# AUGMENTED WATER LAW

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*There are two possible broad strategies to address the challenge of water scarcity—limit water demand through conservation or augment the water supply. With respect to increasing supply, there are several possible approaches, including traditional approaches such as drilling more wells, increasing reservoir capacity, rainwater harvesting, and seawater desalination. But these approaches may ultimately only exacerbate water scarcity or result in unacceptable environmental impacts. This Article focuses on three nontraditional approaches to water augmentation—bulk water imports, watershed management, and cloud seeding. This Article evaluates the viability of each of these approaches within the context of existing legal regimes and proposes three possible reforms that could facilitate responsible nontraditional water augmentation projects when appropriate.*

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## I. INTRODUCTION

One of the most significant implications of global climate change is the possibility of more significant droughts.[1] Water law and policy must respond to the potential for more severe drought conditions, particularly where drought conditions are exacerbated by growing populations and increasing consumption patterns.[2] Much of the focus in water law and policy has been on the demand side of water management—discussing incentives to encourage water-use efficiency.[3] Scholars and officials have focused on how the law might be reformed to encourage water conservation and thus decrease water demand to adapt to drought conditions.[4]

Less attention has been devoted to legal issues associated with the augmentation of water supplies.[5] Traditionally, water augmentation has included drilling more wells, increasing reservoir capacity, harvesting rainwater, and desalinating seawater. This Article focuses on the present and future of the law governing three types of nontraditional water augmentation—bulk water imports, watershed management, and cloud seeding. Bulk water imports involve a water-poor jurisdiction importing water in bulk, via pipeline or tanker, from another (presumably) water-rich jurisdiction.[6] For example, California has considered importing water in bulk via tanker from Canada to deal with its severe, ongoing drought.[7] Watershed management involves the removal of vegetation that takes in water that might otherwise be available for human use.[8] This vegetation may be an invasive species or scrub brush increasing the risk of wildfire.[9] Cloud seeding involves the dispersal of particles into the air to create clouds and induce rainfall.[10] This Article broadly examines these three nontraditional water

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1. Alejandro E. Camacho, *Adapting Governance to Climate Change: Managing Uncertainty Through a Learning Infrastructure*, 59 EMORY L.J. 1, 24–25 (2009).
2. Rhett B. Larson, *Reconciling Energy and Food Security*, 48 U. RICH. L. REV. 929, 930–31 (2014).
3. *See, e.g.*, Ronald A. Kaiser, *Texas Water Marketing in the Next Millennium: A Conceptual and Legal Analysis*, 27 TEX. TECH L. REV. 181, 183–85 (1996); Barton H. Thompson, Jr., *Institutional Perspectives on Water Policy and Markets*, 81 CAL. L. REV. 671, 755–61 (1993).
4. Robert Glennon, *Water Scarcity, Marketing, and Privatization*, 83 TEX. L. REV. 1873, 1885 (2005); Mary Ann King, *Getting Our Feet Wet: An Introduction to Water Trusts*, 28 HARV. ENVTL. L. REV. 495, 507 (2004).
5. *But see* Rhett B. Larson, *Innovation and International Commons: The Case of Desalination Under International Law*, 2012 UTAH L. REV. 759, 777–95.
6. Elise L. Larson, Note, *In Deep Water: A Common Law Solution to the Bulk Water Export Problem*, 96 MINN. L. REV. 739, 739 (2011).
7. Peter Bowal, *Canadian Water: Constitution, Policy, and Trade*, 2006 MICH. ST. L. REV. 1141, 1173.
8. George Cameron Coggins, *Watershed as a Public Natural Resource on the Federal Lands*, 11 VA. ENVTL. L.J. 1, 13 (1991).
9. *See generally* Keith H. Hirokawa, *Driving Local Governments to Watershed Governance*, 42 ENVTL. L. 157 (2012).
10. Ray Jay Davis, *Atmospheric Water Resources Development and International Law*, 31 NAT. RESOURCES J. 11, 15–17 (1991).

augmentation strategies within the existing legal environment and proposes reforms to facilitate appropriate implementation of these strategies.

This Article proceeds in three parts. Part II briefly describes the development, current state, and implementation of bulk water imports, watershed management, and cloud seeding. Part III places these water augmentation strategies within a legal context, discussing in particular the role of state, interstate, and international water law in influencing how these strategies are implemented. Part IV proposes three broad reforms that could serve to facilitate responsible development and effective oversight of water augmentation strategies. This Article provides only an overview of a few potential reforms and a brief evaluation of their relative risks and potential benefits, and makes no prescriptive normative statement about the advisability or feasibility of such reforms. Additional research into the environmental and economic implications of nontraditional water augmentation projects will be required to tailor legal regimes that can effectively and equitably implement these projects.

## II. WATER AUGMENTATION STRATEGIES

The combination of climate change, population growth, and increasing consumption patterns in many arid regions may make water conservation strategies a necessary but insufficient approach to addressing water scarcity.[11] In some cases, regions may not be able to conserve their way out of water scarcity, and may have no other option but to augment their water supplies.[12] This Part briefly describes the development and current state of three possible approaches to water augmentation and evaluates their respective costs and benefits.

### *A. Bulk Water Imports*

Imagine the world is like a golf ball—a sphere covered in divots.[13] Each divot is a basin in which all water drains, whether to the ocean, an inland lake, or an aquifer.[14] Bulk water imports involve moving large amounts of water from one basin to another via pipeline or tanker.[15] Singapore, for example, largely depends on bulk water imports via pipeline from

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11. Patricia Wouters et al., *Water Security, Hydrosolidarity, and International Law: A River Runs Through It . . .* , 19 Y.B. INT'L ENVTL. L. 97, 98 n.6 (2009).

12. *Id.* at 99.

13. Rhett B. Larson, *Interstitial Federalism*, 62 UCLA L. REV. 908, 911 (2015).

14. *Id.*

15. RHETT LARSON, THE CASE OF CANADIAN BULK WATER EXPORTS 5 (Canadian Global Aff. Inst. 2015), https://d3n8a8pro7vhmx.cloudfront.net/cdfai/pages/609/attachments/original/1440452326/Canadian_Bulk_Water_Exports.pdf?1440452326.

Malaysia.[16] In an effort to wean itself from its dependency on a neighboring country, however, Singapore has made significant progress toward achieving independence in its water supply from Malaysia under its NEWater program.[17] Singapore plans to rely entirely on recycled water and desalination, and to no longer depend on Malaysian water imports.[18] Effectively, Singapore prefers the energy-intensive but independently sustainable development of its own water resources rather than depending on raw water imports from a neighboring state.[19] Turkey provides water from the Alaköprü Dam in bulk to northern Cyprus via an undersea pipeline.[20] This project has been controversial, and could aggravate tensions between Turkish-Northern Cypriots and Greek-Southern Cypriots.[21]

Canada and the United States provide a particularly useful example of repeated efforts to develop water import programs and the obstacles facing such development and implementation.[22] In 1998, a Canadian company called the Nova Group procured a permit to export 600 million liters of water from Lake Superior via tanker to Asian buyers.[23] Public opposition based on the national security and environmental risks of this operation resulted in the permit being revoked.[24] Not all Canadian bulk water exports have been large projects that were ultimately shut down by public opposition.[25] Smaller water transfers occur frequently between Canadian and U.S. border communities, typically without any national-level oversight. Some of the ongoing water transfer relationships include those between Surrey, VC, and Blaine, WA; and LaSalle, ON, and Detroit, MI.[26]

Bulk water transports also have tremendous implications for domestic water policy.[27] Certainly, in both the domestic and international context, bottled water would constitute a bulk water transfer.[28] The growing market for bottled water creates stronger incentives to move water in bulk between

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16. Suzanne Timmons Lewis, *Domestic Solutions to the International Problem of Water Scarcity: Singapore, a Case Study*, 42 GA. J. INT'L & COMP. L. 247, 256 (2013).

17. Elizabeth Weise, *In a Drought, Should We Drink Sewage? Singapore Does*, USA TODAY (June 2, 2015, 7:12 PM), http://www.usatoday.com/story/tech/2015/06/02/singapore-water-recycled-sewer-water-newater-california-drought/27958823/.

18. Lewis, *supra* note 16, at 258–61.

19. *Id.* at 249.

20. Eugene Kontorovich, *Economic Dealings with Occupied Territories*, 53 COLUM. J. TRANSNAT'L L. 584, 617 (2015).

21. *Id.* at 617–19.

22. *See generally* Larson, *supra* note 13, at 926–31; LARSON, *supra* note 15, at 4–5.

23. Sandra Zellmer, *The Anti-Speculation Doctrine and Its Implications for Collaborative Water Management*, 8 NEV. L.J. 994, 1001 (2008).

24. *Id.*

25. *See* LARSON, *supra* note 15, at 2.

26. *See id.*

27. *See, e.g.*, Robert A. Pulver, Comment, *Liability Rules as a Solution to the Problem of Waste in Western Water Law: An Economic Analysis*, 76 CAL. L. REV. 671, 694–95 (1988).

28. Douglas A. Kysar, *Sustainable Development and Private Global Governance*, 83 TEX. L. REV. 2109, 2116–17 (2005).

basins.[29] Beyond the bottled water example, piped and diverted bulk water transports occur intranationally as well.[30] For example, the Imperial Canal and the Central Arizona Project Canal divert water away from the Colorado River for use outside of the basin itself, effectively creating a bulk water export out of the Colorado River basin.[31] Recent interstate water rivalries sparked when Texas contemplated a project involving water withdrawals within Oklahoma for export to Texas.[32]

Usually these bulk water transports are conducted via pipeline or tanker, and the transportation costs are often prohibitive.[33] However, technological innovations could facilitate more efficient transportation of freshwater in bulk.[34] As California contemplates potential alternative water sources, desalination in San Diego could cost as much as $5 per cubic meter, whereas transport of water from Alaska via towed-bag technology could be as low as $2 per cubic meter.[35] As is often the case with technological innovations, old legal regimes are often ill-suited to address new technologies.[36]

Regardless of technology, water is heavy, and its transport tends to be costly and energy intensive with attendant environmental impacts such as greenhouse gas emissions.[37] Furthermore, if water is exported faster than it naturally recharges, then despite the renewing effects of the hydrologic cycle, water resources can be depleted.[38] This is particularly true of inter-basin transfers.[39] Such depletion ultimately impacts stream flow (i.e., the amount of water in the stream), overall runoff, soil quality, and ecosystem health.[40] This is perhaps the greatest concern and the controversy typically cited in opposition to bulk water exports.[41] Concerns for water depletion, while a common objection to bulk water exports, may ultimately prove to be only

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29. Christine A. Klein, *Water Transfers: The Case Against Transbasin Diversions in the Eastern States*, 25 UCLA J. ENVTL. L. & POL'Y 249, 252 (2007).

30. *See* Pulver, *supra* note 27, at 695.

31. *Id.*; *see also* James S. Lochhead, *An Upper Basin Perspective on California's Claims to Water from the Colorado River Part II: The Development, Implementation and Collapse of California's Plan to Live Within its Basic Apportionment*, 6 U. DENV. WATER L. REV. 318, 367 (2003).

32. *See generally* Alexandra Campbell-Ferrari, *Managing Interstate Water Resources:* Tarrant Regional *and Beyond*, 44 TEX. ENVTL. L.J. 235 (2014).

33. LARSON, *supra* note 15, at 3–4.

34. *See generally* Andrew Hodges, Kristiana Hansen & Donald McLeod, *The Economics of Bulk Water Transport in Southern California*, 3 RESOURCES 703 (2014).

35. *Id.* at 709, 712.

36. *See, e.g.*, Troy A. Rule, *Airspace in an Age of Drones*, 95 B.U. L. REV. 155, 166–67 (2015).

37. Cynthia DeLaughter, Comment, *Priming the Water Industry Pump*, 37 HOUS. L. REV. 1465, 1491 (2000).

38. LARSON, *supra* note 15, at 3.

39. *See* Noah D. Hall & Benjamin L. Cavataro, *Interstate Groundwater Law in the Snake Valley: Equitable Apportionment and a New Model for Transboundary Aquifer Management*, 2013 UTAH L. REV. 1553, 1574. *See generally* Kirt Mayland, *Navigating the Murky Waters of Connecticut's Water Allocation Scheme*, 24 QUINNIPIAC L. REV. 685 (2006).

40. Hall & Cavataro, *supra* note 39; *see also* Mayland, *supra* note 39, at 726–27; LARSON, *supra* note 15, at 3.

41. LARSON, *supra* note 15, at 3.

one of many potential challenges, including the possibility of importing invasive species or pathogens along with the bulk water.[42]

### *B. Watershed Management*

Watershed management refers to the removal of vegetation from a catchment, such as scrub brush or invasive species, as a part of a broader timber harvest plan.[43] Watershed management has several potential benefits. First, removal of scrub brush and immature trees can improve forest health by allowing other trees to reach full maturity.[44] Second, this removal may help avoid or mitigate wildfire risks and insect infestation, like that of bark beetles.[45] Third, improved forest health and fewer wildfires can decrease erosion and runoff to rivers, improving water quality.[46] Fourth, removing vegetation within the watershed at a responsible rate can increase stream flow, thereby augmenting water supplies.[47]

Healthy forests protect winter snowpack from melting too fast and prevent losing precipitation to immediate evaporation.[48] Forests affected by wildfires, on the other hand, expose more snow to evaporation and adversely impact water quality through runoff.[49] Investments in improved forest health increase water quantity and water quality.[50] More than 80 years of research throughout the western U.S. documents the potential for improved watershed management to increase stream flow.[51] The removal of vegetation from forests frees up water that would otherwise be embedded in flora, which can inhibit forest maturation and aggravate risks of wildfire.[52]

Nevertheless, removal of this vegetation can adversely impact aquatic and wildlife habitats if done in a way that is not sustainable. There is a real danger of reducing shade cover, eliminating key nesting areas, and increasing

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42. *See, e.g.*, Tony George Puthucherril, *Ballast Waters and Aquatic Invasive Species: A Model for India*, 19 COLO. J. INT'L ENVTL. L. & POL'Y 381, 395–96 (2008).

43. Diane E. McConkey, Note, *Federal Reserved Rights to Instream Flows in the National Forests*, 13 VA. ENVTL. L.J. 305, 311 (1994); *see also* Brandon Loomis, *Reduction in Tree Cover over Rivers Could Mean More Water Flow*, ARIZ. REPUBLIC (Oct. 30, 2015, 10:38 PM), http://www.azcentral.com/story/news/arizona/investigations/2015/10/31/reduction-tree-cover-over-rivers-could-mean-more-water-flow/74882770/.

44. *See* McConkey, *supra* note 43.

45. *Id.* The ultimate effectiveness of watershed management in addressing wildfire concerns is the subject of intense scholarly debate. *See generally* WILDFIRE POLICY: LAW AND ECONOMICS PERSPECTIVES (Karen Bradshaw Schulz & Dean Lueck eds., 2012).

46. *See* McConkey, *supra* note 43.

47. *Id.*; *see also* Loomis, *supra* note 43.

48. Alden R. Hibbert, *Water Yield Improvement Potential by Vegetation Management on Western Rangelands*, 19 J. AM. WATER RESOURCES ASS'N 375, 378–79 (1983).

49. *See id.* at 377.

50. *See generally* Charles A. Troendle et al., *The Coon Creek Water Yield Augmentation Project: Implementation of Timber Harvesting Technology to Increase Streamflow*, 143 FOREST ECOLOGY & MGMT. 179 (2001).

51. *Id.*

52. *Id.*; *see* Hibbert, *supra* note 48, at 377.

access to fragile banks for grazing animals.[53] Furthermore, removal of the kind of scrub brush, immature trees, and invasive species required for improved forest health and stream flow can be costly with uncertain returns on such investments, in part because this vegetation has a narrow trunk diameter that does not lend itself well for use as timber.[54] Burning vegetation for energy or paper production is possible, but it can cause pollution during production in addition to the other environmental impacts associated with brush removal.[55]

### *C. Cloud Seeding*

Cloud seeding involves inducing precipitation that can be used to produce rain or snow and thereby augment water supplies.[56] As global temperatures rise, clouds could become an increasingly important direct source of water.[57] The Clausius Clapeyron curve for water vapor shows that for every 1°C rise in temperature the atmosphere's ability to hold water increases by 7%.[58] As such, as global temperatures rise with increasing atmospheric greenhouse gas concentrations, the water-holding capacity of the atmosphere increases—clouds will hold more water.[59]

There are multiple approaches to cloud seeding.[60] Seeds are generally dispersed via airplanes or cannons.[61] Hygroscopic (warm cloud) seeding disperses seeds in the lower part of clouds.[62] Static (cold cloud) seeding spreads ice-nucleating agents into clouds already containing moisture that condenses around the nuclei and falls as precipitation.[63] The ideal particles for condensation nuclei are charged particles that will attract the oppositely charged water molecules in the air and particles with significant surface

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53. H. Michael Rauscher, *Ecosystem Management Decision Support for Federal Forests in the United States: A Review*, 114 FOREST ECOLOGY & MGMT. 173, 174 (1999).

54. Elisabeth Long, Note, Wyoming v. USDA*: A Look Down the Road at Management of Inventoried Roadless Areas for Climate Change Mitigation and Adaptation*, 40 ECOLOGY L.Q. 329, 341 (2013). *But see* Karen Bradshaw Schulz & Dean Lueck, *Contracting for Control of Landscape-Level Resources*, 100 IOWA L. REV. 2507, 2533–35 (2015) (discussing the incentives some forest landowners have to invest in watershed protection).

55. Bärbel Langmann et al., *Vegetation Fire Emissions and Their Impact on Air Pollution and Climate*, 43 ATMOSPHERIC ENV'T 107, 107 (2009); *see also* Emery Cowan, *How Good Earth's Plans Have Played Out*, ARIZ. DAILY SUN (Sept. 26, 2015), http://azdailysun.com/news/local/how-good-earth-s-plans-have-played-out/article_70741036-707d-508c-8ac9-a94e1ea8b999.html (discussing a plan to turn thousands of acres of forest into biofuel).

56. Davis, *supra* note 10.

57. Kevin E. Trenberth et al., *Observations: Surface and Atmospheric Climate Change*, *in* CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS 262 (2007).

58. *Id.*

59. *Id.*

60. *See generally* ARNETT S. DENNIS, WEATHER MODIFICATION BY CLOUD SEEDING (Anton L. Hales ed. 1980).

61. *See id.* at 96–97.

62. *See id.* at 66, 70, 93.

63. *Id.* at 97.

water.[64] Common particles used in cloud seeding operations include dry ice (frozen carbon dioxide) and silver iodide.[65]

Precipitation can begin within fifteen to thirty minutes of seeding and can extend as far out as one hundred miles downwind.[66] While aircraft delivery is more accurate, averaging 10%–20% additional yield over ground-based generation (averaging 10%), it is also more expensive.[67] New technologies and agents are being developed to increase and better control yield, yet uncertainties remain in the deployment of cloud-seeding technologies.[68]

Whether cloud seeding is a viable option for enhancing precipitation depends largely on how well it could work in any given region. Studies show that seeding is effective and induces—depending on operational parameters—an additional 5%–25% precipitation from clouds, most citing a range from 10%–15%.[69] As recently as 2003, a national research council questioned seeding effectiveness, adding that the problem was a failure to accurately predict the results and understand atmospheric processes.[70] In response, Wyoming sought to find verifiable results with a $14 million experiment extending from 2008–2014.[71] Using the parallel Sierra Madre and Medicine Bow mountain ranges, storms were seeded over one range while the other acted as a control.[72] When including measurements of snowmelt-driven stream flow, results indicated a 5%–15% increase in precipitation and were reported during the 2014 Colorado River Water Users Association conference.[73]

Ecological concerns have heightened the barriers to the deployment of cloud seeding. The image of aircrafts blazing through the atmosphere and cannons deployed on the peaks of mountains dumping silver iodide into the environment understandably raises environmental concerns.[74] Such concerns

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64. Xueliang Guo et al., *A Numerical Comparison Study of Cloud Seeding by Silver Iodide and Liquid Carbon Dioxide*, 79 ATMOSPHERIC RES. 183, 184 (2006).

65. *Id.*

66. *Id.* at 213–16.

67. *Id.*

68. Daniel Rosenfeld et al., *A Quest for Effective Hygroscopic Cloud Seeding*, 49 J. APPLIED METEOROLOGY & CLIMATOLOGY 1548, 1560–61 (2010).

69. Cinnamon P. Carlarne, *Arctic Dreams and Geoengineering Wishes: The Collateral Damage of Climate Change*, 49 COLUM. J. TRANSNAT'L L. 602 (2011); Morteza Khalili Sr. et al., *Results of Cloud Seeding Operations for Precipitation Enhancement in Iran during 1999–2007*, presented at Planned and Inadvertent Weather Modification/Weather Modification Association Conference (Apr. 21, 2008), http://ams.confex.com/ams/17WModWMA/techprogram/paper_139149.htm.

70. Carlarne, *supra* note 69, at 645.

71. Allen Best, *Biggest Cloud-Seeding Experiment Yet Only Sparks More Debate*, LIVESCIENCE (Dec. 26, 2014, 1:30 PM), http://www.livescience.com/49263-cloud-seeding-experiment-debate.html.

72. Anil Acharya et al., *Modeled Streamflow Response Under Cloud Seeding in the North Platte River Watershed*, 409 J. HYDROLOGY 305, 306–09 (2011).

73. *Id.* at 309–13.

74. Erica C. Smit, Note, *Geoengineering: Issues of Accountability in International Law*, 15 NEV. L.J. 1060, 1086–87 (2015).

include the potential for bioaccumulation of silver iodide in the environment.[75]

In addition to environmental concerns, cloud seeding could raise significant concerns for human safety.[76] For example, from 1967 to 1972, the U.S. military used cloud seeding as a tactical weapon for its war effort in Vietnam, "Operation Popeye."[77] Despite the controversial effectiveness of Operation Popeye, this and other military efforts eventually led to the International Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques of 1977 (ENMOD).[78] The ratification of ENMOD and the supposed underlying efficacy of Operation Popeye indicate the potential for flood damage induced by cloud seeding, including injuries, death, and property destruction.[79] Issues of causation and liability allocation associated with such damages would remain a primary challenge for the law's attempts to address cloud seeding as a viable and safe water augmentation strategy.[80]

## III. THE LAW OF WATER AUGMENTATION

Water law typically contemplates either groundwater or surface water.[81] Water generated from the types of augmentation strategies and technologies discussed above does not obviously fit into either category.[82] As such, water law principles are often an awkward fit when applied to augmented water. This Part evaluates how current principles of water law can be applied to or adapted to fit the issues surrounding water augmentation strategies.

### *A. Prior Appropriation and Water Augmentation*

Water augmentation policy is perhaps most relevant in arid regions with an already limited and strained water supply.[83] Water rights in the arid western United States are generally based on the doctrine of prior appropriation.[84] This "first in time, first in right" approach allocates water rights to users in order of priority and limits the amount of water that can be

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75. *Id.*

76. *Id.* at 1071.

77. Noah Byron Bonnheim, *History of Climate Engineering*, 1 WILEY INTERDISC. REVS.: CLIMATE CHANGE 891, 893 (2010).

78. James R. Fleming, *The Climate Engineers*, 31 WILSON Q. 46, 56 (2007).

79. *Id.*

80. *Id.* at 56–57.

81. John D. Leshy, *A Conversation About Takings and Water Rights*, 83 TEX. L. REV. 1985, 1988–89 (2005).

82. *See* Adrian Shelley, Note, *Fair, Effective, and Comprehensive: The Future of Texas Water Law*, 41 TEX. ENVTL. L.J. 47, 49–50 (2010).

83. Leshy, *supra* note 81, at 1992.

84. *Id.* at 1987–88.

put to beneficial use without waste.[85] The doctrine provides certainty and encourages the use of scarce western water resources without waste.[86] Under the prior appropriation system, when river flows are insufficient to satisfy all rights, a senior appropriator will place a "call on the river."[87] The call forces junior appropriators to stop diverting until the senior's right is satisfied.[88] Failure to use water beneficially for a period of years could result in forfeiting the water right.[89]

Perhaps the most important legal distinction under prior appropriation law for water augmentation is the distinction between developed water and salvaged water.[90] Developed water is water imported into a system that was not previously part of the basin—such as bulk water imports.[91] Salvaged water, on the other hand, is water that is part of the river basin that was otherwise inaccessible or unusable, but is made usable by human intervention.[92] For example, an advanced well-drilling technique could make a deep fossil aquifer accessible, or water-treatment technology could make an otherwise unusable water source sufficiently clean for human use.

Developed water is owned by the party that develops it, independent of the prior appropriation system.[93] As such, a party that imports water into a basin owns that water without it being subject to senior priority claims.[94] Salvaged water, however, remains part of the priority system, and the party that salvaged the water has no special or superior claim to the water even though without the salvaging party's intervention, the water would have been otherwise unavailable.[95] For example, in *Southeastern Colorado Water Conservancy District v. Shelton Farms, Inc.*, a party that removed an invasive species, which was taking water from the banks of a stream, claimed rights to the augmented water that the removal generated.[96] The court held, however, that the water was salvaged water and subject to prior appropriation.[97]

85. Eli Feldman, *Death Penalty for Water Thieves*, 8 U. DENV. WATER L. REV. 1, 3 (2004); Alexandra B. Klass, *Property Rights on the New Frontier: Climate Change, Natural Resource Development, and Renewable Energy*, 38 ECOLOGY L.Q. 63, 86 (2011).

86. Michael Toll, Comment, *Reimagining Western Water Law: Time-Limited Water Rights Permits Based on a Comprehensive Beneficial Use Doctrine*, 82 U. COLO. L. REV. 595, 607 (2011).

87. Brian E. Gray, *No Holier Temples: Protecting the National Parks Through Wild and Scenic River Designation*, 58 U. COLO. L. REV. 551, 579 (1988).

88. *Id.*; *see also* Feldman, *supra* note 85.

89. Henry E. Smith, *Governing Water: The Semicommons of Fluid Property Rights*, 50 ARIZ. L. REV. 445, 468 (2008).

90. Kaiser, *supra* note 3, at 255.

91. *Id.*

92. *Id.*

93. *Id.*

94. *See id.*

95. *Id.*

96. Se. Colo. Water Conservancy Dist. v. Shelton Farms, Inc., 529 P.2d 1321, 1323 (Colo. 1974) (en banc).

97. *Id.* at 1327.

The distinction between developed and salvaged water is both highly relevant and potentially highly problematic for water augmentation projects. Traditional approaches to water augmentation, such as desalination, raise important questions related to this distinction.[98] Water generated from seawater desalination is likely developed water, whereas water generated from desalinating brackish groundwater or saline-contaminated surface water is likely salvaged water.[99] The application of this distinction thus arguably incentivizes desalinating seawater over treating pollution or improving inland water supplies.[100]

For nontraditional water augmentation strategies, the application of this distinction and its related incentives are potentially even more complicated. Bulk water imports are likely developed water.[101] As such, a senior water rights holder could invest in bulk water imports, increase their available supply, and still maintain priority over junior appropriators. In drought conditions, should senior appropriators hold superior rights to so much water? Water generated through watershed management is likely salvaged water.[102] Indeed, watershed management is perhaps the paradigmatic example of salvaged water, given its striking similarities to the facts of *Shelton Farms*.[103] In such a case, what incentives exist for improved watershed management if those investing in it cannot secure the benefit of augmented water?

Cloud seeding is perhaps the most complicated of the nontraditional water augmentation approaches under the salvaged/developed water distinction. Is the water in a cloud part of the basin? Is it part of the basin only if the water came from that basin, or only while the cloud is over that basin? Is it truly developed water? The law has no answer for these questions, and therefore leaves a cloud of uncertainty hanging over cloud seeding.

### *B. Transboundary Water Rights and Water Augmentation*

One common assumption in water law is a policy preference for basin-level governance.[104] Under what is called the "internalization prescription for government jurisdiction," power should be assigned over spillover goods, like water, "to the smallest unit of government that

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98. Larson, *supra* note 5, at 789.

99. *See id.*

100. *Id.* at 793.

101. *See supra* note 91 and accompanying text (discussing water that is imported into a system where it was not originally located).

102. *See* Kaiser, *supra* note 3, at 255 (discussing the differences between salvaged and developed water); McConkey, *supra* note 43 (describing watershed management).

103. *See* Se. Colo. Water Conservancy Dist. v. Shelton Farms, Inc., 529 P.2d 1321, 1323 (Colo. 1974) (en banc).

104. Larson, *supra* note 13, at 955–56.

internalizes the effects of its exercise."[105] Spillover goods are those like water and air, which move between jurisdictions.[106] As these goods move between jurisdictions, assigning the appropriate level of governance is a challenge, particularly because governments can externalize costs, like with pollution originating in one jurisdiction and flowing downstream or blowing away to other jurisdictions.[107]

To achieve internalization of costs and avoid free-riding, "[w]hen the effects of a public good or bad spill over jurisdictions, a special district should provide the good or control the bad."[108] The model for this type of approach is the multi-state river basin commission, which is a recent, though increasingly common, feature of inter-jurisdictional water resource management, in both domestic and international water law.[109]

In domestic water law, it is common to manage transboundary waters at the basin level through an interstate compact, which falls between state and federal governance levels.[110] For example, the Delaware River Basin Commission manages the Delaware River under an interstate compact between those states sharing the river.[111] In international water law, it is common to manage transboundary rivers through regional interstate water commissions established by treaty.[112] For example, the International Borders and Water Commission (IBWC) manages the Colorado River under the 1944 Rivers Treaty between the U.S. and Mexico.[113]

This basin-level governance approach constitutes an attempt to comply with the internalization prescription in water resource management.[114] While it may more effectively avoid externalities, it raises difficult political conditions when sovereign jurisdictions attempt to cooperate in managing a shared resource, like water, that is often uniquely politically charged.[115] In doing so, the transboundary governance regimes can be too strong and excessively interfere with the sovereignty of some member jurisdictions.[116] On the other hand, these transboundary governance regimes can be

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105. ROBERT D. COOTER, THE STRATEGIC CONSTITUTION 125 (2000).
106. *Id.* at 106.
107. *Id.*
108. *Id.*
109. *See* Noah D. Hall, *Interstate Water Compacts and Climate Change Adaptation*, 5 ENVT'L & ENERGY L. & POL'Y J. 237, 266–68, 288–90 (2010); Owen McIntyre, *The Proceduralisation and Growing Maturity of International Water Law*, 22 J. ENVTL. L. 475, 476–77 (2010).
110. *See* Larson, *supra* note 13, at 930–31.
111. *See* Larson, *supra* note 5, at 810.
112. *See id.* at 802.
113. Eric L. Garner & Michelle Ouellette, *Future Shock? The Law of the Colorado River in the Twenty-First Century*, 27 ARIZ. ST. L.J. 469, 503 (1995).
114. Larson, *supra* note 13, at 955.
115. *See id.* at 962.
116. *Id.*

purposefully weak and underfunded, which may avoid the risks to sovereignty but ultimately undermine the internalization prescription.[117]

Basin-level governance and striking the appropriate balance between strong and weak governance regimes may be uniquely difficult for water augmentation projects. In a traditional water augmentation program like desalination, it is unclear if the basin is even the appropriate geographic level, given the possible inter-basin impacts from coastal contamination, such as impacts on marine species and greenhouse gas emissions.[118] For bulk water transports, water is often moved from one basin to another, and cloud seeding has obvious inter-basin implications.[119] As such, for these water augmentation approaches, it is even less clear that basin-level governance is appropriate. Hence, one of the fundamental assumptions underlying transboundary water law may not hold in the case of governing water augmentation projects.

### *C. The Law of Bulk Water Commerce*

Bulk water transports raise difficult water law issues beyond the salvaged/developed water distinction and basin-level governance questions. One of the difficulties facing water law at both the national and international level is distinguishing raw water from embedded—or "virtual"—water.[120] Virtual water is water that is embedded in products.[121] For example, one kilogram of grain has 1,000 liters of water embedded within it.[122] The difficulty facing the application of water law is often knowing when water law applies and when it does not, given that accounting for virtual water potentially places essentially everything under water law.[123] For the purposes of this Article, bulk water transports refer to the transport of raw water, as opposed to virtual water. Nevertheless, the law of raw-water transport has important implications for the regulation of trade in virtual water, as is discussed below.[124]

The relationship between Canada and the U.S. is illustrative of the general challenge associated with the international transfer of bulk raw water. Recently, the Canadian government issued licenses to Canadian companies in British Columbia authorizing the export of nearly 55.5 million cubic

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117. *Id.*

118. *See generally* Larson, *supra* note 5.

119. *See* LARSON, *supra* note 15, at 3.

120. J. A. "Tony" Allan, *Virtual Water – The Water, Food, and Trade Nexus: Useful Concept or Misleading Metaphor?*, 28 WATER INT'L, Mar. 2003, at 4, 9, http://www.soas.ac.uk/water/publications/papers/file38394.pdf.

121. *Id.*

122. *See* A.Y. Hoekstra & A. K. Chapagain, *Water Footprints of Nations: Water Use by People as a Function of Their Consumption Pattern*, 21 WATER RESOURCES MGMT., no. 1, 2007, at 35, 38.

123. *See generally* LARSON, *supra* note 15.

124. *Id.*

meters of water annually by ocean tanker.[125] The Canadian companies with these licenses would then award contracts to foreign companies to export water from Canada.[126] A Canadian company called Snowcap received one such permit and awarded a contract to a U.S. company, called Sun Belt, to export water from British Columbia to California.[127] However, due to public opposition to these bulk water exports based on environmental concerns, the government of British Columbia issued a ban on exports and rescinded the licenses.[128]

This case illustrates two fundamental legal questions associated with bulk water exports under international law. First, is water a "good" or "product" for purposes of international trade and investment law? The North American Free Trade Agreement (NAFTA) defines goods and products by referencing the definition of the term under the World Trade Organization's (WTO) General Agreement on Tariffs and Trade (GATT).[129] A product is "[s]omething produced by human or mechanical effort or by a natural process."[130] Under NAFTA, water flowing in natural streams, channels, or geologic formations is generally not a good for purposes of international trade and investment law.[131] Virtual water, including water embedded in lettuce, oil, and even bottled water, is a good.[132] It remains unclear whether international trade and investment law should treat water transported by tanker or pipeline as a good.[133]

If water is a good, international law dictates the extent to which nations may be protectionist when it comes to trade in water. Under GATT and NAFTA, nations generally may not discriminate against the goods of other nations or prohibit or impose restrictions on the import or export of goods.[134] The obligations under GATT and NAFTA are broad and are narrowed only in exceptional circumstances such as "critical shortage" or "environmental

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125. Terry L. Anderson & Clay J. Landry, *Exporting Water to the World*, 118 J. CONTEMP. WATER RES. & EDUC. 60, 62 (2001).

126. *See id.*

127. Paul Stanton Kibel, *Grasp on Water: A Natural Resource that Eludes NAFTA's Notion of Investment*, 34 ECOLOGY L.Q. 655, 662 (2007).

128. Christopher Scott Maravilla, *The Canadian Bulk Water Moratorium and its Implications for NAFTA*, 10 CURRENTS: INT'L TRADE L.J., Summer 2001, at 29, 31–32.

129. *See* North American Free Trade Agreement, Can.-Mex.-U.S., Dec. 17, 1992, 32 I.L.M. 289, 298 (1993) [hereinafter NAFTA] (referencing GATT's definition of goods); *see also* Maravilla, *supra* note 128, at 32–33 (discussing the distinctions between the meaning of a good in reference to bulk water).

130. *See* Maravilla, *supra* note 128, at 33 (alteration in original) (citing Webster's Collegiate Dictionary 882 (1995 ed.)).

131. Edith Brown Weiss, *Water Transfers and International Trade Law*, *in* FRESH WATER AND INTERNATIONAL ECONOMIC LAW 61, 69 (Edith Brown Weiss et al. eds., 2005).

132. *See id.* at 70.

133. *Id.*

134. *See* Maravilla, *supra* note 128, at 33. *Compare* NAFTA, *supra* note 129, at 303 (referencing art. 309 restrictions on imports and exports), *with* General Agreement on Tariffs and Trade, Oct. 30, 1947, T.I.A.S. 1700, 55 U.N.T.S. 194, 224–26 [hereinafter GATT] (discussing original restrictions on imports and exports).

measures necessary to protect human, animal or plant life or health, . . . [or] to measures relating to the conservation of living and non-living exhaustible natural resources."[135] A nation could claim one of these exceptions as applicable to ban bulk water exports.

The legal treatment of bulk water exports has enormous implications for global water management.[136] If bulk water is a good, then nations will generally not be able to ban its export unless it avails itself to one of these narrow exceptions.[137] This could allow water-rich countries to reap economic benefits while improving the water security of importing nations.[138] However, it could also create unsustainable water exports, damaging both the national environment and the national security of exporting nations by shipping out water faster than nature can replenish it.[139] Such bulk water exports may alleviate water scarcity in other nations, but at the same time create or support industries, ecosystems, and communities dependent upon foreign sources of water.[140] As such, importing nations could ultimately trade national security for water security.[141] Furthermore, water as an economic good must be reconciled with the idea of water as a fundamental human right and a critical ecological resource.[142] Is it possible for water-rich nations to export water in bulk without threatening their own ecosystems and security while at the same time helping other nations without creating unsustainable dependencies?

Domestic water law reflects similar challenges. The U.S. Constitution grants Congress the exclusive authority to regulate interstate commerce.[143] This exclusive grant contains an implicit limit on state power to interfere with interstate commerce—what is called the Dormant Commerce Clause.[144] Courts apply strict scrutiny in reviewing the constitutionality of any state law or regulation commercially discriminating against another state.[145] If the state law or regulation at issue is nondiscriminatory but

135. *See* NAFTA, *supra* note 129, at 699 (noting that GATT article XX(b) and (g) are incorporated in NAFTA article 2101).

136. LARSON, *supra* note 15, at 4.

137. *Id.* at 5.

138. *Id.*

139. *Id.*

140. *Id.*

141. *Id.*

142. *Id.*; *see also* Rhett B. Larson, *The New Right in Water*, 70 WASH. & LEE L. REV. 2181, 2225 (2013) ("The challenge presented in formulating a right to water is to meet the purpose of such a right—protecting the disadvantaged—while at the same time ensuring that water provision is economically sustainable by treating water as a valuable and often scarce resource.").

143. *See* U.S. CONST. art. I, § 8, cl. 3.

144. *See, e.g.*, United Haulers Ass'n v. Oneida-Herkimer Solid Waste Mgmt. Auth., 550 U.S. 330, 338 (2007).

145. *See, e.g.*, Hughes v. Oklahoma, 441 U.S. 322, 336 (1979). In *Hughes v. Oklahoma*, the Court stated that "the burden falls on the State to justify [the regulation] both in terms of the local benefits flowing from the statute and the unavailability of non-discriminatory alternatives adequate to preserve the local interests at stake." *Id.* (quoting Hunt v. Wash. St. Apple Advert. Comm'n, 432 U.S. 333, 353 (1977)).

nevertheless burdens interstate commerce, courts apply a less stringent standard, upholding the state action "unless the burden imposed on [interstate] commerce is clearly excessive in relation to the putative local benefits."[146]

Water is unique under the Dormant Commerce Clause.[147] Arid states often import water from water-rich neighboring states, and those water-rich states frequently establish legal barriers to preclude water export.[148] In 1908, the U.S. Supreme Court upheld New Jersey's ban on water export in *Hudson County Water Co. v. McCarter*.[149] In that case, Justice Holmes stated:

> [F]ew public interests are more obvious, indisputable and independent of particular theory than the interest of . . . a State to maintain the rivers that are wholly within it substantially undiminished, except by such drafts upon them as the guardian of the public welfare may permit for the purpose of turning them to a more perfect use.[150]

Essentially, the Court held that state regulations protecting in-state instream flows from impacts imposed by out-of-state appropriators are a valid exercise of a state's police power and consistent with the Constitution, thereby effectively excluding instream flow from categorization as an "article of commerce."[151]

The holding in *Hudson County* was later addressed by the Supreme Court in *Sporhase v. Nebraska*.[152] In that case, the Court invalidated a Nebraska restriction on groundwater exports as unconstitutional under the Dormant Commerce Clause.[153] A farmer owning land straddling the Colorado–Nebraska border applied for a permit to withdraw groundwater from his land in Nebraska to irrigate crops located on his land in Colorado.[154] Nebraska denied the permit under a statute allowing the state to deny groundwater withdrawal permits that are (1) unreasonable; (2) contrary to groundwater conservation; (3) detrimental to the public welfare; or (4) for

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146. Pike v. Bruce Church, Inc., 397 U.S. 137, 142 (1970).

147. *See generally* Christine A. Klein, *The Dormant Commerce Clause and Water Export: Toward a New Analytical Paradigm*, 35 HARV. ENVTL. L. REV. 131, 135 (2011) (noting the unique obstacles the Dormant Commerce Clause poses to water exports).

148. *See, e.g.*, Tarrant Reg'l Water Dist. v. Herrmann, 133 S. Ct. 2120 (2013) (involving a dispute over Texas's contemplated import of water from Oklahoma into arid regions in Texas); *see also* First Amended Complaint at 2–7, Wind River Res., LLC v. Guenther, No. 3:09-cv-08023-PGR (D. Ariz. Apr. 27, 2009), 2009 WL 4248707.

149. *See* Hudson Cty. Water Co. v. McCarter, 209 U.S. 349, 356–57 (1908).

150. *Id.* at 356.

151. *See* A. Dan Tarlock, *The Law of Equitable Apportionment Revisited, Updated, and Restated*, 56 U. COLO. L. REV. 381, 381 (1985); Frank J. Trelease, *State Water and State Lines: Commerce in Water Resources*, 56 U. COLO. L. REV. 347, 347 (1985).

152. Sporhase v. Nebraska, 458 U.S. 941, 945 (1982).

153. *Id.*; *accord* Klein, *supra* note 147, at 132.

154. *Sporhase*, 458 U.S. at 944; *see also* Christine A. Klein, *The Environmental Commerce Clause*, 27 HARV. ENVTL. L. REV. 1, 44–46 (2003).

export to states that do not grant reciprocal rights to withdraw and export groundwater to Nebraska.[155] The Court upheld denial under the first three justifications but struck down the requirement for reciprocity as a facially unconstitutional burden on interstate commerce.[156] The *Sporhase* decision raises important questions, including the extent to which it may have overruled the Court's previous Dormant Commerce Clause decisions upholding water-export restrictions, to what extent the Court was distinguishing between surface water and groundwater, and to what extent the particularly sympathetic facts of *Sporhase* (i.e., he was simply moving water around on his own land, which just happened to straddle a jurisdictional boundary) made the decision difficult to harmonize and apply to interstate water-export cases in general.[157]

## IV. FACILITATING RESPONSIBLE WATER AUGMENTATION

As discussed above, the application of water law principles to nontraditional water augmentation approaches raises difficult questions. Most importantly, how can the law encourage innovation and investment in water augmentation where necessary, and in a way that is ecologically responsible and limits the potential for water disputes? This Part discusses and evaluates three possible legal reforms that could facilitate the responsible development and implementation of nontraditional water augmentation strategies.

### *A. Granting Priority to Augmented Water Rights*

To better encourage investments in forestry management and remediation of contaminated water sources, water law could be reformed to grant some limited rights to salvaged water. For example, all water rights transactions within a particular jurisdiction could include a hold-back of a certain percentage of the total quantity of the right transferred. The water held back from each transfer would be held in trust by the state for the preservation of instream flows and as a discounted source of water available to parties investing in forestry management.[158]

That discounted source of water rights would be available to two possible buyers. First, discounted water rights could be purchased by a party that invests in forestry management, including removal of scrub brush, and

155. *Sporhase*, 458 U.S. at 955–56; *see* NEB. REV. STAT. ANN. § 46-613.01 (West, Westlaw through 104th Leg., 2d Reg. Sess.).

156. *Sporhase*, 458 U.S. at 957–58.

157. *See* Klein, *supra* note 154, at 46–47.

158. *See, e.g.*, Ivan M. Stoner, *Leading a Judge to Water: In Search of a More Fully Formed Washington Public Trust Doctrine*, 85 WASH. L. REV. 391, 397–98 (2010) (discussing the use of public trusts to promote environmental interests).

demonstrates in its application to purchase discounted water that its actions would decrease wildfire risks and increase stream flow.[159] Second, parties engaged in remediation of water contamination would have access to discounted water by, for example, engaging in in-situ treatment of surface water contaminated by non-point source pollution such as salinity and nutrient runoff from agriculture that are not otherwise addressed by existing environmental laws.[160] The discount in each case would depend on a demonstration in an application to purchase discounted water rights that investments improved water access, and the discount would be based on a percentage of the money invested and its overall efficacy. Even if such a percentage could be effectively established with some public consensus, the issue of what priority date, if any, to assign to purchased discounted rights would still need to be resolved. One possible approach would be a negotiated rulemaking process involving senior water rights holders agreeing to assign some priority to those rights in exchange for general water augmentation.[161]

Developed water could remain independent of the priority system to incentivize investments in augmentation.[162] There may be cases in which individual parties hold very senior priority water rights to large quantities of water, and are also able to secure additional supplies of developed water. In such cases, the best approach to equitable apportionment of water may be a more efficient market for water rights. Water rights markets, however, are often plagued by inefficiencies, including high transaction costs associated with objection processes to sever and transfer applications and changes in diversion points.[163]

Two possible reforms could mitigate such inefficiencies. First, laws could limit objections to sever and transfer applications or changes in diversion points only to parties that make a prima facie case of interference with a vested right. Second, parties engaged in sever and transfer or changes in diversion points could pay into a trust fund that would compensate any

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159. *See supra* Part II.B; *see also* Kaiser, *supra* note 3, at 199 (discussing the sale of water rights to conservators); Ronald B. Robie, *Modernizing State Water Rights Laws: Some Suggestions for New Directions*, 1974 UTAH L. REV. 760, 764 (discussing the importance of resource management and the protection and enhancement of the environment).

160. *See generally* David Zaring, *Agriculture, Nonpoint Source Pollution, and Regulatory Control: The Clean Water Act's Bleak Present and Future*, 20 HARV. ENVTL. L. REV. 515 (1996).

161. *See, e.g.*, Howard S. Seitzman & Andrew Bowman, *Negotiated Rulemaking: A Consensus Building Approach to Environmental Regulation*, 28 ST. B. TEX. ENVTL. L.J. 75 (1997).

162. *See* Larson, *supra* note 13, at 956–58 (discussing the trade of developed water for food with nonriparian states, which would not usually be allowed under prior systems).

163. *See, e.g.*, Jonathan H. Adler, *Water Rights, Markets, and Changing Ecological Conditions*, 42 ENVTL. L. 93, 101–04 (2012) (discussing the high costs associated with water markets). For example, petitions to sever water rights from land and transfer them to another, or to change a diversion point from a stream, generally require approval from a state agency and are subject to notice, comment, public objection, and often an administrative hearing process to determine if such changes interfere with vested rights or are against the public interest. *See* Barbara Katz, State Water Res. Control Bd., *Water Rights 101*, at 60–63, www.waterboards.ca.gov/academy/documents/wr101/water_rights101.pdf (last visited Apr. 17, 2016).

adverse impacts to more senior appropriators' rights.[164] This would be somewhat similar to the approach used to encourage development of gristmills in the nineteenth century, which often resulted in flooding upstream landowners' properties.[165] The role of the state trust, however, might avoid possible objections to a purer application of the liability rule associated with dam development—for example, that such an approach effectively constituted a private right of eminent domain.[166] These two reforms could improve water rights and market efficiencies and encourage developed water owners to redistribute surplus water sources. This approach would allow senior right holders to be compensated when transfers or changes in diversion interfere with their rights without causing market inefficiencies.

It is difficult, and perhaps inadvisable, to account for water generated by cloud seeding within a prior appropriation regime. Cloud seeding may not be the sole or even the main reason for demonstrated increased flows, and this causation issue, combined with the complexity of inter-basin rights allocations, could make transaction costs associated with apportioning rights to cloud seeders prohibitively costly.[167] As such, unless and until a prior appropriation regime could be established at the inter-basin level, and until increased flows are conclusively demonstrated as resulting from cloud seeding, augmented water from cloud seeding should arguably be treated as salvaged water.[168] Presently, incentives already exist for some small-scale investment in cloud seeding to increase snow pack for ski resorts.[169] Increased public funding in cloud-seeding research is possibly necessary to understand more clearly the extent to which stream-flow increases can be effectively attributed to cloud-seeding efforts. Without that information, treating cloud seeding as developed water seems likely to result in water rights disputes that will not have a firm evidentiary basis for resolution.

### *B. Transboundary Water Rights Management of Augmentation*

In general, the jurisdictional boundaries governing spillover goods like water should correspond to the geographic contours of such goods—in the

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164. *See, e.g.*, Pulver, *supra* note 27, at 720. For example, if a change in diversion point or a transfer of water rights impacts available water or hydraulic head (pressure that pushes water to downstream users), the change impacts vested (and in some cases senior) water rights. *See id.* at 683.

165. *See, e.g.*, Troy A. Rule, *Property Rights and Modern Energy*, 20 GEO. MASON L. REV. 803, 833–34 (2013).

166. *See id.* at 819–20.

167. *See supra* Parts II.C, III.C; *see also* Virginia Simms, Comment, *Making the Rain: Cloud Seeding, the Imminent Freshwater Crisis, and International Law*, 44 INT'L LAW. 915, 928–30 (2010).

168. *See supra* notes 90–92 and accompanying text (explaining the difference between developed water and salvaged water).

169. *See* Daniel Scott & Geoff McBoyle, *Climate Change Adaptation in the Ski Industry*, 12 MITIGATION & ADAPTATION STRATEGIES FOR GLOBAL CHANGE 1411, 1419 (2007).

case of water, the jurisdictional boundaries should correspond to the drainage basin.[170] However, in the case of most augmentation projects, inter-basin impacts require a broader approach to governance.

In the case of bulk water imports, jurisdictions could integrate both bulk water and virtual water in accounting for water exports.[171] For example, countries could account for water embedded in agricultural imports and exports in evaluating water supplies and relative drought resiliency.[172] This water accounting approach may provide a more accurate sense of a jurisdiction's true water security status by demonstrating to what extent exported water is offset by imported water, and whether water trades create unsustainable dependencies for trading partners.[173] Governments could limit permits for inter-basin bulk water transfers in a way that preserves instream flows and natural recharge rates and does not exacerbate water trade deficits created by the movement of virtual water.[174] This approach would facilitate sustainable water management while still allowing access to water supplies by water-insecure jurisdictions.[175] Part of encouraging sustainable inter-basin management should be effective water pricing across industrial sectors to encourage conservation so that goods are produced with the most water-efficient methods and thus with the minimum amounts of both actual and virtual water.[176]

For water augmentation projects in general, laws should be reevaluated for the advisability of basin-level governance. Bulk water imports often involve inter-basin cooperation, as evidenced by existing bulk water imports like Colorado River water into San Diego or Euphrates River water into Cyprus.[177] Desalination and cloud seeding have potential inter-basin impacts as well.[178] As such, the internalization prescription and basin-level governance may not be appropriate for these approaches to water augmentation and may instead require regional, national, or international governance regimes.

### *C. Bulk Water Imports as Articles of Commerce*

Both international and domestic U.S. water law could treat all water as a good for purchases under international trade and investment law and the Dormant Commerce Clause.[179] Arguably, distinguishing bulk water transfers

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170. Larson, *supra* note 13.
171. LARSON, *supra* note 15, at 6.
172. *See id.*
173. *Id.*
174. *Id.*
175. *Id.*
176. *Id.*
177. *See* Hodges, *supra* note 34, at 708, 711.
178. *See* Larson, *supra* note 5, at 764; Trenberth et al., *supra* note 57.
179. *See* Larson, *supra* note 13, at 933.

from bottled water transfers or transfers of water embedded in agricultural products is arbitrary.[180] Water moves between jurisdictions either way.[181] This would eliminate an otherwise poorly drawn distinction while acknowledging that bulk water exports exist and should be subject to regulation.

While categorizing water as a good has risks associated with commodification of a critical resource, commodification can be an important way to better value water.[182] A market that facilitates internalizing the costs of water consumption is an important tool for advancing sustainable water management.[183] When consumers do not internalize the costs of water consumption, water is often wasted.[184] Water can be both a valuable commodity and a human right when it is appropriately valued, and when that value is reflected in affordable rates for basic human consumption and adequately accounts for the value of instream water to the environment.[185]

Water law could also distinguish between inter-basin and intra-basin bulk water transfers. Small-scale intra-basin transfers, like those that occur between border municipalities in the U.S. and Canada, could be formalized by a treaty between the federal governments of both nations.[186] Europe already takes a similar approach, ratifying multiple transboundary groundwater-sharing agreements between subnational governments in one broad treaty.[187] For large, inter-basin bulk water transfers, the provisions of GATT and regional investment treaties like NAFTA could apply.[188] In those cases, countries could legally restrict bulk water transfers in cases of "critical shortage" or for the protection of human health or the environment.[189] This would mean limiting bulk water exports of groundwater that exceed the rate of natural recharge of the aquifer.[190] Bulk water transports of surface water should be limited to preserve a specified minimum instream flow.[191]

A similar approach could be taken with respect to water law under the U.S. Dormant Commerce Clause. Raw and virtual water should be treated the same with the same police power exceptions to the prohibition against barriers to interstate commerce imposed by state governments. Perhaps, even more effective would be to comply with the internalization prescription, assign effective trustee powers over interstate rivers to an interstate river

180. LARSON, *supra* note 15.
181. *Id.*
182. *Id.*
183. *Id.*
184. *Id.*; *see* Larson, *supra* note 142, at 2228.
185. LARSON, *supra* note 15.
186. *Id.*
187. *Id.* at 6. *See generally* European Outline Convention on the Transfrontier Co-Operation Between Territorial Communities or Authorities, 20 I.L.M. 315 (1980).
188. LARSON, *supra* note 15, at 6.
189. *Id.*
190. *Id.*
191. *Id.*

commission created by compact, and then allow that commission to govern water transfers between basin states.[192] The commission would have a fiduciary obligation—enforceable under the U.S. Supreme Court's original jurisdiction—to manage the interstate water source for the equal benefit of all basin states.

## V. CONCLUSION

With growing populations, increasing consumption patterns, and the potential for increased drought frequency and severity in some areas due to climate change, it is possible that the world will not be able to conserve its way to water security. There are three main priorities for water management. First, we must understand what we have. This means greater investment in water system modeling, data on water supplies, and improved clarity and efficiency in water markets. Second, we must conserve what we have through greater incentives for conservation. This includes improved water pricing to facilitate internalization of the cost of consumption and a reevaluation of the concept of forfeiture under prior appropriation law, so that water users are rewarded, rather than punished, for improved water efficiency. Third, if necessary, we must increase what we have through greater investment in the responsible development and implementation of water augmentation projects.

192. Larson, *supra* note 13, at 929–31.