).

B. Wildfire Solutions

The federal government has warned that 234 Superfund sites are vulnerable to wildfires.[120] Of those, 68 have already

105. President Donald Trump has, in the past, delisted sites and pushed the Superfund program to the backburner. Scholars and advocates worry that his second term could bring less funding for the program. The fiscal 2021 budget, for example, proposed cutting Superfund funding by $113 million, after similar proposed cuts for fiscal year 2020. *See* E.A. (Ev) Crunden, *Trump Leaves Murky Superfund Legacy*, E&E News (Jan. 13, 2021), https://www.eenews.net/articles/trump-leaves-murky-superfund-legacy/.
106. *What Worsening Floods Mean for Superfund Sites*, Sci. Friday (Apr. 19, 2024), https://www.sciencefriday.com/segments/superfund-sites-flooding-climate-change/.
107. Hasemyer & Olsen, *supra* note 37.
108. *Id.*
109. U.S. EPA, *Superfund Site: Dewey Loeffel Landfill Nassau, NY*, https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0201218 (last visited Feb. 10, 2025).
110. Barbara Reina, *With Flooding on the Rise, Hudson Valley Superfund Sites Are at Risk*, River (June 21, 2022), https://www.chronogram.com/river-newsroom/with-flooding-on-the-rise-hudson-valley-superfund-sites-are-at-risk-18194632.
111. *Id.*
112. *Id.*
113. *Id.*
114. *See What Worsening Floods Mean for Superfund Sites*, *supra* note 106.
115. Jorja Roman, *Rensselaer County Legislature Proposes Law to Limit Discharge of Possible Carcinogen in Water*, Spectrum 1 News (Oct. 11, 2017), https://spectrumlocalnews.com/nys/capital-region/news/2017/10/12/nassau-superfund-site-discharge-proposal.
116. National Institutes of Health, Toxicological Profile for 1,4-Dioxane (2007), https://www.ncbi.nlm.nih.gov/books/NBK153666/.
117. Rensselaer County, N.Y., Local Law No. 1 (2018), https://www.rensselaer-county.org/wp-content/uploads/LL-1-of-2018-2.pdf.
118. U.S. EPA, Technical Fact Sheet—1,4-Dioxane (2014), https://semspub.epa.gov/work/01/575107.pdf.
119. Roman, *supra* note 115.
120. GAO, *supra* note 20.

seen fires approach.[121] Understanding the prevalence and immediacy of wildfires at Superfund sites, it is important to survey how local governments—whether located near a Superfund site or not—are responding to and preparing against the rapid spread of contaminants within our nation's forests.

The Carr Fire of 2018 began some five miles west of the Iron Mountain Mine Superfund site in Redding, California, on July 23, 2018.[122] It ultimately overran the site, crippling critical wastewater treatment infrastructure that captures as much as 168 million gallons of acid mine drainage each month. It took more than five weeks to contain.[123] A spokeswoman for Shahid Mahmud, head of EPA's National Mining Team, said that because of the more frequent and larger conflagrations, including the Carr Fire, cleanup plans for former mines are now designed with wildfires in mind.[124]

The former mine leaches water more corrosive than battery acid, which also contains large amounts of zinc, copper, and cadmium.[125] Were it to flow untreated into surrounding streams, the toxic water would kill fish, including the endangered winter-run Chinook salmon, and destroy the habitat for area wildlife.[126] The acid and poisons in the tainted water could eventually contaminate Spring Creek Reservoir, which holds mountain runoff before it enters the Sacramento River eight miles above Redding, a city of 90,000 that depends on the river for its drinking water.[127]

In anticipation of the fire burning power poles, site managers shut off electricity to the treatment facility that cleans the toxic acid drainage before it enters the watershed. Fire also crawled into the mine along hundreds of feet of polyethylene pipe, a fuse that could have ignited the combustible pyrite—fool's gold—causing an explosion deep inside the cavern. After the treatment system shut down, an emergency collection reservoir and a million-gallon holding tank captured the tainted water before it could reach nearby streams. Firefighters extinguished the flames creeping along the pipe inside the mine before they ignited the pyrite, preventing an explosive fire that could have released choking clouds of sulfur dioxide. The million-gallon tank collected 395,000 gallons of acid mine water that was neutralized once electricity was restored to the treatment facility a few days after the fire. Plastic pipes that caught fire were replaced by stainless steel pipes.

The close call prompted EPA officials to note the danger wildfire posed to the site, in a five-year review completed a month after the fire.[128] This five-year review called for ICs like California Department of Forestry and Fire Protection access and use restrictions and continued operational controls. The five-year review noted that ICs are effective because they prevent human exposures and adverse impacts to the integrity or protectiveness of the interim remedial measures.

Critics alleged that the state knew the Carr Fire could happen, but failed to prevent it.[129] Indeed, dozens of interviews and records show that the blaze was forecast for several years prior.[130] Thus, at the very minimum, sites that are vulnerable to wildfires—either because of their remoteness or topography—should implement ICs that grant access to the state departments of forestry or fires, where applicable, and create plans that restrict electricity and other harms in the wake of a fire near a site.

V. Recommendations

Climate-resilient policies are integral to the future of Superfund site management. Experts tell us that disaster preparedness can most effectively occur at the local level. Understanding that Superfund sites—and the communities around them—are particularly vulnerable to climate disasters, it is imperative to find solutions in anticipation of these wildfires and flooding to minimize inevitable damage. Across the country, climate-vulnerable municipalities have adopted unique measures to prepare against disasters. Site managers at Superfund sites can implement similar strategies by utilizing ICs to prevent the sprawl of toxins into the outer community.

While local leaders can typically implement disaster-resilient land use measures without permission from EPA, site managers, conversely, must work with the local leaders to execute ICs. Many communities have expressed frustration at EPA's inaction at Superfund sites. In April 2024, the Office of Inspector General for EPA found that EPA Region 7 did not effectively engage with the community affected by the Findett Corp. Superfund site.[131] Similarly, Rensselaer County residents living near the Dewey Loeffel Landfill complained that they had to take matters into their own hands, instead of deferring to EPA site management.

121. *See* Michael Kodas & David Hasemyer, *Wildfires Fueled by Climate Change Threaten Toxic Superfund Sites*, NBC News (Dec. 23, 2020), https://www.nbcnews.com/news/us-news/wildfires-fueled-climate-change-threaten-toxic-superfund-sites-n1252156 (noting that in 2010, the 109,000-acre Jefferson Fire spread across the Idaho National Laboratory, a nuclear energy research facility, where it burned over Superfund sites that had been cleaned of radioactive contamination over the previous 17 years). In 2018, the Carr Fire burned across 359 square miles of northern California and swept over the Iron Mountain Mine Superfund site, threatening to release corrosive chemicals into the watershed. The narrowly averted disaster spurred EPA to reexamine the threat posed by wildfires to Superfund sites, especially old mines.
122. *See* Kodas & Hasemyer, *supra* note 121; *see also* Owen Mulhern, *Chemically Contaminated Superfund Sites Threatened by Climate-Amplified Disasters*, Earth.org (Feb. 9, 2021), https://earth.org/data_visualization/superfund-wildfire/.
123. *See* Kodas & Hasemyer, *supra* note 121.
124. *Id.*
125. *Id.*
126. *Id.*
127. *Id.*
128. U.S. EPA, Sixth Five-Year Review Report for Iron Mountain Mine Superfund Site, Shasta County, California (2018), https://semspub.epa.gov/work/09/100010569.pdf.
129. Keith Schneider, *California Knew the Carr Wildfire Could Happen. It Failed to Prevent It*, ProPublica (Dec. 18, 2018), https://www.propublica.org/article/california-carr-wildfire-failed-to-prevent-it.
130. *Id.*
131. Office of Inspector General, U.S. EPA, EPA Region 7 Did Not Effectively Engage With the Community Surrounding the Findett Corp. Superfund Site (2024), https://www.epaoig.gov/sites/default/files/reports/2024-04/_epaoig_20240417-24-e-0033_cert_002.pdf.

Thus, while communities should continue to implement appropriate measures to deal with climate disasters, this Comment calls EPA staff members to action so that local leaders—overburdened as they already are—do not have to take on extra responsibilities.[132] Site managers should identify sites that are climate-vulnerable and, where applicable, add in disaster mitigation ICs. There are myriad legal tools EPA has at its disposal, including remedy selection, operation and maintenance (O&M) agreements, five-year agreements, and consent decree provisions. The Comment briefly explores how EPA can leverage these tools to make Superfund sites more health-protective at multiple crossroads in the Superfund remedial process.

A. Remedy Selection and ROD

The best, most health-protective use of ICs is implementing them in the initial remedy selection.[133] The Superfund program's remedy selection process links the analysis of site cleanup alternatives, conducted in an RI/FS, with the documentation of the selected remedy in a ROD.[134] CERCLA established five principal requirements for the selection of remedies. Remedies must (1) protect human health and the environment; (2) comply with applicable or relevant and appropriate requirements unless a waiver is justified; (3) be cost effective; (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and (5) satisfy a preference for treatment as a principal element, or provide an explanation in the ROD as to why this preference was not met.[135]

EPA can include ICs in remedy selection by considering them as a potential component of a cleanup plan, particularly when engineering controls alone may not be sufficient to prevent human exposure to contamination. The ROD should clearly define the types of ICs required, the areas where they will be applied, and the responsible party's obligations regarding implementation and maintenance.[136] The ROD should include provisions for monitoring and enforcement actions against the responsible party if they fail to comply with the IC requirements. EPA may involve local governments and communities in the development of the ICs to ensure their practicality and acceptance.

B. O&M Agreements

O&M measures are those "initiated after the remedy has achieved the remedial action objectives and remediation goals in the ROD, and is determined to be operational and functional, except for ground- or surface-water restoration actions covered under [40 C.F.R.] §300.435(f)(4)."[137] O&M measures are designed to maintain the remedy at a site to ensure that the remedy remains protective of human health and the environment.[138]

O&M measures may require maintenance of ICs, or, if EPA failed to include ICs in the initial remedy selection, it could also include ICs in O&M agreements. This is achieved by explicitly outlining the specific legal and administrative mechanisms that will be used to restrict land use and access to a contaminated site, ensuring that the responsible party is legally obligated to maintain these controls throughout the O&M period.

C. Five-Year Review and Alterations to the ROD

Finally, EPA can include ICs during the five-year review process by changing the ROD. Under CERCLA §121(c), EPA is required to review the remedies at Superfund sites where hazardous substances remain at levels that potentially pose an unacceptable risk.[139] Such reviews must be conducted every five years or may be conducted more frequently if necessary to ensure the protectiveness of the remedy.[140] The five-year review requirement applies remedial actions selected under CERCLA §121, upon completion of which the hazardous substances, pollutants, or contaminants will remain on-site.[141]

Changes to RODs can occur under either a ROD amendment or a less rigorous explanation of significant difference (ESD) process. When a fundamental change is made to the basic features of the remedy selected in a ROD with respect to scope, performance, or cost, the lead agency is required to develop and document the change consistent with the ROD process.[142] This entails the issuance of a revised proposed plan that highlights the proposed changes. An amended ROD that documents the change follows the proposed plan. The portion of the ROD being amended is evaluated using nine criteria, focusing on those central to the rationale for the selected remedy.[143]

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132. National League of Cities, *Municipal Workforce Labor Shortage*, https://www.nlc.org/resource/improving-opportunities-and-boosting-economic-mobility/challenges/municipal-workforce-labor-shortage/ (last visited Feb. 10, 2025) (indicating that there is a nationwide labor shortage for the municipal work force).
133. OSWER, U.S. EPA, Rules of Thumb for Superfund Remedy Selection (1997), https://semspub.epa.gov/work/HQ/174931.pdf.
134. *Id.*
135. CERCLA, 42 U.S.C. §121.
136. OSWER, U.S. EPA, Institutional Controls: A Guide to Preparing Institutional Control Implementation and Assurance Plans at Contaminated Sites (2012).
137. National Oil and Hazardous Substances Pollution Contingency Plan, 40 C.F.R. §300.435(f)(1).
138. OSWER, U.S. EPA, Operation and Maintenance in the Superfund Program (2001).
139. U.S. EPA, Five-Year Review Process in the Superfund Program (2003).
140. *Id.*
141. *Id.*
142. NCP §300.435(c)(2)(ii)(A)-(H).
143. *See* OSWER, *supra* note 133. The evaluation of alternatives explains the lead agency's rationale for selecting the preferred alternative. The nine criteria used to evaluate the alternatives and compare them to one another in the detailed analysis in the FS should also be presented in the proposed plan. The nine criteria fall into three groups: threshold criteria, primary balancing criteria, and modifying criteria. A description of the purposes of the three groups follows: threshold criteria are requirements that each alternative must meet to be eligible for selection; primary balancing criteria are used to weigh major trade offs among alternatives; and modifying criteria may be considered to the extent that information is available during the FS but can be fully considered only after public comment is received on the proposed plan. In the final balancing of trade offs between alternatives upon which the final remedy selection is based, modifying criteria are of equal importance to the balancing criteria.

An ESD is a document that describes changes to a remedy for an environmental cleanup site without fundamentally altering the original remedy. Changes outlined in an ESD can include modifying soil sampling procedures, changing soil remediation standards, altering waste management strategies, or adding ICs to allow for more flexibility. For example, in the Town of Pines Superfund site in Indiana, EPA issued an ESD, explaining:

> The purpose of this ESD is to document the addition of potential ICs to allow for more flexibility as part of the soil remedy for the Site and to provide access to the Site to conduct the soil and groundwater remedies, remove hexavalent chromium as a contaminant of concern (COC) for soil, and clarify the scope of the selected soil remedy in the ROD.[144]

In a 2011 Office of Solid Waste and Emergency Response (OSWER) directive, EPA notes that if a five-year review reveals that ICs are necessary to help ensure protectiveness at a site but were not selected as part of the original remedy, modification of the ROD generally would be appropriate.[145] Thus, EPA has contemplated the use of after-the-fact ICs. Given the many sites that EPA has already purportedly remedied, including ICs in the ROD during the five-year review may be the most viable solution for many sites.[146]

VI. Conclusion

ICs will not allow communities to completely avoid the harms of climate disasters; however, site managers and local leaders can try to mitigate the impacts by incorporating climate-resilient measures as early in the cleanup process as possible. To determine which sites are most in need of ICs, EPA can draw on its tools like the climate vulnerability assessment to create an order of sites that necessitate bolstered measures like ICs.

144. U.S. EPA, Explanation of Significant Differences: Town of Pines Superfund Site (2020), https://semspub.epa.gov/work/05/953655.pdf.

145. Memorandum from James E. Woolford, Director, EPA Office of Superfund Remediation and Technology Innovation & Reggie Cheatham, Director, EPA Federal Facilities Restoration and Reuse Office, re: Transmittal of OSWER Directive "Recommended Evaluation of Institutional Controls: Supplement to the 'Comprehensive Five-Year Review Guidance'" (Sept. 13, 2011), https://semspub.epa.gov/work/HQ/175441.pdf.

146. According to EPA's Superfund Remedy Report, as of the latest data available, EPA has completed remedies on 1,548 sites. *See* Office of Land and Emergency Management, U.S. EPA, Superfund Remedy Report 17th Edition (2023), https://semspub.epa.gov/work/HQ/100003149.pdf.