

BACKFIRED! DISTORTED INCENTIVES IN WILDFIRE SUPPRESSION TECHNIQUES

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Abstract

Wildfires' increasing growth and spread have prompted aggressive approaches to fighting fire. The techniques used by firefighters can cause great damage to timberlands. Yet, there is currently no external review of the efficiency, costs, or impacts of various firefighting techniques. Consequently, there is no meaningful way to compare the relative costs and benefits of various strategies. This Article provides a ground breaking first ex post analysis of the effects of wildfire firefighting techniques. It provides a detailed case study of the technique of backfire—use of fire to fight fire—to demonstrate that the incentives of firefighters can be poorly aligned with the interests of landowners and environmentalists interested in protecting timberlands. Despite the costs inflicted by backfire, firefighters increasingly use it as a firefighting technique. The result is that enormous swaths of forest are burned to fight fire that could be suppressed with far less environmental and property loss. Using backfire as an example, this Article illustrates the importance of ex post analysis of wildfire suppression techniques and the value of such analysis in encouraging more sustainable firefighting techniques.

INTRODUCTION

Wildfires' enormous increase and damage necessitates an aggressive response.¹ Government firefighting agencies have responded with rapidly-growing budgets and highly-publicized suppression activities.² But, the threat and

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¹ See Kate Robertson, *Forest Fire's Price Tag*, THE S.F. CHRON., June 8, 2010, available at <http://financialedge.investopedia.com/financial-edge/0610/A-Forest-Fires-Price-Tag.aspx>.

² In 2008, the L.A. Times published an exposition on intentional waste of resources by government firefighting agencies, reporting that expensive aircrafts often are used during fire in response to political pressure, even when it is known that the use of aircraft will not further fire suppression goals. Julie Cart & Bettina Boxall, *Air Tanker Drops in Wildfires Are Often Just for Show*, L.A. TIMES, July 29, 2008, available at <http://www.latimes.com/news/local/politics/cal/la-me-wildfires29->

immediacy of wildfire seasons provide little time for reflection. Accordingly, academia has engaged in virtually no *ex post* analysis of the wisdom and costs of different methods of firefighting.³ Ignoring the relative costs and benefits of firefighting techniques is devastating to America's forests and the people who strive to maintain them.

This is the first article analyzing the *ex post* effects of fire suppression activity.⁴ It analyzes the incentives that drive the current backfire regime and the resulting inefficiencies, linking the backfire regime to a law and economics analysis to demonstrate the misalignment of incentives and why the concerns here differ from other situations in which the government operates as the sole decision maker.⁵

Section I explains that there is currently no *ex post* review of the efficacy of wildfire suppression techniques. Section II presents a case study of backfire and explains the negative long-term impacts its over-use can cause. Section III provides a law and economics rationale explaining that compensation under takings law is necessary to protect environmental losses caused by backfire. Section IV provides a policy proposal to correct distorted incentives in the application of suppression techniques, by requiring compensation for *misapplied*

2008jul29,0,6778040,full.story (reporting that “[a]viation costs amount to about one-fifth of [U.S. Forest Service] fire-suppression spending . . . \$296 million in 2007.”).

³ Wildfire has garnered increasing attention among legal scholars lately, after a long period of inattention. See Robert B. Keiter, *The Law of Fire: Reshaping Public Land Policy in an Era of Ecology and Litigation*, 36 ENVTL. L. 301 (2006) (exploring wildfire policies); Rebecca K. Smith, *War on Wildfire: The U.S. Forest Service's Wildland Fire Suppression Policy and Its Legal, Scientific, and Political Context*, 15 U. BALT. J. ENVTL. L. 25 (2007) (summarizing the interplay among federal agencies in wildfire suppression); Jamison Colburn, *The Fire Next Time: Land Use Planning in the Wildland/Urban Interface*, 28 J. LAND RESOURCES & ENVTL. L. 223 (2008).

There are only a small number of articles which use a law and economics approach to assess wildfire policies. See Jonathan Yoder, *Liability, Regulation, and Endogenous Risk: The Incidence and Severity of Escaped Prescribed Fires in the United States*, 51 J.L. & ECON. 297 (2008); A.A. Dyer et al., *The Role of Private Individuals and Firms, States, and the Federal Government in Protection of State and Private Lands from Hazards of Wildfire*, COLO. ST. U. SPECIAL SERIES NO. 26 (1983).

Much of the literature is focused on environmental concerns, and have policy analysis limited to *ex ante* considerations of forest health legislation. See, e.g., Robert B. Keiter, *Breaking Faith with Nature: The Bush Administration and Public Land Policy*, 27 J. LAND RESOURCES & ENVTL. L. 195 (2007); Evan N. Turgeon, *Federal Forests, Biomass, and Ethanol: Energy Security Sabotaged*, 39 ENVTL. L. REP. NEWS & ANALYSIS 10,140 (2009). Prolonged discussions of the specific fire management practices that occur *after* a wildfire begins still remain missing.

⁴ See sources cited *supra* note 3.

⁵ See Jack L. Knetsch, *Resource Economics: Persistent Conventions and Contrary Evidence*, in FORESTRY AND THE ENVIRONMENT: ECONOMIC PERSPECTIVES 243, 251 (W.L. Adamowicz et al. eds., 1993) (“the use of economics in the analysis of forestry and environmental issues can increase understanding of conflicts, improve design of policy proposals, and lead to more informed resource management choices.”).

suppression techniques, and a requirement that governmental firefighters internalize the cost of poor decision-making. Section V concludes by arguing that more extended analysis of the policies surrounding the use of backfire and other wildfire suppression techniques is needed.

I. ENVIRONMENTAL REVIEW OF WILDFIRE SUPPRESSION TECHNIQUES

Wildfires are an enormous and growing problem; they pose risks to human lives and impose tremendous ecological and property loss.⁶ Wildfires are also incredibly costly—in recent years the federal government has spent more than \$3 billion annually to fight wildfire.⁷ Climate change experts predict the severity and growth of wildfires will grow with changing weather patterns.⁸ Further, more homes are being built in areas that were traditionally forested, increasing the risk of wildfire threat to residential dwellings and people,⁹ which increases pressure to suppress wildfires. According, it seems likely that the demand on firefighters to use increasingly aggressive techniques will continue to increase over time.

State and federal agencies are the primary force for fighting wildfire. They operate under “an uncoordinated and fragmented welter of organic statutory provisions, environmental protection mandates, annual budget riders, site-specific legislation, judicial decisions, policy documents, management plans, and diverse state statutory provisions.”¹⁰ Often, areas of a state are divided into areas of federal and state control for suppression.¹¹ In practice, a variety of government firefighting forces often work together.¹²

⁶ See, e.g., *U.S. Fires Release Huge Amounts of Carbon Dioxide, Says New Study*, U. OF COLO. AT BOULDER (Oct. 31, 2007), <http://www.colorado.edu/news/r/e540ccde4a865df53b669e2c73e06fc1.html> (“U.S. fires release about 290 million metric tons of carbon dioxide a year, which is the equivalent of 4 percent to 6 percent of the nation’s carbon dioxide emissions from fossil fuel burning.”).

⁷ ROSS W. GORTE, CRS REPORT FOR CONGRESS, RL30755, FOREST FIRE/WILDFIRE PROTECTION (2006), available at <http://fpc.state.gov/documents/organization/60721.pdf> (noting that “The cost of federal fire management is high and rising. Wildfire appropriations for the FS and DOI totaled less than \$1 billion annually prior to FY1997. For FY2003–FY2005, funding was \$3 billion annually”).

⁸ Kevin C. Ryan, *Climate Change, Fire & Natural Vegetation: Implications for Wilderness Areas*, in WILDERNESS & WILDFIRE 1, 18–21 (Tom Walsh ed., 1989).

⁹ See GORTE, *supra* note 7, at 5 (“people have increasingly been building their houses and subdivisions in forests and other wildlands, and this expanding *wildland-urban interface* has increased the wildfire threat to people and houses”).

¹⁰ Keiter, *supra*, note 3, at 303–04.

¹¹ See, e.g., *Montrose Dist. Wildfire Protection and Mgmt.*, COLO. STATE FOREST SERV., <http://csfs.colostate.edu/pages/montrose-wildfire.html> (last visited Nov. 16, 2010).

¹² *Interagency Effort*, ALASKA DEPT. OF NATURAL RES., <http://forestry.alaska.gov/fire/> (last updated Aug. 14, 2009) (“Fire management planning, preparedness, suppression operations, prescribed fire, and related activities will be coordinated on an interagency basis with the full involvement of DOF and its state, federal and local government cooperators.”).

Firefighters have a number of techniques at their disposal.¹³ The tools have varying levels of cost, efficacy, and risk. For example, historic techniques, such as digging firelights, are effective but labor intensive and put firefighters at risk. Modern techniques, such as using helicopters to drop water or chemical fire retardants on flames, are costly and less effective.¹⁴ The decision about which of many techniques to use is controlled by an incident command team of agency leaders who oversee firefighting decisions.¹⁵

Wildfire suppression efforts are resource-constrained.¹⁶ As with other government expenditures—healthcare, education, and environmentally-sound infrastructure development—there is simply not enough money to attain the goal of perfect protection from wildfire. Consequently, the government must prioritize what to protect and how best to protect those most valued assets.¹⁷ Currently, government firefighting agencies (GFAs) make such prioritization decisions without regard to the economic value of private property or ecological cost.¹⁸ “Often [GFAs] use resources because of the public and political pressure to do something, even though it has no effect on the fire and is an economic waste.”¹⁹ Further, factors such as under-preparation, acute stress, and ambiguous authority can produce suboptimal decisions by firefighters.²⁰ Although well-intentioned, the lack of review of firefighting methodologies creates a “fiscal illusion,”²¹ under

¹³ See, e.g., *Wildlands Fire Science*, KERN COUNTY REGIONAL OCCUPATIONAL PROGRAM, <http://kcsos.kern.org/kcrop/trade> (last updated Dec. 12, 2001) (“Classroom instruction, demonstration, and hands-on field application will be given in basic firefighting, standards for survival, engine, and pump operations, backfiring methods and equipment use, chainsaw operations, map and compass use, air operations, basic hand tool sharpening and use, fireline construction, and forest conservation”).

¹⁴ See, e.g., Cart & Boxall, *supra* note 2.

¹⁵ See, e.g., ALASKA DEPT. OF NATURAL RES., *supra* note 12 (a description of an incident management team).

¹⁶ See Michael Useem et al., *Developing Leaders for Decision Making Under Stress: Wildland Firefighters in the South Canyon Fire and Its Aftermath*, in ACADEMY OF MANAGEMENT LEARNING & ED. 461, 476 (2005) (noting that “firefighters are often denied [] requests because of competing priorities, safety concerns, or *resource constraints*”) (emphasis added).

¹⁷ See, e.g., *Deferees v. United States*, 738 F. Supp. 380, 385 (D. Or. 1990) (noting that “[w]ith limited resources to devote to many fires, the Forest Service had to establish suppression priorities”).

¹⁸ Timothy Ingalsbee, *Money to Burn: The Economics of Fire and Fuels Management, Part One: Fire Suppression*, WESTERN FIRE ECOLOGY CENTER (June 2000), http://www.fire-ecology.org/research/money_to_burn.html.

¹⁹ *Id.* at 4 n.16. (quoting Richard Mangan, *Issues in Large Wildfire Suppression Cost Reductions, Symposium on Fire Economics: Planning and Policy Bottom Lines*, San Diego, Cal., Apr. 6, 1999).

²⁰ See Useem, *supra* note 16, at 461.

²¹ A “fiscal illusion” occurs when the government is not required to internalize the social costs of its negative externalities because it “operates under the illusion that its

which firefighting agencies do not internalize the social cost of setting backfires. The result is substantial environmental and private costs.

The problem of these misaligned incentives is evident in the use of backfire. Backfire is a firefighting technique that involves intentionally setting land on fire to fight an out-of-control wildfire. Although sometimes effective, backfire is risky and imposes enormous fiscal and environmental losses. Yet, it is increasingly used. This Article argues backfire provides an example of the problem that is created by failing to review the impact of various firefighting techniques. It raises the question of whether some tools impose such a great cost on landowners and timberlands that their use should be constrained to situations in which they produce a benefit at least equal to the harm they cause across the dimensions of protecting life, property, and environmental values.

As described in the case study of backfire below, the incentives of firefighters may poorly align with stakeholders affected by the suppression techniques used. The directives given to firefighters may reflect vegetation management goals, risk minimization, the desire to use a fire as training for a particular technique, or agency objectives. In contrast, land managers seek protection for their property, wildland urban interface owners want their homes protected, and ecologists are worried about the effects on animal and vegetative life. These conflicting objectives of the various stakeholders lead to conflicting viewpoints about the best suppression techniques in any given scenario. Yet, given the exigent nature of wildfire, the government acts alone in making decisions about which suppression tools to use. Below, this Article uses the example of backfire to show that it is not unilateral decisionmaking that is problematic, but rather the poorly aligned incentives among stakeholders that can lead to concerning wildfire suppression techniques.

II. AN OVERVIEW OF BACKFIRE

This section begins an extended case study of the firefighting technique of backfire, to demonstrate an *ex post* policy analysis of a heavily-used but sometimes controversial firefighting technique. Backfire is an intentionally-lit fire designed to control an out-of-control wildfire.²² When a wildfire meets a backfire, the backfire may reduce the wildfire by depleting fuel in its path.²³ Backfire produces

actions are costless.” Abraham Bell & Gideon Parchomovsky, *Takings Reassessed*, 87 VA. L. REV. 277, 291 n.53 (2001).

²² See, e.g., National Interagency Fire Center, ‘Backfire’ to ‘Torching’: *Wildfire Terms*, CNN (June 26, 2002, 1:21 PM), <http://archives.cnn.com/2002/US/06/26/wildfire/terms/index.html> (defining backfire as “[a] fire set along the inner edge of a fire line to consume the fuel in the path of a wildfire and/or change the direction of force of the fire’s convection column”).

²³ See, e.g., *Fire Wars: Description of “Wildfire Simulator,”* NOVA ONLINE, http://www.pbs.org/wgbh/nova/fire/simu_text.html (last updated June 2002) (explaining that “[a] backfire is used to widen a fireline by burning away the fuel that lies between the fireline and the wildfire”).

unpredictable results, but is frequently used because it is the lowest cost alternative among the array of wild fire suppression tools government firefighters may use. Section A describes how backfires can serve to benefit some parties while harming others.

Backfire is an increasingly controversial technique, but receives little *ex post* analysis by policy makers or academics.²⁴ Concerned members of the public recognize this troubling lack of attention, noting, “The Forest Service and the firefighting bureaucracy continue to refuse to distinguish natural wildfires from discretionary backfires and burnouts when they map and report [] wildland fires. Forest Service and university researchers have not helped; research revealed no studies examining this aspect of the smoke issue.”²⁵ Further, *ex post* review of backfire—like many wildfire suppression techniques—is extraordinarily limited. Section B explains that the current system of providing accountability for inappropriate lit backfires—tort liability—is insufficient.

A. About Backfire

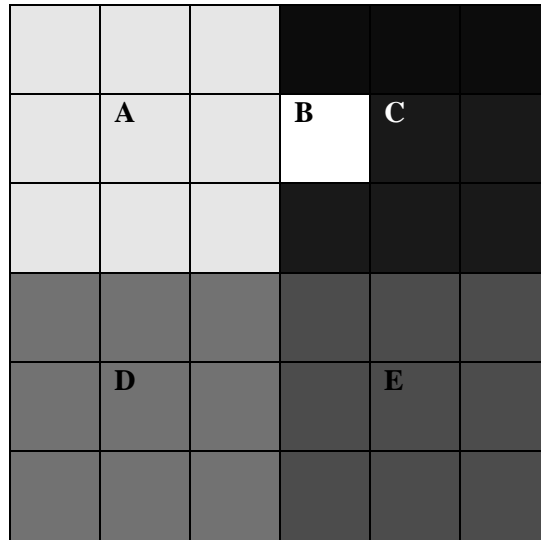
To explain the dynamics of backfire, consider the figure below. It represents a basic township grid, which is the tool used by firefighters and institutional landowners to spatially conceptualize large areas of land.

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

²⁴ Felice Pace, *Fire and Smoke*, THE GOAT BLOG (July 31, 2009), <http://www.hcn.org/blogs/goat/fire-and-smoke>.

²⁵ *Id.*

For the sake of example, consider land ownership as indicated by the shading below:



In this example, Property Owners A, C, D, and E are large landowners while Property Owner B is a smaller home owner. By tracing a hypothetical fire shed through the diagram, the dynamics surrounding backfire become clear.

Assume a wildfire begins in section 8 of the grid, on the land of Property Owner A. The fire could spread to none, any, or all of the other areas of the grid. To reach an adjacent landholding, the fire must pass through area 4, 9, 16, 17, or 18. The spread of the fire is dependent upon firefighting efforts, natural conditions, and the fuel on the land.

The success, or failure, of firefighting tactics is partially dependent upon several factors: (1) the response time of firefighters, (2) the techniques firefighters use, and (3) the skill of the firefighters. If, for example, there is a single fire station in the township, which is located on grid 5, it would likely be easier to protect grid 5 then grid 17.

Natural conditions include: (1) the wind and weather conditions at the time of the fire, and (2) the geography of the land. For example, a western wind increases the risk of fire from 8 spreading to 4, 9, or 16 but precludes the possibility that 6, 7, or 14 would be burned. If the land in grid 17 is steep, difficult to access, and has little natural sources of water, the risk of fire spreading from 8 to 17 and 20 substantially increases.

Fire suppression techniques differ among landowners. The techniques used impacts the speed with which fire spreads on their land. For example, if Property Owner A practices regular thinning, has a strong road system, and provides support to firefighters, the risk of fire spreading from 8 to 20 is dramatically reduced. Thus, Property Owner B's risk is reduced because of his neighbor's actions. Similarly, if

Property Owner A permitted dead and dying trees to remain in his forest, did not maintain the road system, and was unwilling or incapable of supporting firefighters, Property Owner B's risk of fire damage would substantially increase.

B. Tort Liability Provides Insufficient Protection Against Excessive Use of Backfire

Government firefighting agencies have increasingly relied upon backfires over the past several decades. As a result, the numbers of backfires—and attendant losses incurred by owners of timberland—have risen sharply. Yet, some argue this over-use of backfire is environmentally devastating.²⁶ Currently, courts do not require the government to compensate victims of backfire for the diminution in property value incurred as a result of government action.²⁷

Wildfire operates under an unusual wrinkle in the sovereign immunity doctrine. Under the Federal Tort Claims Act of 1946 (FTCA), the United States government is treated as an ordinary citizen in *some* cases of wildfire liability.²⁸ Under the FTCA, claims against the United States must originate under state statutory or common law.²⁹ To recover damages, complainants must demonstrate actual negligence by the government employee(s). The exact contours of government liability for the actions of GFAs are unclear.³⁰

²⁶ Felice Pace, *Wildfire and Firefighting in Klamath County*, KLAMBLOG (July 14, 2009), <http://klamblog.blogspot.com/2009/07/wildfire-and-firefighting-in-klamath.html> (providing an extended critique of the damage caused by backfires lit far from oncoming fire).

²⁷ See, e.g., *Backfire 2000 v. United States*, 273 F.Appx. 661 (9th Cir. 2008) (holding Forest Service's decision to set a backfire was within the discretionary function exception, based on cost, safety, and resource damage); *Graves v. United States*, 2007 WL 776101 (E.D. Cal.) (finding the United States Forest Service's decision to set a backfire on plaintiff's property fell under the discretionary function exception, precluding liability pursuant to the FTCA).

²⁸ Allan J. West, *Compensation for Fire Damage in Industrialized Countries: USA*, in *WILDLAND FIRES AND THE LAW: LEGAL ASPECTS OF FOREST FIRES WORLDWIDE* 149, 150 (Jacques Bourrinet ed., 1992) (“[a]nother form of compensation for losses due to wildfire are claims and litigation against the wildland fire protection agencies for real, or perceived negligence in fighting the fire, or permitting it to start or escape. The claims litigation process varies . . . but at the federal level the process by which an individual or organization files a claim for damage or loss caused by the government is covered by the Tort Claims Act. If the U.S. Government denies the claim, usually because they determine there was no negligence, the individual or organization can then pursue the matter through the courts”).

²⁹ David L. Ohler, *John Q. Public Versus Smokey the Bear: Liability and Natural Fire Policy*, in *WILDERNESS & WILDFIRE* 8, 8 (Tom Walsh ed., 1989) (“[b]ecause the FTCA makes the United States liable as a private individual, a suit under the FTCA must rest on state law. A claim must be based on either statutory law (laws adopted by the legislature), or common law (laws made by judges in their decisions”).

³⁰ See *Id.* at 9–10.

The government is typically found liable for wildfire damage caused through its actions as a land manager, but is not liable when it acts in its firefighting capacity. This is best illustrated through a series of examples. If the government starts a controlled burn that happens to spread to adjacent privately-owned property, it is liable for the damage caused.³¹ In such instances, the government is held liable under the same standards as would apply to a private citizen.³² If the government acts as a decision-maker, however, rather than in its capacity as a landowner, sovereign immunity applies.³³ Courts afford government firefighting agencies complete, unreviewable discretion to decide how or whether to fight wildfire; private parties may not recover later even if the decisions were shown to be erroneous.³⁴

The impact of immunity from tort liability in its decision-making function is that government firefighting agencies have few incentives to minimize losses borne by landowners. Unlike private landowners, the actions of government land management and firefighting agencies do not adjust to different firefighting liability rules.³⁵ This finding should prove unsurprising to public choice scholars, who have long recognized that the government responds differently to tort liability than a private actor's response.³⁶

The inefficiency of tort liability is further demonstrated through external considerations. For example, individual firefighting officials might act in a self-interested manner that is not influenced by tort payouts, such as acting to protect a

³¹ *Rayonier Inc. v. United States*, 352 U.S. 315 (1957) (holding the government liable when Forest Service firefighters failed to completely control a fire *that had started on federal land*).

³² *Anderson v. United States*, 55 F.3d 1379 (9th Cir. 1995) (holding that where a private party would be held liable for negligently setting a controlled burn so too was the United States liable under the Federal Tort Claims Act).

³³ *See Miller v. United States*, 163 F.3d 591 (9th Cir. 1998) (finding that sovereign immunity applies and bars recovery when government firefighting agencies exercise their judgment in allocating resources as between multiple wildfires).

³⁴ *Id.*

³⁵ *See Yoder, supra* note 3, at 304 n.10.

³⁶ Compare Daryl J. Levinson, *Making Government Pay: Markets, Politics, and the Allocation of Constitutional Costs*, 67 U. CHI. L. REV. 345 (2000) (arguing that government does not internalize costs in the same manner as private firms), with *contra* Michael A. Heller & James E. Krier, *Deterrence and Distribution in the Law of Takings*, 112 HARV. L. REV. 997, 999 (1999) (noting that requiring just compensation for taking private property affects decisions about what property to take), and Harold J. Krent, *Preserving Discretion Without Sacrificing Deterrence: Federal Governmental Liability in Tort*, 38 UCLA L. REV. 871, 872 (1991) (“[i]f the theory of tort law is in part to compel private entities to become more efficient in light of potential tort liability, then there is no apparent reason why potential liability should not similarly force the government to be more prudent in its operations”).

reputation.³⁷ On an agency level, environmental scrutiny may also make change or contracting difficult.³⁸ Therefore, tort liability provides an insufficient shield against the excessive use of backfire.

III. A POLICY PROPOSAL FOR CORRECTING THE INCENTIVES SURROUNDING BACKFIRE

This section draws on a law and economics framework to analogize backfire to other situations in which property owners with diametrically different interests can force government action that benefits one party and harms the other. The argument is that when the government employs suppression techniques that benefit one party at a cost to the other, it should be forced to compensate the harmed property owner. Government destruction of property value does not always result in compensation for the property owner. Sometimes the government forces the benefitted property owner to compensate the disadvantaged party. In other instances, private parties are left holding the loss of a government action that was designed to benefit other private parties.

How do we differentiate between different types of government activities that destroy private property? Legal scholars note that sifting through cases produces “unclear” results,³⁹ because precedential value may be limited by the fact-specific nature of the cases.⁴⁰ This paper looks beyond the narrow universe of backfires to a broader conception of how to delineate between government destruction of private property that is deserving of compensation from that which is not. These distinctions are inexact. To draw them, it is useful to look to seemingly analogous situations and explore when courts have found compensation to be appropriate.

There are four characteristics of backfire that make it especially well-suited to a compensation requirement. First, the government exercises a monopoly position in setting backfires. Second, when the government sets a backfire, it creates a windfall for which no private market mechanism exists to force compensation. Third, although the transaction costs of government calculation of compensation are high, they are lower than the costs associated with the private alternative. Finally, the primary benefit of backfire is not realized by a broad, diffuse group of

³⁷ See Krent, *supra* note 36, at 886 (“[o]thers may be motivated to avoid liability by more personal incentives, whether to avoid the stigma of being found negligent or to avoid possible disciplinary action by their superiors”).

³⁸ See Barry R. Goldman, Note, *Can the King Do No Wrong? A New Look at the Discretionary Function Exception to the Federal Tort Claims Act*, 26 GA. L. REV. 837, 853–54 (1992) (“the stigma attached to creating liability for the agency might deter a government agent from actively promulgating and enforcing contentious agency policies”).

³⁹ Saul Levmore, *Obligation or Restitution for Best Efforts*, 67 S. CAL. L. REV. 1411, 1416 (1994).

⁴⁰ See *id.* at 1415 (opining that “it is at least possible that the [party] in that case needed to act with such speed and imagination that the judicial decision following the event is either of no precedential importance or can be understood as an empathetic gesture in favor of heroic sacrifices”).

“the public,”⁴¹ but instead, a small, identifiable group of adjacent and near-by property owners. In combination, these factors create a situation in which one party is harmed to benefit another identifiable group by the government, but is left without remedy.

A. The Government Holds a Decision-Making Monopoly

The government sometimes serves as an arbiter of last resort. When the government intervenes in a situation where parties could reasonably bargain but do not, compensation should generally not be granted to the disappointed. But, when the government intervenes in a circumstance in which the parties cannot bargain because of an external force, a stronger case exists for compensation.

1. When Private Parties Can Bargain, Government Intervention Is Less Troubling

When private negotiating mechanism fails, parties may agree to turn to the government to resolve the disagreement. For example, parties arranging a merger agreement under time constraints often leave some issues of the agreement intentionally unresolved, relying upon the common law, however this often leads to the possibility of future litigation to resolve the issues.

Another example of reliance on the government as an arbitrator of disputes occurs at the agency level, as is the case of a conflict between tangerine and almond growers in Central California.⁴² Generations of almond growers have deployed hives of bees to pollinate their trees. Tangerine growers on adjacent land used to be indifferent to this practice. The increasing popularity of seedless fruit, however, has made the bees problematic for tangerine producers. Bees produce undesirable piths, resembling seeds, in tangerines and no effective strategy exists to confine the bees to almond crops. Almond growers cannot produce their desired crops without the bees and tangerine growers cannot produce their desired crops with the bees. The groups have been unable to reach a private resolution, and are relying upon state agriculture officials to resolve their controversy.⁴³

Under such circumstances, there is no need for the government to force compensation to the losing party—such as through eminent domain or clean-up costs. If the courts or the state legislature decides in favor of either side, the other will have had full access to resolutions via private bargaining and the political or judicial process. Tangerine and almond growers can form and rely upon interest groups to represent their position. They can influence agency rulemaking through

⁴¹ Stopping a wildfire may benefit “the public” in a generic, theoretical sense. Perhaps even more specifically, a diverse group may be benefitted because the air and water become cleaner when the wildfire is extinguished. This result, however, is not the primary purpose of fighting wildfire or using backfire.

⁴² Tracie Cone, *Tangerine Growers Tell Beekeepers to Buzz Off*, ASSOCIATED PRESS, Jan. 9, 2009, <http://www.thefreelibrary.com/Tangerine+growers+tell+beekeepers+to+buzz+off-a01611763189>.

⁴³ *Id.*

public input. If the group that loses happens to value the presence or absence of bees more than the other party does, it can contract around government regulation to reach the more highly valued result.⁴⁴ With this robust set of options, neither law nor practicality mandates that the government should compensate the disappointed party.⁴⁵

2. When Private Parties Cannot Bargain and the Government Intervenes, Compensation May Be Necessary

Private parties cannot bargain effectively during emergencies because they cannot rationally contract with one another to decide whose property will be sacrificed to save another. The exigent circumstances distort the bargaining power of parties who likely face the loss of property.⁴⁶ It is antithetical to the coordinating capacity of police power to create a decision-making democracy. Instead, dictatorial decision-making produces the most efficient results in exigent circumstances.

The inability of private parties to bargain in cases of emergency does not necessarily require that the government provide compensation. Consider the example of admiralty law's salvage doctrine, which governs rescues of ships sinking at sea.⁴⁷ The owner of a boat in peril cannot rationally bargain with a salvage vessel that has a near monopoly on the boat's rescue.⁴⁸ If the salvage is successful, the salvor receives a portion of the value of the rescued vessel from its owner so as to create an incentive to rescue—while not allowing the full amount of windfall for which the salvor might be able to bargain as the target vessel is about to sink.⁴⁹ In this situation, the government provides a baseline rule by which parties are obligated to abide.⁵⁰ The government does not coordinate the transaction

⁴⁴ This is subject, of course, to the holdout problem in which the side that is legally supported would have a monopoly position and could extort the opposite side to pay more than the value otherwise assigned to having or not having bees.

⁴⁵ See *Miller v. Schoene*, 276 U.S. 272, 279-80 (1928) (finding no compensation was necessary when a state ordered a party to cut down uninfected trees to ensure that they would not infect nearby apple orchards).

⁴⁶ The canonical torts cases illustrating this point are based in admiralty law. See generally *Vincent v. Lake Erie Transp. Co.*, 124 N.W. 221 (1910) (describing the difficulty of describing which of two mutually-exclusive property interests to protect in the exigent circumstance of a storm); *Ploof v. Putnam*, 71 A. 188 (1908) (noting that in situations of necessity one cannot bargain adequately).

⁴⁷ For a discussion of the law and resulting incentives surrounding salvage law, see Saul Levmore, *Waiting for Rescue: An Essay on the Evolution and Incentive Structure of Affirmative Obligations*, 72 VA. L. REV. 879, 909-13 (1986) (arguing that mandatory, government-set compensation for third parties who rescue a sinking ship produces appropriate incentives to assist in an exigent circumstance, but the level of compensation must be appropriately set to discourage moral hazard among potential rescuers).

⁴⁸ *Id.*

⁴⁹ *Id.*

⁵⁰ *Id.*

however, or become involved in the actual transfer of funds (unless judicial resolution becomes necessary).

Rescues at sea provide a useful illustration that not all private intervention in emergency situations requires that the government assume the risk of property damage. Backfire differs from salvage law in an important way, however, with wildfire, the government exercises a decision-making monopoly, whereas in rescues at sea, the government does not directly cause or intervene in the rescue. This is to say that government action or inaction in wildfire may increase the need for a backfire. The choice of where to set a backfire may be correct or incorrect. Regardless of the correctness of the choice, private parties cannot influence these decisions, which rest within the sole domain of the government.

3. The Government Holds a Decision-Making Monopoly in a Transfer Between Private Parties Under Exigent Circumstances

Backfire only occurs in exigent circumstances that preclude acceptable bargaining between private parties. To overcome this difficulty, the government—under the police power—adopts a monopoly position in wildfire decision-making. This situation precludes the parties that are impacted by backfires from engaging in the Coasian bargaining that will eventually occur between the tangerine and almond growers. The government supplants normal contracting mechanisms and, with them, the access to the political process that is usually available to harmed groups.

Police power affords the government the power to supplant private interests and act unilaterally in pursuit of the common good. Police protection and firefighting are two classic examples of the government's exercise of police power. When the government chooses to act in this capacity, it exercises a monopoly position; private parties are legally prevented from intervening. The government becomes the sole decision-maker in directing actions that affect both public and private interests. When acting in this capacity, the government is protected by sovereign immunity.

In firefighting, the government is free to allocate resources as it sees fit. For instance, a GFA may in its sole discretion, choose not to fight a wildfire at all.⁵¹ Similarly, a municipality may decide not to plow a particular street during a heavy storm. Just as we trust the residents of the street to exert sufficient pressure so that their street will be plowed in the future, so too do we trust interest-holders in most wildfire contexts to create sufficient public pressure to ensure a government response that is reasonable in the aggregate. Lighting backfires differs, however, from choosing to fight one fire over another. The property value is not lost or lessened by omission to act, but rather, through a government action that actively devalues the land. This differs from the government omitting one action to take

⁵¹ See generally *Miller v. United States*, 163 F.3d 591 (9th Cir. 1998) (holding that a property owner could not recover against the government when a GFA has decided not to fight a wildfire which burned the property owner's land).

another. Instead, it is a direct transfer of one property to another private party. Because the exigent nature of backfires precludes private negotiating or access to the political process,⁵² its use is worrisome in ways that other transfers, such as welfare or taxes, are not.⁵³

B. There Are Large Windfalls that Private Markets Cannot Recover

The benefit received by adjacent landowners—whose properties are protected from backfire—can be described as a windfall. The “windfalls for wipeouts” literature describes windfalls as economic gains that do not result from “work, planning, or other productive activities that society wishes to reward.”⁵⁴ The government’s choice of where to set a backfire is based on subjective, external factors, such as weather or geographic characteristics.⁵⁵ *Ex ante*, institutional landowners do not know whether they will be the beneficiary or the party harmed by backfire. The decision may literally revolve around where, among several properties, a bolt of lightning strikes. As such, private parties can do little to ensure that they will receive the benefit of a backfire on their neighbors’ land. Hence, it is a windfall.

⁵² Although individual parties who are harmed by backfire have little political recourse, evidence suggests that interest groups can effectively modify firefighting policy. This dynamic is evident in the different perception of backfire use as between state and federal firefighting agencies. Institutional private landholders report satisfaction with the level of backfires that are set by state firefighting agencies. Their complaint about the overuse of backfire rests almost entirely with federal firefighters. At the state level, institutional private landowners have active, well-funded lobbying groups to reflect their interests. Although these groups are primarily focused upon issues of forestry, they occasionally become involved in issues pertaining to wildfire. Each of the institutional landowners interviewed was aware and involved in at least one state-level interest group; none participated in federal interest groups. Further, not uncommonly, representatives of private institutional landowners serve on the boards that govern the state wildfire agencies.

⁵³ In a related scenario, the government exercises a monopoly over product recalls. *See generally* Levmore, *supra* note 39 (which provides a detailed discussion of the role of the government and impact on private companies in product recall scenarios). In the recall context, the government is not made to compensate businesses that lose substantial value when their products are recalled. Also, *Frupac Int’l Co. v. Fireman’s Fund Ins. Co.*, No. 90-1537, 1990 WL 204380 (E.D. Pa. Dec. 11, 1990), held that an insurer was not entitled to government compensation for the recall of grapes that it insured. This differs from the wildfire analysis and solution presented in this Article because the beneficiaries of the recall are not identifiable, and therefore, the cost of saving them cannot be shifted onto the beneficiaries. As a result, the government would be forced to bear the cost of the recall if it were made to compensate companies whose products were recalled. This outcome would inappropriately chill the socially useful activity of recall.

⁵⁴ Eric Kades, *Windfalls*, 108 YALE L.J. 1489, 1491 (1999).

⁵⁵ The exception is when the government employs alternative firefighting methodologies to avoid backfiring a particular area, such as a home site or historically significant area.

Legal scholars suggest, “[t]here is no private market mechanism for redistributing windfalls.”⁵⁶ This is because “parties experiencing gains are unlikely to report their good luck.”⁵⁷ People are foreseeably reticent to report that they should be forced to compensate another person. The situation is somewhat analogous to one lobbying the government so that he or she alone should pay higher taxes for a benefit already received and which cannot be reversed. In the absence of a private market, the government alone is able to redistribute windfalls. Although the government has the power to establish a system for redistributing all windfalls, doing so would create tremendous transaction costs for little gain. For that reason, “windfall capture makes sense only for larger windfalls . . . [and] infrequent types of gains.”⁵⁸ Backfires therefore qualify as a form of windfall that is large and infrequent enough to merit the transaction costs that the government will incur to coordinate compensation for the windfall.

One might view the act of compelling the government to compensate landowners when it sets wildfires as a form of tax or user fee. As with virtually any tax, assigning a cost to wildfire would cause the government—as the consumer of wildfire—to adjust its behavior.⁵⁹ The increased cost of backfire—relative to other forms of management strategy—will make backfire proportionally less attractive. Private parties cannot reach this result, because the benefits of backfire are a windfall to adjacent landowners.

C. The Government Faces Lower Transaction Costs than Private Parties

One concern about having the government coordinate backfire is the high transaction cost of reaching compensation determinations. Such analysis would require a fact-intensive inquiry into who, precisely, is benefitted by a successful backfire,⁶⁰ and how much was lost by the party whose land was backfired.

⁵⁶ Kades, *supra* note 54, at 1492.

⁵⁷ *Id.*

⁵⁸ *Id.* at 1499.

⁵⁹ *See id.* at 1495 (noting that taxes cause consumers to change behaviors and substitute alternative goods that otherwise would be less attractive).

⁶⁰ The actual assessment of givings would require intensive fact finding and rely heavily upon expert opinion. To illustrate the difficulties that would arise, consider again the Figures 1 and 2 presented in Section I. As established in Section I, the spread of wildfire is based upon variables, some of which are controllable and others clearly not. As such, the valuation of property for takings and givings is complex.

First, consider the takings analysis. Under current policy, firefighters must prioritize defense of Property Owner B’s home on grid 10 above other fire suppression efforts. To protect B, two tactical shifts are likely to occur. First, firefighters will allocate most resources towards squares 8 and 9. This moves the limited resources away from other areas, thus reducing or eliminating the protection available to Property D. Second, firefighters might use backfire, burning land that might not otherwise burn in sections 8 or 9 to prevent the fire spreading to 10. This directly destroys the land of Property Owner A to benefit Property Owner B.

Although making these calculations is costly, the government is the party best positioned to make them. Unlike the bee situation, a mix of practical effects precludes private bargaining among parties about backfire compensation during each stage of backfire.

For instance, private parties impacted by backfire cannot contract *ex ante* to allocate protection to the highest-value user. The reason is twofold. First, transaction costs for reaching a bargain are extraordinarily high. Deals that could be struck *ex ante* are infeasible due to the endless combination of scenarios that could arise. The same property owner can value different portions of the property differently. For example, a stand of mature timber is worth far more than a portion of land that has been recently clear cut, but not yet replanted. Allocating values to such diverse permutations over thousands of acres of land is prohibitively costly. Second, and more importantly, agreements between private parties cannot control the actions of government firefighters. Quite simply, government firefighters would not be required to abide by such contracts. Yet, to fulfill a contract, private parties cannot feasibly set their own backfires because of the insurmountable risk of accidental spread and strict liability for any resulting damage. The government has a practical monopoly on setting backfires.

D. A Small, Identifiable Group Benefits

One of the strongest counterpoints to compensating backfires arises from case law denying compensation when the government destroys private property to stop a potential harm to the public. In *Customer Co. v. City of Sacramento*,⁶¹ police officers damaged a store by firing tear gas into it in an attempt to force a felony suspect to surrender. The felon had randomly entered the store; nothing in the record indicated that he had a connection to the owners or employees.⁶² During the police action the store was severely damaged. “Damage to the store included numerous broken windows, wall mirrors, and acoustical ceiling panels. The store’s *entire inventory* of food and other merchandise had been contaminated with tear

Next, consider the difficulty of calculating givings. If Property B is saved because of firefighter efforts, it seems likely that other properties were similarly saved because the fire was extinguished or diverted. But, it is impossible to know *which* properties were saved. Any of the properties adjacent to Property B might have benefited from the increased protection it received (grids 5, 4, 9, 10, 11, 14, 15). But, it is impossible to know if any of them actually benefited, because wildfire is such that it could have spread in any direction. There is no *ex ante* means of predicting where fire will spread nor reliable *ex post* analysis of fire spread unless the fire actually burned.

The analysis of properties benefited is similarly complicated because it is impossible to estimate whether only adjacent lands were saved or if other nearby lands were also saved. Should landowners who are nearby but not adjacent (grids 12, 13, 21, 22, 23) also be assessed?

⁶¹ 895 P.2d 900 (Cal. 1995).

⁶² *Id.* at 902-04.

gas.”⁶³ The plaintiff brought suit under the Tort Claim Act (TCA) and, based on a section of the California Constitution regarding just compensation for “private property . . . taken or damaged for public use,” also claimed inverse condemnation. Considering only the inverse condemnation claim, the Californian Supreme Court found that the damage to the store and its inventory did not constitute a taking.⁶⁴ This finding was partially premised on the “emergency exception,” which permits injury to—or utter destruction of—private property that results from the legitimate exercise of the police power in emergency situations.⁶⁵ This exception is grounded in reasoning that a “just compensation requirement . . . might well deter law enforcement officials from acting swiftly and effectively to protect public safety in emergency situations.”⁶⁶

In some ways, *Customer Co.* is analogous to backfire. The felon randomly chose a particular store among many, just as a relatively random wildfire can damage one among several properties. The police acted in an emergency capacity, just as firefighters do in wildland situations. A substantial amount of private property was damaged by government officials due to no fault of the property owner. Setting aside the obvious fact-based distinctions between these situations—and the common availability of the TCA to provide remedy⁶⁷—a meaningful difference exists between the two cases. In *Customer Co.*, the primary beneficiary of the felon’s capture was the public at large. To meaningfully identify any individual beneficiary—that is, precisely who was saved by the police action—is impossible. Had the police not intervened in the store, no information indicated that the felon would have harmed the *Customer Co.* store owners or their neighbors. Temporally, the presumable next crime was utterly unpredictable. From this flows the unpredictability of the next victim—or beneficiary—of the police action. In contrast, the primary beneficiaries of backfires *are* identifiable. Fire science can reasonably predict which among several adjacent properties was saved. More importantly, the universe of potential beneficiaries is small.

To conceptualize the difference, imagine the benefit gained as a simple fraction:

$$\frac{\text{Persons actually benefitted}}{\text{Persons potentially benefitted}}$$

In the *Customer Co.* case, the denominator is infinitely large. The felon could have left the store, boarded a plane, and committed a new crime in another

⁶³ *Id.* at 904-05 (emphasis added).

⁶⁴ *Id.* at 904-05.

⁶⁵ *Id.* at 909-10.

⁶⁶ *Id.* at 910.

⁶⁷ The *Customer Co.* court emphasized that the TCA *might* provide a remedy for the store owner. *Customer Co.*, 895 P.2d at 389. Similarly, whether the TCA provides a remedy for backfire is unclear. This Article does not suggest this as a remedy because it fails to capture the windfall realized by adjacent landowners, and results in sole reliance on government compensation—which may overly chill the use of backfires.

country. In contrast, with backfire, the denominator is quite small. Wildfire spreads in a continuous pattern.⁶⁸ Institutional landowners, for the purposes of this paper, are defined as landowners who possess properties of at least 5,000 contiguous acres. Typically, the wildland-urban interface is diffusely scattered throughout a landscape. Therefore, calculating the number of properties to which a fire hypothetically could spread is a reasonable exercise, unlike calculating the numbers of persons who hypothetically could be harmed by an escaped felon.

Further, the fact-finding costs of identifying benefitted property owners are relatively low. Detailed public records of landholdings are readily available from county recording offices. In the *Customer Co.* case, tracking the location of all nearby potential victims would be prohibitively costly and likely impossible. Therefore, land situations are particularly well-suited for a system of government compensation as the fixed nature of real property makes otherwise astronomical fact-finding costs manageable.

Because backfire benefits primarily a fixed, identifiable group of property owners, it is suited to takings compensation. In this way, backfire resembles situations in which an isolated group is disadvantaged to help another small, identifiable group.⁶⁹ Government intervention is necessary when either the beneficiaries cannot be identified exactly or the government acted in a monopolistic capacity. If the fraction above had a defined numerator and denominator, no need would exist for government compensation. The party harmed could pursue a tort remedy against the parties benefitted.

When the government exercises monopoly power to harm one party to benefit another, however, the harmed party is sometimes left without a remedy. The party cannot pursue the private beneficiary under tort liability, because the beneficiary did not cause the harm, and the party cannot sue the government because it is protected under sovereign immunity.⁷⁰ In this situation, the government imposes harm, and an attendant cost, on a private party to benefit another. The harmed party is left holding the cost, making government action especially susceptible to incentives that have little bearing on economic efficiency. In such cases, as with

⁶⁸ For information the spread of fire, see generally David G. Green, *Shapes of Simulated Fires in Discrete Fuels*, 20 *ECOLOGICAL MODELING* 32 (1983); although a fire can change paths or “jump” certain obstacles without fuel (such as roads or streams), these detours represent only minor interruptions in an otherwise steadfast spread.

⁶⁹ Spot zoning is somewhat analogous to this kind of direct harm/benefit occurring within a small group. Each has a small denominator (number of beneficiaries) with an unidentifiable numerator (number of people who are actually benefitted). In the zoning context, the problem is that of line drawing: did the person two houses down benefit? Four houses down? Spot zoning also has a typically immune third-party decision-maker (the municipality), which results in one party being harmed to directly benefit another, yet left without compensation. Unlike wildfire, spot zoning occurs over a relatively extended time horizon and undergoes a public hearing process.

⁷⁰ Again, in the context of backfire, the ability of an individual to bring a TCA suit is unclear. See *Customer Co.*, 895 P.2d 900. For the purpose of this thought experiment, the possibility of a TCA suit is precluded.

backfire, the system of takings and giving can serve to align the distorted incentives by shifting the risk of an erroneous decision to the decision-maker, but placing the cost of the benefit flowing from an efficient decision onto the benefitted party.

E. Conclusion

Deference to government officials in exigent circumstances seems logical. Seldom questioned is a law enforcement officer's decision to pursue a carjacker rather than a pickpocket. Would this deference withstand a law enforcement service that regularly chose to ignore the carjacker to capture the pickpocket? In the context of wildfire suppression, government agencies consistently capture the pickpocket and ignore the carjacker. That is, by prioritizing the value of structures above private timberlands, GFAs make economically inefficient choices.⁷¹ Moreover, fire suppression agencies operate with virtually no exterior accountability for decisions,⁷² resulting in a cost structure that creates absurd incentive effects.⁷³

Currently, GFAs are able to use backfire to protect certain parties' property without bearing the cost or compensating those parties that are harmed. The government agencies are responding to public pressures, rather than engaging in economic efficiency or balancing the concerns of institutional private landholders against wildland-urban landholders. Payment structures and public pressures distort incentives and choices about which among several resources to protect.⁷⁴ Further, government agencies can use backfire as an alternative to other practices for which they would have to pay. In this way, government agencies benefit from the use of backfire, while private institutional landowners with damaged land are left to bear the costs. Much of the problem arises from a lack of public

⁷¹ It is important to distinguish the decision to protect structures from the decision to protect life. GFAs take the unopposed position that protection of life—that of firefighters and citizens—is the highest priority when fighting fire. FOREST SERV., U.S. DEP'T OF AGRIC., FIRE SUPPRESSION COSTS ON LARGE FIRES: A REVIEW OF THE 1994 FIRE SEASON 13–14 (1995) (noting that the order of prioritization is “life, property, and resources”). But protecting structures is not the same as saving lives during fire. Mandatory evacuations are enforced against citizens in wildland-urban interface areas. This is a distinct and higher priority than protecting buildings.

⁷² A notable exception is media scrutiny.

⁷³ See DENNY TRUESDALE, U.S. DEPARTMENT OF AGRICULTURE—FOREST SERVICE, FIRE AND AVIATION MANAGEMENT, FIRE SUPPRESSION COSTS ON LARGE FIRES: A REVIEW OF THE 1994 FIRE SEASON 10 (1995) (“There are few incentives to take risks that could lead to reductions in large fire suppression costs.”). The report adds that a survey of forest managers revealed that many “would have fought fires differently, and at lower cost, if the money had come from the forest's allocated budget.” *Id.*

⁷⁴ See Lauren Wishnie, Note, *Fire and Federalism: A Forest Fire Is Always an Emergency*, 17 N.Y.U. ENVTL. L.J. 1006, 1007 (2008) (“Successful management requires accepting that choices must be made about what resources to protect and what resources to sacrifice.”).

understanding of the risks of building in wildland-urban interface areas. In wildfire, “[b]ecause hazards and risks cannot be eliminated, just altered or reduced, the public needs to understand the relative risks.”⁷⁵ Policies that might be effective are often “difficult or impossible to implement” because of “[a]n absence of public understanding.”⁷⁶

IV. A PROPOSAL FOR VALUING BACKFIRE COMPENSATION

This section draws upon a framework of damage to timberland caused by wildfire presented in *A Modern Overview of Wildfire Law*.⁷⁷ That paper explains that the damage occurs in: (1) lost stumpage value, (2) infrastructure damage, (3) retarded tree growth, (4) waterway and soil composition and productivity, (5) disease and insect damage, (6) human activity and mortality, and (7) wildlife losses. A brief explanation of each is below.

Lost stumpage value is reflective of the merchantable timber lost to fire that could have otherwise been harvested and sold at market value but must instead be harvested at a rapid pace, irrespective of market prices, and sold at a discount because it is burned. Infrastructure damage occurs when wildfire ruins roads, building, equipment, or other capital improvements on the timberland. Retarded tree growth means that even surviving trees experience delayed growth because they underwent the trauma of a fire. Watersheds and waterways suffer from the lack of vegetative cover and entrance of debris unto their systems, while soil composition is also changed by fire. Trees are especially vulnerable to attack by disease and insect after a fire—each of these can cause damage to large stands of timber relatively quickly. Wildfire poses obvious threat to human life, but may also cause side effects from issues such as smoke inhalation. Finally, wild animals that are part of the forest ecosystem die and experience painful injury during wildfire. Collectively, each of these factors represents the damage caused to timberlands by wildfire.

Drawing upon the framework composed of these factors, this section provides a proposal for how a court should determine its value and adjustments that should be made to that valuation based upon mitigating factors.

Just compensation is owed to landowners whose property is taken by backfire for the following losses: loss stumpage value, infrastructure damage, mitigating retarded tree growth, restoring waterways, managing soil composition and productivity, mitigation costs against disease and insect damage. These can be categorized in three ways: straightforward property takings, lost future value, and

⁷⁵ Kurt M. Menning, *Practical and Institutional Restraints on Adopting Wide-Scale Prescribed Burning: Lessons from the Mountains of California*, in *LIVING ON THE EDGE: ECONOMIC, INSTITUTIONAL AND MANAGEMENT PERSPECTIVES ON WILDFIRE HAZARD IN THE URBAN INTERFACE* 73, 84 (Austin Troy & Roger G. Kennedy eds., 2007).

⁷⁶ *Id.* at 80.

⁷⁷ Karen Bradshaw, *An Overview of Modern Wildfire Law*, 21 *FORDHAM ENVTL. L. REV.* 445 (2010).

mitigation/regeneration costs. The losses incurred through human activity and mortality and wildlife losses are generally not compensable.

Table 3. Classifying compensable losses in backfire damage

Compensable Losses	Non-compensable Losses
Property Damages	Human Activity
Loss of Future Value	Wildlife Losses

A. Straightforward Property Takings

Two areas of compensating timberland takings are clear: stumpage value and infrastructure damage clearly must be compensated if the elements of a taking are satisfied. The more difficult inquiry is assessing how to value just compensation for these takings, particularly given the market factors and tax benefits associated with stumpage value.

Two cases clearly provide that stumpage value is a compensable loss in a timberland taking.⁷⁸ In each case, the court ruled that an owner of trees dead or declining because of government actions deserved compensation. Loss of all merchantable timber on a property damages the landowners' ability to operate as a commercial timber harvester. The burned land has only negligible value for other purposes—the remoteness, lack of infrastructure (such as water, roadways, electricity, or sewage systems), and property value decline caused by the aesthetic damage of fire make it infeasible for the land to be put to profitable alternative use. Valuing the diminution in value due to timber burning is difficult. *Cooper* did not engage the value question, and *Arkansas Game and Fish* undertook an incredibly detailed, fact-specific approach that would prove difficult to replicate. But, by combining the principles of these cases with the IRS cases that provide insight into how to assess the salvage value of timber, a framework becomes clear.

Combining elements of the cases and sources presented in this paper provides the following details for assessing the stumpage value. The diminution in value of a taken property should be assessed *after* it has reached a point of stability.⁷⁹ This might be several months or years after the wildfire takes place. Appraisers, designated as registered professional foresters, should evaluate randomly-selected plots of land in a survey, and then extrapolate their findings across the damaged property. Landowners should be compensated for all timber rendered nonmerchantable by the taking, measured in board feet and valued according to local timber sales occurring prior to the wildfire. Nonmerchantable taking may include either entire trees, which have died, or portions of declining trees. Perhaps most controversially, case law clearly indicates this value should not be adjusted by salvage value or tax loss.

⁷⁸ See *Ark. Game & Fish Comm'n v. United States*, 87 Fed. Cl. 594, 641 (2009); *Cooper v. United States*, 827 F.2d 763, 764 (Fed. Cir. 1987).

⁷⁹ *Cooper*, 827 F.2d at 764.

Infrastructure damage is even more clear-cut: the loss of structures or equipment is the prototypical takings case. Just compensation is frequently awarded through eminent domain or inverse condemnation. With these two clear-cut examples in hand, we turn to the more difficult considerations of loss future value and mitigation/regeneration costs.

B. Lost Future Value

Timber losses extend beyond the loss of merchantable timber, which is, by definition, mature. Future streams of income, in the form of younger trees, both seedlings and saplings, are also lost. Precedent also suggests that these losses should be compensated: "There is nothing . . . that would bar recognition of such losses, as losses, whether they resulted from fatal or nonfatal injuries, to merchantable or nonmerchantable timber, including mature or *partially mature trees or even immature plantations*."⁸⁰ There is not, however, an example of case law of *how* saplings and seedlings are to be valued. Saplings are trees which have grown for between two and fifteen years. They are not yet old enough to be harvested, but have the potential of being harvested in the future. Seedlings are young trees that are planted directly into the ground. Because of the differing availability of saplings and seedlings on a market, the loss of each should be evaluated differently when assessing the diminution of value in a property.

There are a few possible ways to evaluate the loss of seedlings. One would be the replacement value of the young trees, but this would be overly compensatory. There is no established market for saplings in the number necessary to replenish a damaged forest. Further, the cost of transporting and replanting partially-grown trees would be very expensive. In other situations, this expense might be justifiable, but not here, if we consider the underpinnings of just compensation. The Supreme Court has ruled that the purpose of just compensation is to put the owner of property "in as good a position pecuniarily as if his property had not been taken."⁸¹ A commercial timber harvester values his trees not for their aesthetic worth, but rather for the future value as harvestable timber. As such, it is the loss of income, and not the loss of the trees themselves, which are valued and therefore compensable. Thus, to restore the position of a timberland owner who has lost saplings, the appropriate method of valuing his loss is the net present value of the trees lost.

The net present value calculation is straightforward. The future value of the trees would be discounted by the time necessary for them to reach maturity, adjusted by the percentage possibility of each tree's mortality due to natural causes and cost of future harvest. This calculation, which is universally accepted to value assets which will reach full value at some point in the future, can provide an assessment of what the value of saplings should be.

⁸⁰ *Westvaco Corp v. United States*, 639 F.2d 700, 703 n.4 (Ct. Cl. 1980) (emphasis added).

⁸¹ *Olson v. United States*, 292 U.S. 246, 255 (1934).

The value of seedlings—very young trees directly planted in the ground—is reached through a different process. There is a vibrant market for seedlings and their planting. Thus, the diminution of value caused by loss of seedlings should be assessed at their market price, plus planting costs. This is in keeping with the Supreme Court’s instruction that where “exchanges of similar property have been frequent,” just compensation is “arrived at by the haggling of the market.”⁸²

C. Mitigation and Regeneration Costs

Arkansas Game and Fish recognized that regeneration costs are a component of just compensation for timberland takings. In that case, the plaintiff was awarded damages for “removing extensive, invasive wetlands vegetation, [and] . . . remediating the soil and habitat, so that the same type of bottomland timber that was taken by [the] Corps can be restored.”⁸³ This case permits regeneration costs for (1) removing invasive vegetation, (2) remediating the soil, and (3) remediating the habitat. The limiting principle to restoration costs is commercial—making the changes necessary to restore the landscape to the point that the taken timber can be restored.⁸⁴ Also, it is incumbent on the landowner to mitigate damages—the court did not permit the landowner to claim losses based upon unmitigated damages.

The plaintiff in *Arkansas Game and Fish* did not request damages for controlling disease and insect damage after a catastrophe. But, the rationale for these expenditures mirrors that used for awarding damages for removal of invasive vegetation, remediation of soil, and remediation of habitat. Without mitigating the damage caused by insects, the forest will provide a hostile environment for existing and new trees that will negatively impact their growth and mortality rates. This in turn affects the profitability of the tree stand in substantial, measurable ways. The commercial viability of a replanted forest is substantially lessened if mitigation measures are not taken to ward off disease and insects, just as it would be from soil that was not remediated or invasive plants not removed. For this reason, the logic in *Arkansas Game and Fish* for damages inclusive of regeneration costs should be extended to disease and insect mitigation caused by backfire.

D. Non-Compensable Losses

Two harms caused by a partial taking of commercial timberland are not compensable: losses associated with human activity and wildlife damage. The losses associated with human activity are ruled out relatively simply. Wildlife damages, however, present a more nuanced issue.

⁸² *Kimball Laundry Co. v. United States*, 338 U.S. 1, 6 (1949).

⁸³ *Ark. Game & Fish Comm’n*, 87 Fed. Cl. at 641.

⁸⁴ As compared to a rationale that might permit, for example, regeneration to re-create an aesthetically pleasing landscape, which would be more resource-intensive and would include reintroduction of wildlife species.

Human harms resulting from wildfire damage are unfortunate but not central when considering wildfire as a taking of timberland property. The commercial nature of institutional landowners renders such considerations secondary to motives such as profit maximization. Further, many of the parties harmed do not suffer a property taking, and are therefore ineligible for just compensation under the Fifth Amendment. Similarly, the lost productivity of employees of timberland owners is not compensable.

Wildlife losses are more difficult to evaluate. On one hand, wildlife is the property of the sovereign.⁸⁵ As such, mortality to wildlife due to backfire is likely not classified as a taking, as it is difficult for a landowner to satisfy the requirement of showing a property interest in a wild animal. But, “the law has tended to single out landowners for exceptional treatment . . . grant[ing] them the right to limit hunter access as well as charge for access.”⁸⁶ In other words, the sale of hunting rights can be a source of income for landowners. If a backfire reduces the willingness of outsiders to pay for hunting access, then the commercial output of the land is lessened as a result of the government action. But, unlike the reasoning applied to mitigation and regeneration, the rehabilitation of wildlife is not necessary to the primary business objective of timber production. In practice, foresters currently take on the costs of mitigation and regeneration, although they receive no reimbursement for doing so, but do not incur the costs of restoring damaged wildlife. This is indicative of the fact that “wildlife tends not to be the most valued characteristic of [a] land parcel.”⁸⁷ It is therefore unprofitable for the landowner to incur the cost of rehabilitating wildlife, compared to the small income gained through hunting licensure. As such, rehabilitation of wildlife has no analogy in recognized compensable injury to timberland, and should not be compensated.

Based upon the above analysis, this Article purposes the formula for calculating just compensation in cases of backfire should be the sum of A, B, and C below. The method of calculating each factor, as based on case law discussed above, is indicated in italics.

A) Property damage

- a. Stumpage value (*Value of timber rendered nonmerchtable, measured in board feet and valued according to pricing of local timber sales in a non-catastrophic market.*)
- b. Infrastructure damage

B) Mitigation/regeneration costs (*Costs attributable to restoring conditions to allow for future tree growth at a rate comparable to what existed pre-backfire*)

⁸⁵ Dean Lueck, *Wildlife Law*, in 3 THE NEW PALGRAVE DICTIONARY OF ECONOMICS AND THE LAW 696 (Peter Newman ed., 1998).

⁸⁶ *Id.* at 697.

⁸⁷ *Id.* at 698.

- a. Removing invasive vegetation
- b. Remediating the soil
- c. Remediating the habitat
- d. Disease and insect mitigation

C) Loss of future value

- a. Seedlings (*Market price of seedlings + planting costs*)
- b. Saplings (*Net Present Value of damaged saplings*)

This proposal represents the first comprehensive analysis of the diminution in value caused to timberland by backfire. It fills a void that currently exists in case law. Further, it removes a barrier to establishing backfires as a taking; using this formula, it becomes clear, prior to a possible legal action, what the approximate costs of backfire will be to potential parties. This will allow government firefighters to price the value of backfire appropriately.

CONCLUSION

Fighting wildfires occurs in a high-pressure environment which mandates quick action. After the fire occurs, however, there is the opportunity to review the techniques used by GFA's and to assess their effectiveness relative to the costs these techniques impose on stakeholders. Currently, this opportunity is not being realized by policymakers who could propose novel solutions to correct potentially damaging suppression actions. This Article argues that policy-level assessments of various wildfire suppression techniques are vital for the safety of timberlands and the interests of people who maintain them.

Through an extended case study of backfire, it is possible to begin to understand the increased use and controversy of this suppression technique. A law and economics argument will help us understand that compensation is appropriate for backfire, because its use is currently costless to the government firefighters who decide to use it, but very costly for property owners. Finally, a different compensation system than currently used would restore the currently distorted incentives for wildfire and produce a system in which backfire would continue to be used, but in a manner more reflective of the environmental costs it imposes. Through this extended example, it is demonstrated that there is substantial need for policy review of wildfire suppression techniques, and policy solutions to address situations where policies are found to be suboptimally used.