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Insufficiency of New Hampshire's Instream Flow Regulation to Ensure the Viability of Its Rivers as Economics Environmental, and Social Assets

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THE INSUFFICIENCY OF NEW HAMPSHIRE'S INSTREAM FLOW REGULATION TO ENSURE THE VIABILITY OF ITS RIVERS AS ECONOMIC, ENVIRONMENTAL, AND SOCIAL ASSETS

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INTRODUCTION

New Hampshire's population growth,[2] with accompanying increases in water demand,[3] urban development,[4] and impervious surfaces,[5] poses alarming anthropogenic threats to the flow regimes and ecological integrity of New Hampshire's rivers and streams.[6] These anthropogenic threats are concerning because "New Hampshire's rivers and streams comprise one of its most important natural resources, historically vital to New Hampshire's commerce, industry, tourism, and the quality of life of New Hampshire people."[7] To protect its rivers and streams, the New Hampshire legislature enacted the Rivers Management and Protection Program ("RMPP") with the stated purpose of "ensur[ing] the continued viability of New Hampshire rivers as valued economic and social assets for the benefit of present and future gen-

2. RICHARD L. FORSTALL, NEW HAMPSHIRE POPULATION OF COUNTIES BY DECENNIAL CENSUS: 1900 TO 1990 (1995), http://www.census.gov/population/cencounts/nh190090.txt; NEW HAMPSHIRE QUICKFACTS FROM THE U.S. CENSUS BUREAU, http://quickfacts.census.gov/qfd/states/33000.html (last visited Jan. 31, 2009). *See also infra* Part III.B.

3. LAKES MGMT. ADVISORY COMM. AND THE RIVERS MGMT. ADVISORY COMM., THE SUSTAINABILITY OF NEW HAMPSHIRE'S SURFACE WATERS 9 (Jan. 2008) [hereinafter LAKES MGMT. ADVISORY COMM.], http://des.nh.gov/organization/divisions/water/wmb/lakes/documents/sustainability_initiative.pdf. *See also infra* Part III.B.

4. LAKES MGMT. ADVISORY COMM., *supra* note 3, at 9. *See also infra* Part III.B.

5. LAKES MGMT. ADVISORY COMM., *supra* note 3, at 2. *See also infra* Part III.B.

6. LAKES MGMT. ADVISORY COMM., *supra* note 3, at 9. *See also infra* Part III.

7. N.H. REV. STAT. ANN. § 483:1 (2008).

erations."[8] To sustain the viability of New Hampshire's rivers as valued economic and social assets, the RMPP requires the promulgation of regulations that establish and enforce protected instream flows to "protect the resources for which the river or segment is designated" and to maintain water for instream public uses.[9] Instream public uses, all of which are important components of New Hampshire's economy, environment, and the well-being of its citizens, include the maintenance and enhancement of aquatic and fish life, as well as wildlife habitat.[10]

Three overarching reasons render New Hampshire's instream flow regulation[11] insufficient to provide the flows necessary to maintain and enhance its streams' aquatic life, fish life and habitat, and wildlife habitat in the face of anthropogenic threats to flows accompanying New Hampshire's population growth. First, the administrative scheme protecting instream flows is not comprehensive, in that its regulation of all flow sources within a watershed is disjointed and limited.[12] The administrative scheme regulating flow sources is disjointed because it does not regulate ground and surface water withdrawals under a common permitting scheme.[13] The administrative structure is limited in regulating flow sources because it does not cover small withdrawals that on aggregate remove a significant amount of water from streams; it does not have the authority to curb groundwater withdrawals more than five hundred feet from a protected river; and it completely ignores protecting baseflow through land use regulations that promote recharge and curb the expansion of impervious surfaces.[14]

Second, the lotic geographic scope of New Hampshire's instream flow regulations is insufficient to maintain and enhance its streams' aquatic and fish life, as well as its fish and wildlife habitat.[15] The piecemeal protection of these regulations does not protect the ecological integrity of the tributaries or coastal sections of the streams, which serve as vital organs in a river's ecosystem. Further, because the RMPP does not designate protection for the Androscoggin Basin, the instream flow regulation does not protect the flow regimes of the Androscoggin River.[16]

Third, while the extensive MesoHABSIM (MesoHabitat Simulation Model)[17] method used to determine sufficient instream flows is seemingly sufficient to protect all riparian wildlife during their differing

8. *Id.*
9. N.H. REV. STAT. ANN. § 483:9-c (2008).
10. *Id.*; LAKES MGMT. ADVISORY COMM., *supra* note 3, at 1.
11. *See* N.H. CODE ADMIN. R. ANN. ENV-WS 1901.01-1908.01 (2008).
12. *See infra* Part V.B.
13. *Id.*
14. *Id.*
15. *Id.*
16. *Id.*
17. *See infra* Part V.B.

bioperiods[18], determination and regulatory establishment of these protected flows takes time, and the method exposes riparian wildlife to ecologically threatening anthropogenically-induced low flow events.[19]

Part I of this article explains why the maintenance of natural instream flow regimes is critical to the ecological integrity of New Hampshire's riparian habitats. Part II details New Hampshire's economic interest in sufficiently protecting its rivers' natural flow regimes. Part III explains and identifies the anthropogenic threats to New Hampshire's natural flow regimes. Part IV describes why instream flow regulations, in addition to common law and statutes, are needed to adequately protect New Hampshire's rivers' flow regimes. Part V details the three inadequacies of New Hampshire's instream flow regulations in protecting the ecological integrity of its riparian habitat, including its disjointed and limited administrative structure, its limited ecological scope, and its failure to provide its streams with interim protections while the State determines and implements protected flows. Part VI concludes by offering suggestions to improve the instream flow regulations to better protect the outstanding characteristics and public uses of New Hampshire's streams.

I. ECOLOGICAL IMPORTANCE OF ESTABLISHING PROTECTIVE INSTREAM FLOWS

"Every river has a unique [natural] flow, signature [or regime] that is determined by the climate, geology, topography, vegetation, and other natural features of its watershed."[20] A river's natural flow regime consists of varying seasonal flows that oscillate in magnitude, duration, frequency timing, and rate of change.[21] Extreme flows, such as floods or droughts that occur once every fifty years, are also part of a river's natural flow regime.[22] The maintenance of a river's natural flow regime is of paramount importance to the protection of a stream's aquatic life for four main reasons.[23] First, flows "shape the physical

18. Piotr Parasiewicz, *Habitat Time Series Analysis to Define Flow Augmentation Strategy for the Quinebaug River, Connecticut and Massachusetts, USA*, RIVER RESEARCH AND APPLICATIONS 24: 439–452 (2008) [hereinafter Parasiewicz, *Habitat Time*] *available at* http://instreamhabitat.org/resources/Parasiewicz_2008_TimeSeries.pdf (last visited June 22, 2009) (noting that an organism's bioperiod is the organism's critical intra-annual seasons with specific biological functions, such as spawning or rearing and growth).

19. *See infra* Part V.B.

20. SANDRA POSTEL & BRIAN RICHTER, RIVERS FOR LIFE: MANAGING WATER FOR PEOPLE AND NATURE 18 (2003).

21. COMM. ON REVIEW OF THE USGS NAT'L STREAMFLOW INFO. PROGRAM, NAT'L RESEARCH COUNSEL, ASSESSING THE NAT'L STREAMFLOW INFO. PROGRAM 125 (2004), *available at* http://water.usgs.gov/nsip/nasreport/es/NRC_Report.html.

22. POSTEL & RICHTER, *supra* note 20, at 18.

23. *Id.* at 20-21.

habitats of rivers and their floodplains."[24] In shaping riparian habitat, flows broaden the distribution and abundance of aquatic organisms and riparian vegetation.[25] Second, native aquatic species have adapted to survive in their river's natural flow regime, and have "evolved survival and reproductive strategies that are keyed to natural flow conditions."[26] Thus, different groups of aquatic organisms inhabiting a river's ecosystem have evolved with the river to reproduce and survive according to the river's naturally changing depth, spatial lateral expansion, velocity, temperatures, light availability, chemical composition, turbidity, and sediment distribution.[27] Third, natural flow regimes supply adequate water depth at critical times of the year that facilitates species movement up and downstream, as well as lateral species movement to and from floodplains.[28] These seasonal spatial movements to favorable habitat for feeding and breeding are critical to the growth and reproduction of aquatic organisms.[29] Lastly, the maintenance of natural flow regimes provides a lotic environment that resists invasive species and enhances the productivity, and thus abundance of a river's native organisms.[30] When alterations in natural flow regimes reduce a species' abundance or exterminate a species by removing the flows necessary for that species to reproduce, feed, or access dependent habitat, the reduction in abundance of that species also creates a trophic cascade that can send devastating ripples throughout a river's food web and drastically alter its ecological composition.[31]

Within a river's natural flow regime, the high, low, extreme, and intermediary flows provide different functions that maintain a river's ecological integrity.[32] Annual high flows, also referred to as flood flows, play an important role in enabling the reproduction of aquatic organisms.[33] Flood flows grant fish access to warm-watered floodplain habitat and are rich with nutrients and insects, which fuels rapid fish growth and enables fish to spawn and lay their eggs.[34] Flood flows also deposit

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24. *Id.* at 20.
25. *Id.*
26. *Id.* at 20-21.
27. *Id.* at 21; NANCY GORDON ET AL., STREAM HYDROLOGY: AN INTRODUCTION FOR ECOLOGISTS 18-25 (1992); Bradford Bowman, *Instream Flow Regulation: Plugging the Holes in Maine's Water Law*, 54 ME. L. REV. 287, 292 (2002).
28. POSTEL & RICHTER, *supra* note 20, at 21.
29. *Id.*
30. *Id.*
31. *Id.* at 6, 21, 26, 35, 36. *See generally* Tiffany M. Knight, Michael W. McCoy, Jonathan M. Chase, Krista A. McCoy & Robert D. Holt, *Trophic Cascades Across Ecosystems*, 437 NATURE 880 (2005) ("Trophic cascades arise when predators reduce prey abundance, indirectly relaxing consumption on lower trophic levels." Refer to article for an example of a trophic cascade occurrence.).
32. POSTEL & RICHTER, *supra* note 20, at 20.
33. *Id.*
34. *Id.* at 73.

seeds in floodplains[35] and trigger insect life cycle phases.[36] Additionally, flood flows provide migration and spawning cues for fish and create suitable spawning areas for fish by depositing gravel and cobble in riverbeds.[37]

Aside from flood flows, regularly occurring high flows provide important habitat maintenance and energy source functions for a river. At the tail end of droughts or seasonal low flows, these high flows cool the water temperature, inject high levels of critical dissolved oxygen, restore water quality, and supply nutrient-rich flows that carry organic material and insects.[38] High flows also restore the original character of lotic ecosystems by shaping the depth and width of river channels, and by forming pools, riffles, and runs that provide important habitats for aquatic organisms.[39] These channel-forming events create bank undercuts and large shallow zones, which fish use to avoid predators and feed freely.[40] Without annual channel-forming flows, fast moving, narrow, and simplified canals develop that do not provide adequate feeding or protective habitat for aquatic organisms.[41] Further, high flows aerate eggs in spawning grounds,[42] transport macroinvertebrates and fry downstream to new habitat,[43] and flush sand and silt from cobbles and gravel.[44] These flows create habitat for macroinvertebrates, suitable spawning ground for fish to lay eggs, and places for fry to occupy.[45]

Unlike high flows with their relatively short annual duration, low flows, also called base flows,[46] persist for the majority of an annual seasonal cycle.[47] Thus, low flow levels dictate the composition of species that can survive in a given river because they determine a river's available habitat for a majority of the year.[48] Adequate seasonal low flows maintain suitable water temperatures,[49] provide enough habitat space for organisms,[50] protect aquatic organisms from capture by terrestrial

35. *Id.* at 74.
36. *Id.* at 20.
37. *Id.*
38. *Id.* at 70.
39. Id.
40. *Id.* at 71-72.
41. *Id.* at 72.
42. *Id.* at 20.
43. *Id.* at 22.
44. *Id.* at 71.
45. *Id.* at 70-71.
46. *Id.* at 20.
47. *Id.* at 67.
48. *Id.*
49. *Id.* at 20.
50. *Id.*

predators,[51] and cue the reproduction of riparian vegetation, such as the bald cypress and water tupelo, that require their roots to dry out for germination.[52] Additionally, adequate low flows allow groundwater tables to remain high to support floodplain vegetation,[53] allow for fish to move to feeding and spawning areas,[54] and prevent the aggregation of fish in densely populated pools where fish have a tougher time surviving due to higher temperatures, lower oxygen, and often fiercer competition for scarce resources.[55] Adequate low flows also maintain a river's chemical integrity by preventing saline water in coastal zones from pushing inland,[56] diluting contaminants,[57] and providing sufficient amounts of dissolved oxygen.[58] Many states determine the maximum discharge of pollutants into a stream based on an historical ten-year average of the lowest natural stream flow over a seven day period ("7Q10").[59] If states do not maintain natural low flows, legally permissible pollutant discharges can have lethal consequences for aquatic life, especially if technology-based pollution control standards regulate effluent limitations. Even the natural frequency of extreme low flows is beneficial to rivers, as drought flows can purge invasive species from the river and recruit native floodplain vegetation.[60]

When natural flow regimes fluctuate, the composition and abundance of fresh water organisms changes because of alterations in energy sources, habitat reductions, predator-prey relationships, reproductive limitations, and chemical and physical variations.[61] A stream's naturally occurring aquatic organisms evolve to become critical components and drivers of a stream's food web, and the organisms perform

51. *See id.* at 67. *See also* NORTHEAST GEORGIA REGIONAL DEVELOPMENT CENTER, A GUIDEBOOK FOR LOCAL GOVERNMENT FOR DEVELOPING REGIONAL WATERSHED PROTECTION PLANS app. B-7 (2001), *available at* http://www.georgiaplanning.com/watertoolkit/Documents/WatershedPlanningTools/APPENDIXB.doc (last visited Mar. 12, 2009).

52. *Id.* at 67-68.

53. *Id.* at 68.

54. *Id.* at 22.

55. *Id.* at 23.

56. *Id.* at 12-13.

57. *Id.* at 14.

58. PAUL S. GILLER & BJORN MALMQVIST, THE BIOLOGY OF STREAMS AND RIVERS 31 (1998).

59. USGS: Georgia Low Flow Frequency Information, http://ga2.er.usgs.gov/lowflow/helplowflowstats.cfm (last visited Mar. 11, 2009) (citing R. F. Carter & S. A. Putnam, *Low Flow Frequency of Georgia Streams*, U.S. Geological Survey Water-Resources Investigations Report 77-127 (1978)) (explaining 7Q10 and Georgia's use of 7Q10 values to regulate water withdrawals and discharges into streams). *See also* N.H. CODE ADMIN. R. ANN. ENV-WQ 1705.02 (2009); *id.* at 1702.44 (2009) (defining 7Q10 as "the lowest average flow which occurs for 7 consecutive days on an annual basis with a recurrence interval of once in 10 years on average, expressed in terms of volume per time period"); *id.* at ENV-WS 1903.02 (2009).

60. POSTEL & RICHTER, *supra* note 20, at 20.

61. *Id.* at 20-21, 35, 67, 70.

critical ecosystem services such as maintaining water quality, decomposing organic material, absorbing contaminants, and producing food.[62] Thus, the elimination or reduction of algae, fungi, worms, fish, amphibians, macroinvertebrates, and other freshwater organisms can have devastating effects that ripple through trophic levels because, in complex aquatic environments, species' survival is often interconnected, and thus dependent on the survival of other organisms.[63] In order to maintain the ecological integrity of streams and to prevent irreversible harm from species elimination and assemblage changes, states must establish protected flow regimes to provide the necessary seasonal flows for each organism's critical bioperiods[64] and to protect flows from anthropogenic stresses.[65]

II. THE ECONOMIC IMPORTANCE OF PROTECTING THE NATURAL FLOW REGIME OF NEW HAMPSHIRE'S RIVERS AND STREAMS

Protecting natural flow regimes is vital to preserving the ecological integrity of streams as well as the recreational benefits, aesthetic enjoyments, and spiritual benefits that accompany an ecologically sound river system.[66] However, protecting natural flow regimes offers more to the average New Hampshire citizen who does not necessarily appreciate or correctly value the existence of healthy lotic ecosystems and the ecosystem services[67] they provide. As this section discusses, all of New Hampshire's citizens have an important economic interest in protecting the natural flow regimes of their streams because the economic prosperity of New Hampshire is inextricably intertwined and dependent on the maintenance of natural instream flows.

New Hampshire's economy is heavily dependent on revenue from tourism and travelers, which consists of roughly 8 percent of its gross state product.[68] Fishing, boating, and swimming, all flow dependent

62. *Id.* at 35.

63. *Id.*

64. Piotr Parasiewicz, *Habitat Time Series Analysis to Define Flow Augmentation Strategy for the Quinebaug River, Connecticut and Massachusetts, USA*, RIVER RESEARCH AND APPLICATIONS 24: 439–452 (2008) [hereinafter Parasiewicz, *Habitat Time*] *available at* http://www.neihp.org/Documents/mesohabsim/Parasiewicz_2008_HabitatTimeSeriesAnalysis.pdf (last visited Jan. 30, 2009) (noting that an organism's bioperiod is the organism's critical intra-annual seasons with specific biological functions, such as spawning or rearing and growth).

65. *See* POSTEL & RICHTER, *supra* note 20, at 3-5, 20-26, 35-36, 67-74.

66. *See id.* at 7-13.

67. *Id.* at 8.

68. ANNE NORDSTROM, THE NEW HAMPSHIRE LAKES, RIVERS, STREAMS AND PONDS PARTNERSHIP, THE ECONOMIC IMPACT OF POTENTIAL DECLINE IN NEW HAMPSHIRE WATER QUALITY: THE LINK BETWEEN VISITOR PERCEPTIONS, USAGE AND SPENDING 21 (2007), http://www.nhlakes.org/docs/Surface-Waters-PhaseIV-Final-Report.pdf.

activities, significantly contribute to New Hampshire's tourism industry, generating "$379 million in total annual sales, or roughly 26 percent of all summer tourism spending; about $134 million in household income; and about 6,000 full-time and part-time jobs."[69] Visitors who come to New Hampshire to fish, boat, or swim, alone represent about 14.9 million visitor days.[70]

The summer visitors who come to New Hampshire to boat, fish, or swim are sensitive to changes in its rivers' flow regimes.[71] Forty-three percent of visitors would decrease their visits if they perceived that flows became less than adequate for fishing, boating, or swimming.[72] Increasing water demands from growing urban populations and the shrinking contribution of base flow in regions experiencing increased development may lead to inadequate flows for fishing, boating, and swimming in low flow summer months if the implementation of protective measures does not occur. The fishermen, boaters, and swimmers who would leave the state due to inadequate flows, alone would lead to a loss of more than one million annual visitor days of the total 14.9 million visitor days by fishermen, boaters, and swimmers, and out of 51.4 million total visitor days in New Hampshire.[73] The economic loss from the 43 percent of anglers, boaters, and swimmers who would decrease their visits if they perceived less than adequate flows roughly equates to a $29 million loss in total sales, a $10 million loss in household income, and 460 lost jobs.[74]

Additionally, overcrowding, declines in water clarity and purity, and declines in natural views and scenery, all of which can depend on sufficient seasonal flows,[75] would have additional devastating impacts on New Hampshire's economy.[76] If water clarity and purity worsened, 69 percent of visitors would decrease their visitor days, resulting in roughly a $50 million loss in total sales, an $18 million loss in household income, and 811 lost jobs.[77] If the natural views and scenery that rivers provide worsened, 56 percent of visitors would decrease their visitor days, resulting in roughly a $27.6 million loss in total sales, a $9.8 million loss in household income, and 440 lost jobs.[78] If river crowding worsened, 46 percent of visitors would decrease their visitor days, resulting in roughly a $19 million loss in total sales, $6.7 million

69. *Id.*
70. *Id.*
71. *Id.* at 26, 28, 30, 37.
72. *Id.* at 5.
73. *Id.* at 10, 37.
74. *Id.* at 37-38.
75. *See supra* Part I.
76. NORDSTROM, *supra* note 68, at 6-7, 9-11, 28-29, 37-38.
77. *Id.* at 28-29.
78. *Id.* at 46-47.

loss in household income, and 305 lost jobs.[79] Thus, New Hampshire's heavy economic dependence on sufficient natural flows to protect its fisheries, physical and chemical characteristics of its swimming holes, and boating opportunities, makes it clear that the protection of natural flow regimes of New Hampshire's rivers has economic implications for all the state's residents.[80]

III. ANTHROPOGENIC THREATS TO THE NATURAL FLOWS REGIMES OF NEW HAMPSHIRE'S RIVERS AND STREAMS

A. ANTHROPOGENIC IMPACTS THAT THREATEN NATURAL FLOW REGIMES

The establishment of protected flow regimes is critical to protect a river's ecological integrity[81] from an onslaught of anthropogenic threats to flows.[82] Protected flow regimes are a necessary safeguard to the social,[83] environmental,[84] and economic[85] benefits derived from an ecologically sound river system. Anthropogenic impacts that threaten natural flow regimes can occur instream, or as water migrates to rivers via ground or surface channels in the river's watershed.[86] Significant impacts to natural instream flows include water diversions, dams, levees, and impervious surfaces and stormwater infrastructure that accompany urban development.[87] Diversions for agriculture, domestic, or industrial uses that increase in intensity with population growth and urban and rural development, and that reduce flows by removing water from streams, are especially severe threats to instream flows.[88] Diversions are especially threatening because if excessive, especially during low flows or droughts, they have the potential to cause species extinction through dewatering streams or to create severe low flow conditions that shrink available habitat, create more competition for food, and decrease water quality.[89] Dams that alter the timing and quantity of flows retain nutrients and habitat forming sediments behind their

79. *Id* at 55-56.
80. *See id.* at 10, 28-29, 46-47, 55-56.
81. *See id.*; *see supra* Part I.
82. *See* POSTEL & RICHTER, *supra* note 20, at 13-17.
83. *See* N.H. REV. STAT. ANN. § 483:1 (2008) ("New Hampshire's rivers and streams comprise one of its most important natural resources, historically vital to New Hampshire's commerce, industry, tourism, and the quality of life of New Hampshire people."); POSTEL & RICHTER, *supra* note 20, at 7-13.
84. *See* POSTEL & RICHTER, *supra* note 20, at 7-13.
85. *See* N.H. REV. STAT. ANN. § 483:1 (2008) ("New Hampshire's rivers and streams comprise one of its most important natural resources, historically vital to New Hampshire's commerce, industry, tourism, and the quality of life of New Hampshire people."); *supra* Part II.
86. POSTEL & RICHTER, *supra* note 20, at 14-15.
87. *Id.* at 13-17.
88. *Id.*
89. *Id.*

walls, can decrease flows to dangerously low levels, may alter natural flow regimes to which a river's organisms have adapted, can block fish migration crucial for feeding and reproduction, increase water temperatures downstream, decrease downstream water quality, and, as a result, often devastate the ecological integrity of rivers and streams.[90] Other instream variables that can drastically alter natural flow regimes include consumptive, invasive water-guzzling riparian vegetation that consumes flows and the removal of vegetative canopies shading streams that keep their water cool and minimize instream evaporation rates.[91]

In addition to instream anthropogenic impacts, the urbanization of previously vegetated and undeveloped watersheds with impervious surfaces and stormwater networks that do not infiltrate stormwater can impact a river's natural flow regime by disrupting the timing, duration, and magnitude of flows from surface water runoff and groundwater baseflow.[92] Impervious surfaces are mainly created by soil compacting activities such as construction, and by paving over large areas to build roads, parking lots, houses, and commercial or industrial facilities.[93] Deforestation also can harden top soil, reduce soil infiltration capacity, and remove roots that suck water into the ground.[94] Precipitation that falls on impervious surfaces without being infiltrated onsite, and that is directed into a stormwater drainage systems composed of curbs, gutters, storm drains and channels without groundwater infiltration components, does not infiltrate into the ground and gradually and sustainably feed rivers and streams as a sustained source of baseflow.[95] Instead, it is efficiently swept and channeled into streams, and thus causes flashy flows.[96] A river victimized by flashy flows experiences flows that rapidly rise to higher than natural levels during the precipitation event and then rescind to lower than natural levels, often for prolonged periods, once the precipitation event has terminated.[97]

When watersheds become urbanized to a point where impervious cover exceeds 10 percent of drainage, the increase in the flashiness of flows and deviation from a river's natural flow regime, can devastate a stream's ecological integrity.[98] Aside from reducing the sustainable

90. *Id.*

91. *See id.* at 13, 14-15.

92. CTR. FOR WATERSHED PROTECTION, IMPACTS OF IMPERVIOUS COVER ON AQUATIC SYSTEMS 25-26 (2003), *available at* http://www.mckenziewaterquality.org/documents/ImpactsofImperviousCover-CWPReport.pdf (last visited Mar. 12, 2009).

93. *Id.* at 25, 27.

94. *Id.*

95. *Id.* at 34.

96. *Id.* at 91.

97. *See id.*

98. *See id.* at 6, 33, 34. The compilations of findings from over 225 research studies exploring the impact of impervious cover and other indicators of urbanization on aquatic systems conclude "that most water quality indicators decline when watershed

supply of baseflow needed for instream species' survival during dry seasons, the powerful, high magnitude, short-lived flashy flows also degrade river channel habitat.[99] Flashy flows widen stream channels through bank erosion, degrade water quality by carrying high concentrations of pollutants, and flush fine sediments into streambeds, which then clog cobble and gravel habitat for aquatic organisms.[100] Additionally, the lack of buffer zones surrounding river banks that provide at least 100 feet of vegetative cover accentuate the flashiness and excessive stream pollution that impervious surfaces cause when they are located close to or abutting streams. This is because vegetative buffer zones provide opportunity for groundwater recharge and filtration of physical and chemical contaminants.[101]

Aside from impervious surfaces and stormwater runoff systems creating lower than natural low flows and eliminating sustained high flows, excessive groundwater pumping can also reduce stream flows to exceedingly lower than natural levels by consistently removing water baseflow that would otherwise make its way into the stream.[102] Climate change should also be considered as a force that impacts sources of flow. As human-induced global warming alters precipitation patterns, rivers may experience more frequent and permanent changes in their normal flow regimes and extreme flow events.[103]

B. THE ANTHROPOGENIC IMPACTS THREATENING THE FLOW REGIMES OF NEW HAMPSHIRE'S RIVERS AND STREAMS

As the preceding sections set forth, protecting the natural flow regimes of New Hampshire's rivers and streams from anthropogenic impacts is vital to preserving their ecological integrity. Protecting natural flow regimes not only protects and enhances fish and wildlife, and benefits New Hampshire's citizens that value streams for their existence, aesthetics, or spiritual gifts, it is also vital to protecting New Hampshire's economic interests. Thus, aside from ecological reasons, New Hampshire's citizens have strong economic incentives to protect the natural flow regimes of their rivers from anthropogenic impacts.

Numerous anthropogenic impacts threaten the natural flow regimes of New Hampshire's streams. Amongst the most concerning are the increased water supply demands and the increased amounts of im-

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impervious cover exceeds 10%, with severe degradation expected beyond 25% impervious cover." LAKES MGMT. ADVISORY COMM., *supra* note 2 at 2.

99. CTR. FOR WATERSHED PROTECTION, *supra* note 94, at 42; N. AM. LAKE MGMT. SOC'Y, 2 FUNDAMENTALS OF URBAN RUNOFF MGMT.: TECHNICAL AND INSTITUTIONAL ISSUES 1, 233 (2007).

100. *Id.*

101. CTR. FOR WATERSHED PROTECTION, *supra* note 94, at 12.

102. POSTEL & RICHTER, *supra* note 20, at 93.

103. *Id.* at 15.

pervious surfaces resulting from rapid population growth and urban development. From 1970 to 2006, New Hampshire's population exploded from 737,681 to 1,314,895 citizens.[104] Compared to New Hampshire's 78.2 percent population growth over this period, the United States population only grew 47.3 percent, from 203,211,926 to 299,398,484 people.[105] To put New Hampshire's population growth in a regional perspective, from 1990 to 2004, New Hampshire's population grew 17.2 percent, twice the rate of the rest of New England.[106] Further, between 2000 and 2025, forecasted population growth is more than 28 percent, with 80 percent of that growth occurring in four southeastern counties, which comprise roughly 33 percent of New Hampshire's land area.[107]

Not surprisingly, aside from an increase in population, New Hampshire is also experiencing an increase in development and deforestation in its watersheds. From 1980 to 1998, 110,000 single-family homes were built, and the state's housing units grew by 55 percent.[108] New Hampshire's population and housing growth rates mirror its staggering deforestation rate from development and economic activities. New Hampshire is losing about 17,500 acres of forest each year.[109] While New Hampshire's population growth, urban development, and deforested land continue to increase, the amount of conserved land protecting watersheds from development is seemingly insufficient to protect the flow regimes of New Hampshire's rivers, especially given the rapid urban development occurring in the southern part of the state. While 27.7 percent of New Hampshire's watersheds are protected as conserved land, up from 22.3 percent in 1998, 75 percent of all conserved land is in the northern half of the state, far away from the watersheds in the southern part of the state, which some experts forecast will experience 80 percent of the State's population growth by 2025.[110] Additionally, roughly half, or 110, of New Hampshire towns still have con-

104. U.S. Census Bureau, http://quickfacts.census.gov/qfd/states/33000.html (last visited Feb. 16, 2009); U.S. Census Bureau, http://www.census.gov/population/cencounts/nh190090.txt (last visited Feb. 16, 2009).

105. *Id.*

106. SOC'Y FOR THE PROT. OF N.H.'S FORESTS, N.H.'S CHANGING LANDSCAPE 1 (2005) [hereinafter SOC'Y PROT. N.H. 2005], *available at* http://www.spnhf.org/research/papers/nhcl2005es.pdf; LAKES MGMT. ADVISORY COMM., *supra* note 3, at 2.

107. SOC'Y PROT. N.H. 2005, *supra* note 106, at 1.

108. SOC'Y FOR THE PROT. OF N.H.'S FORESTS, NEW HAMPSHIRE'S CHANGING LANDSCAPE: POPULATION GROWTH, LAND USE CONVERSION, AND RESOURCES FRAGMENTATION IN THE GRANITE STATE 2 (1999), *available at* http://www.spnhf.org/research/papers/NHCLsummary.pdf.

109. SOC'Y PROT. N.H. 2005, *supra* note 106, at 5; LAKES MGMT. ADVISORY COMM., *supra* note 3, at 2.

110. SOC'Y PROT. N.H. 2005, *supra* note 106, at 1, 11.

served less than 10% of their land.[111] In 2025, seventy-two of New Hampshire's towns will be classified as rural, down from 139 towns classified as such in 1970.[112] Further, only 11.6 percent of the most critical lands around public water supply wells and aquifers have protections in place, which could mean that municipalities may look to rivers for domestic water supply.[113]

New Hampshire's increased population growth and urban development, which has increased impervious surfaces, soil-compacting construction, stormwater drainage systems, the deforestation of watersheds, and water demands, has had an apparent effect on the flow regimes of New Hampshire's rivers and streams.[114] In January of 2008, the New Hampshire's Rivers Management Advisory Committee noted, "[a]lthough New Hampshire is typically thought of as a water-rich state, it is currently experiencing extensive demand for water as its population and economy expand."[115] "Sixty percent of New Hampshire's residents depend on groundwater for their drinking water supplies," and flows have dropped in some New Hampshire streams due to overmining of groundwater supplies that fail to make their way into streams as baseflow.[116] In 2003, there were 492 registered water diverters[117] on fourteen Designated Rivers (containing seventeen designated segments) under the RMPP.[118] In this same year, water use exceeded the General Standard criteria[119] in eleven Designated River segments nine times in July, five times in August and September, two times in January,

111. *Id.* at 12.

112. *Id.* at 2.

113. *Id.* at 9.

114. In 2008, the Lakes Management and Rivers Management Committees acknowledged that "[c]urrent and historical data and trends indicate that water quality and quantity is changing and poorly designed and executed landscape change is the primary cause. More stormwater runoff and increasing amounts of impervious surface are negatively affecting New Hampshire's surface waters." LAKES MGMT. ADVISORY COMM., *supra* note 3, at 8.

115. *Id.* at 9.

116. *Id.*

117. All ground and surface water withdrawers that withdraw "a cumulative amount of more than 20,000 gallons of water per day, averaged over any 7-day period, or more than 600,000 gallons of water over any 30-day period, at a single real property or place of business" must be registered. N.H. REV. STAT. ANN. §§ 488:2-488:3 (2008).

118. N.H. DEPT. ENVTL. SERVS., 2003 ANNUAL REPORT OF WATER USE VERSUS STREAM FLOW ON DESIGNATED RIVERS 10-11 (2005), *available at* http://des.nh.gov/organization/divisions/water/wmb/rivers/instream/documents/entire2003report.pdf.

119. *Id.* at 11. "The General Standard is an assessment and illustration tool to compare basins of different sizes using normalizing criteria. It is not considered to be a protected flow for the river. Lack of compliance with the General Standard is not a violation. Monthly stream flow and water use used in these assessments may not illustrate acute impacts occurring for shorter durations. Because of the averaging affect of assessing water use and stream flows with monthly values, conditions resulting from shorter duration low flows or high intensity water use may not be observable."

February, and November, and one time for all other months when flows are generally higher.[120]

The increase in water demand that removes water from streams and the reduction in baseflow contributions needed to maintain sufficient flows from urban development and deforestation have threatened and continue to threaten to further extenuate the pressures on the natural flow regimes of New Hampshire's rivers.[121] Additionally, droughts and possible changes in precipitation patterns induced by climate change will only magnify the ill effects of population growth and urban expansion on the natural flow regime of New Hampshire's rivers.[122] Heading into 2009, industry, municipalities, bottled water companies, golf courses, farmers, ski resorts, and domestic users continue to utilize New Hampshire's surface and ground waters at increasing rates to satisfy economic and domestic needs.[123] This increased use of New Hampshire's finite water resources threatens the ecological integrity of New Hampshire's watercourses, its fisheries, and the vitality of its economy. As the ensuing sections demonstrate, the protections that New Hampshire's common law and statutes provide inadequately protect the flows necessary to sustain the aquatic and fish life in its streams from anthropogenic threats. Thus, there is a dire need for more effective and comprehensive instream flow legislation to adequately protect the natural flow regimes of New Hampshire's rivers and streams.

IV. WHY INSTREAM FLOW REGULATIONS ARE NEEDED ON TOP OF NEW HAMPSHIRE'S COMMON LAW AND STATUTES TO PROTECT THE NATURAL FLOW REGIMES OF ITS RIVERS AND STREAMS

The maintenance of natural flow regimes is critical to protect the ecological integrity of New Hampshire's streams, its fish and wildlife, its river-based recreation, and its economy. Population growth and development have extenuated a multitude of anthropogenic impacts, threatening the natural flow regime of New Hampshire's rivers. While common law and various statutes provide some flow protections, adequate protection of the flow regimes of New Hampshire's rivers and streams require sufficient instream flow regulations.

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120. *Id.*

121. LAKES MGMT. ADVISORY COMM., *supra* note 3 at 8-10.

122. *Id.*

123. N.H. DEPT. OF ENVTL. SERVS., ENVIRONMENTAL FACT SHEET – WATER USE REGISTRATION AND REPORTING IN NEW HAMPSHIRE 1 (2007), *available at* http://des.nh.gov/organization/commissioner/pip/factsheets/geo/documents/geo-4.pdf.

A. THE INTERPLAY BETWEEN RIPARIAN RIGHTS AND THE PUBLIC TRUST DOCTRINE

As discussed below, New Hampshire's common law doctrine of riparian water rights fails to protect natural flow regimes, while its common law public trust doctrine provides the complimentary overriding legal foundation to protect natural flow regimes. Historically, the riparian common law doctrine has been the legal doctrine applied by the courts to determine the allocation of private instream surface water rights, diffuse surface water rights, and groundwater rights in New Hampshire.[124] Riparian rights are usufructuary rights, and thus a riparian does not possess ownership rights in the water itself, but has a property right in the use of the water.[125] Landowners whose parcels are contiguous to or abut watercourses obtain riparian rights to use water resources.[126] New Hampshire defines watercourses as "water flowing in a definite direction or course in a bed with banks . . . [with] a substantial degree of continuity or permanence."[127] Thus, aside from perennial streams, intermittent streams that run dry annually during summer months, diffuse surface water, and groundwater can carry riparian rights if they have a "well-defined existence with a flow that is frequent and regular" during some times of the year.[128] While riparians possess usufructuary rights by the nature of their land in relation to water sources, their usufructuary rights to surface waters, diffuse water sources, and groundwater are not protective of natural flow regimes because, as described below, the only limitation to their usufructuary rights is a reasonable use requirement.

1. Riparian Rights and Surface Waters

Under New Hampshire common law, all riparians have a right to beneficially use water from a river or stream that passes through or that runs adjacent to their land.[129] Under the traditional riparian rights doctrine, a riparian "may divert water from its channel for any lawful use, so long as he returns it to the channel above the land of the next downstream riparian owner in substantially the same condition as when it reached the upstream riparian owner's land."[130] To satisfy the requirement that all riparians beneficially use water to maintain their riparian right, the riparian's water use must be reasonable, and thus

124. Alexander J. Kalinski & Robert H. Forste, *A Survey of New Hampshire Water Law*, 13 N.H.B.J. 3, 4-5 (1970).
125. *Id.*).
126. JOSEPH L. SAX, ET AL., LEGAL CONTROL OF WATER RESOURCES 21 (3d ed. 1991).
127. Kalinski, *supra* note 135, at 3, 5.
128. *Id.*
129. Wisniewski v. Gemmill, 465 A.2d 875, 877 (N.H. 1983) (citing Poire v. Serra, 106 A.2d 391, 392 (N.H. 1954)).
130. *Id.* (citing Roberts v. Claremont Ry. & Light Co., 66 A. 485, 485 (N.H. 1907).

the quality and quantity of water the riparian may take and return from a stream depends on a court's determination of reasonable use.[131]

While the reasonable use requirement protects riparians from other riparians' unreasonable use, it has not evolved to adequately value the flows necessary to protect the ecological integrity of streams.[132] Because judicial determinations define the concept of reasonable water use, it changes with time according to society's values and needs. The Restatement (Second) of Torts states the reasonableness of a use depends on considerations of the interests of the riparian putting the water to use, the interests of a harmed riparian, and society's interest.[133] The Restatement sets out the following factors that courts use to determine reasonableness:

> [t]he purpose of the use; the suitability of the use to the watershed or lake; the economic value of the use; the social value of the use; the extent and amount of harm it causes; the practicality of avoiding the harm by adjusting the use or method of use of one proprietor or the other; the practicality of adjusting the quantity of water used by each proprietor, the protection of existing values of water uses, land, investments, and enterprises; and the justice of requiring the user causing harm to bear the loss.[134]

Absent compelling public interests, riparians can pollute waters or withdraw quantities of water that are damaging to a water body's ecological integrity if their water use is reasonable in accordance with the court's reasonableness balancing test.[135] Further, when rivers do not have scientifically credible data that details their natural flow regimes, courts are not able to gauge how much flow is necessary to protect a stream's ecological integrity. The court's inability to make such a determination in the absence of historical undisturbed baseline natural flow regime data allows riparian water users to have adverse impacts a stream's ecology.

Allowance of off-tract uses exemplifies how the riparian rights doctrine inadequately protects a stream's natural flow regime. The ripar-

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131. *Wisniewski*, 465 A.2d at 877; *See also* Taggart v. Town of Jaffrey, 76 A. 123, 125 (N.H. 1910) (holding that riparians have "[a] right to the natural flow of the brook, not unreasonably diminished or polluted."); Gillis v. Chase, *67 N.H. 161*,162 (N.H. 1891) (holding "it is only for an unreasonable and unauthorized diversion that the law will imply damage to him, because each riparian proprietor ha[s] the right to a just and reasonable use of the water as it passes through and along his land . . . [a]nd as the reasonableness of the use is, to a considerable extent, a question of degree, and largely dependent on the circumstances of each case.")

132. *See generally* SAX ET AL., *supra* note 137, at 45.

133. RESTATEMENT (SECOND) OF TORTS: REASONABLENESS OF THE USE OF WATER § 850A (1979).

134. *Id.*

135. *See id.*

ian doctrine allows off-tract uses when a court considers it reasonable and the off-tract use does not harm other riparians.[136] Off-tract uses include bulk water transfers, which allow a non-riparian, with the permission of a riparian, to pull tanker trucks up to a water body and pump out water for purposes such as filling swimming pools, hydroseeding, spraying for dust control, roadbed compaction, construction, and other economic activities.[137] Thus, bulk water transfers exemplify how the riparian rights doctrine governing surface waters is problematic, especially in times of low flow conditions, because it fails to protect instream flows from non-riparian water users.

2. Riparian Rights and Diffuse Surface Waters

New Hampshire's riparian rights doctrine also allows for the reasonable use of diffuse surface waters, which are uncollected waters flowing on the surface of the land from falling rain, melting snow, and rising from springs.[138] The reasonableness standard courts use to determine if a riparian permissibly utilizes diffuse surface water is the same reasonableness standard that is applied to use of surface waters.[139] Thus, a land owner may obstruct or divert diffuse surface waters for appropriations that are necessary for reasonable use of his or her land.[140]

3. Riparian Rights and Groundwater Withdrawals

In addition to governing surface and diffuse surface waters, New Hampshire's riparian doctrine, with a prohibition against unreasonable use, governs the use of groundwater that flows in a known course or direction or from natural springs. [141] However, New Hampshire common law regards percolating water that moves through the ground

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136. *Gillis*, 67 N.H. *at* 162 (holding that it is a question of fact as to whether the selling of water for an off-tract use or for a riparian landowner's own purposes is considered reasonable).

137. *See* N.H. DEPT. OF ENVTL. SERVS., ENVIRONMENTAL FACT SHEET – WATER WITHDRAWALS FROM SURFACE WATERS FOR BULK TRANSPORT AND DELIVERY 1 (2008), *available at* http://des.nh.gov/organization/commissioner/pip/factsheets/dwgb/documents/dwgb-1-17.pdf.

138. *See* Alexander J. Kalinski & Robert H. Forste, *A Survey of New Hampshire Water Law*, 13 N.H.B.J. 3, 14 (1970); *See also* Swett v. Cutts, 50 N.H. 439, 446 (1870).

139. *Swett*, 50 N.H. at 446.

140. *Id.* at 446, 448.

141. *See* Bassett v. Salisbury Mfg. Co., 43 N.H. 569, 573-578 (1862) (treating groundwater from natural springs and water naturally draining underground in a known direction as subject to the riparian reasonable use doctrine); Jones v. Portsmouth Aqueduct, 62 N.H. 488, 490 (1883) (subjecting the excavation of land to collect water from underground springs for domestic uses to a reasonable use test when weighed against another riparian's use of the springs that fed into a brook to feed cattle).

and that cannot be proven to flow in a definite course "as being part of the land in which it is found."[142] Because the overlying land owner has an absolute right to use percolating ground water, regardless of the effect on other landowners, the riparian rights doctrine does not protect groundwater resources that do connect to surface water unless studies prove a hydrological connection.[143] This distinction between percolating waters and flowing ground water defies the basic hydrological principle that all water within a watershed that overlies an impervious aquifer eventually flows into the watershed's streams as baseflow. Thus, groundwater contributions to natural flow regimes under New Hampshire common law are not only vulnerable to the riparian reasonable use doctrine's ability to protect flows, but are also vulnerable to landowners' absolute right to withdraw percolating groundwater.

4. The Public Trust Doctrine

In light of the failings of the riparian rights system to protect natural flow regimes, the public trust doctrine provides a legal foundation to protect instream flows from riparian surface and groundwater users. Under the public trust doctrine, New Hampshire holds title to public waters, in trust for the benefit of the public, in the beds of water bodies that are navigable in fact, tidal waters, and all natural water bodies of ten acres or more up to the natural mean high water level.[144] New Hampshire's common law defines "navigable streams" or "navigable waters," as does New Hampshire's statutes, as bodies of water that:

> are used, or are susceptible of being used in their ordinary condition, as highways for commerce, over which trade or travel is or may be conducted in the present customary modes of trade or travel on water, and such term shall not apply to streams or waters which are used merely as public highways for floating logs.[145]

In addition, New Hampshire has historically defined navigable waters as waters that are susceptible "of use as a common highway for the public."[146] Thus, the state holds any river in which one can float a kayak or canoe under ordinary conditions for a portion of the year in trust for the benefit of the public, because kayaking and canoeing are

142. Kalinski, *supra* note 135, at 19-20.
143. *Id.*
144. St. Regis Paper Co. v. N.H. Water Res. Board, 26 A.2d 832, 838 (N.H. 1942); Concord Mfg. Co. v. Robertson, 25 A. 718, 720, 730-31 (N.H. 1890).
145. N.H. REV. STAT. ANN. § 271:9 (2008). *See* Concord Mfg. Co. v. Robertson, 25 A. 718, 720, 731 (N.H. 1890).
146. State v. Gilmanton, 14 N.H. 467, 479 (1843).

customary modes of travel within the statutory definition of navigability.[147]

New Hampshire protects waters held in trust for the use and benefit of the public by mandating that these waters serve public purposes. That is, under the public trust doctrine, New Hampshire protects public purposes such as water quality and public health, water storage, navigation, travel, swimming, bathing, fishing, skating, fowling, cutting ice, and aesthetics.[148] Because adequate flows are necessary to protect these public purposes, the public trust doctrine can help to protect natural flow regimes and, by extension, both groundwater and surface water contributions to those flow regimes.[149] The public trust doctrine protects against alienation of waters held for public trust purposes, unless the legislature conveys those waters in furtherance of public trust purposes or riparians reasonably use such waters or littorals below the natural mean water line without impacting public trust related resources.[150]

The public trust doctrine can restrain a riparian's beneficial use of surface water and groundwater either through legislation or via litigation that seeks common law injunctions or remedial remedies to protect public trust resources. In a litigation context, the protection of public trust resources should trump a riparian's right to use water. The courts have consistently held that while riparian water users "adjacent to lands held in public trust have common law rights which are 'more extensive than those of the public generally,'" riparian water users can reasonably use public trust waters subject only to the paramount right of the state to reasonably protect those waters for public trust purposes.[151] However, in a litigation context, the public trust doctrine really only can serve to protect the ecological integrity of streams after the harm to their ecology has occurred, and it only protects streams on a case-by-case analysis of the facts, which has a limited policy reach in terms of effecting a broad range of riparian behavior on a threatened stream. Further, legal action against a riparian to curb its water use may not hold much weight in the face of a judicially-

147. *See* N.H. REV. STAT. ANN. §§ 271:9, 210:11 (2008).

148. Sundell v. Town of New London, 409 A.2d 1315, 1319 (N.H. 1979); State v. George C. Stafford & Sons, 105 A.2d 569, 572 (N.H. 1954); Hartford v. Gilmanton, 146 A.2d 851, 853 (N.H. 1958); State v. Sunapee Dam Co., 50 A. 108, 108 (N.H. 1900); Concord Mfg. Co. v. Robertson, 25 A. 718, 720-21 (N.H. 1890).

149. Nat'l Audubon Soc'y v. Superior Ct., 658 P.2d 709, 719 (Cal. 1983), *cert. denied*, 464 U.S. 977 (1983); Sibson v. State, 336 A.2d 239, 242 (N.H. 1975); Concord Mfg. Co. v. Robertson, 25 A. 718, 718, 728, (N.H. 1890).

150. Whitcher v. State, 181 A. 549, 554 (N.H. 1935); St. Regis Paper Co. v. N.H. Water Res. Board, 26 A.2d 832, 837 (N.H. 1942); Concord Mfg. Co. v. Robertson, 25 A. 718, 728 (N.H. 1890).

151. Opinion of the Justices, 649 A.2d 604, 609 (N.H. 1994) (citing Sundell v. Town of New London, 409 A.2d 1315, 1317 (N.H. 1979)); Sibson v. State, 259 A.2d 397, 400 (N.H. 1969).

determined reasonable use of water without a sufficient determination of the instream flows needed to protect resources such as fisheries under the public trust.

While it is challenging to secure judicial remedies that adequately protect the ecological integrity of streams in litigation concerning the public trust doctrine, the doctrine does serve as an effective tool for enacting protective regulations. New Hampshire has codified its right to statutorily manage surface waters and groundwater for the benefit of present and future generations in the state's statutes in order to clarify its common law public trust protection of surface and ground water.[152] The New Hampshire legislature can curtail riparian water use under the public trust doctrine without providing riparians with just compensation because riparian water users "are burdened with a servitude in favor of the State which comes into operation when the State properly exercises its power to control, regulate, and utilize" waters protected under the public trust.[153] Thus, under the public trust doctrine, the New Hampshire legislature can enact instream flow and groundwater legislation to protect the ecological integrity of New Hampshire's surface water resources without legally taking a property interest and without providing riparians with just compensation.[154]

B. STATUTORY PROTECTION OF INSTREAM FLOWS ABSENT INSTREAM FLOW LEGISLATION

Adequate instream flow legislation is necessary to protect the natural flow regimes of New Hampshire's rivers because not only is the common law insufficient to protect flows, but so also is New Hampshire's statutory framework. First and foremost, absent instream flow legislation, New Hampshire does not have regulations that limit a riparian landowner's withdrawals so as to protect the flows of New Hampshire's rivers and streams. In addition, there are no state-wide policies limiting the percentage of impervious surfaces in developments to less than 10 percent or mandating the infiltration of stormwa-

152. N.H. REV. STAT. ANN. §481:1 (2008) (entitled State Dams, Reservoirs, and Other Water Conservation Projects; stating in part: "The general court declares and determines that the water of New Hampshire whether located above or below ground constitutes a limited and, therefore, precious and invaluable public resource which should be protected, conserved and managed in the interest of present and future generations. The state as trustee of this resource for the public benefit declares that it has the authority and responsibility to provide careful stewardship over all the waters lying within its boundaries. The maximum public benefit shall be sought, including the assurance of health and safety, the enhancement of ecological and aesthetic values, and the overall economic, recreational and social well-being of the people of the state").

153. Opinion of the Justices, 649 A.2d 604, 609 (N.H. 1994) (citing Sibson v. State, 259 A.2d 397, 400 (N.H. 1969)).

154. *Id.*

ter flows from these impervious watersheds. Thus, there is no regulation to prevent the reductions in sustainable baseflow contributions to streams that impervious surfaces cause by sweeping precipitation directly into streams and preventing precipitation from percolating into the ground.

Therefore, absent instream flow legislation, New Hampshire's only statutory tools to protect instream flows are groundwater regulations, and protective flow conditions in wetland dredge and fill permits and pollutant discharge permits. New Hampshire could place protective flow conditions on permit holders under the state water quality certification provisions of section 401 of the Clean Water Act ("CWA").[155] As discussed below, however, New Hampshire's natural flow regimes receive inadequate protections under its groundwater regulations, and through conditions in dredge and fill permits and pollutant discharge permits.

1. The Groundwater Protection Act

The Groundwater Protection Act,[156] and its accompanying agency regulations, recognizes the interconnectedness between groundwater and surface water, and attempts to protect surface water flows from groundwater pumping. As the Groundwater Protection Act regulations specify, all those who withdraw large volumes of groundwater - that is, at least 57,600 gallons over a twenty four hour period[157] - must obtain a minor or major large groundwater permit from the New Hampshire Department of Environmental Services ("NHDES").[158] The regulations governing issuance of large groundwater withdrawal per-

155. 33 U.S.C. § 1341 (2008).

156. N.H. REV. STAT. ANN. § 485-C, *et seq.* (2008).

157. N.H. REV. STAT. ANN. § 485-C:2 (IX-a) (2008) (stating that a "[l]arge groundwater withdrawal means any withdrawal from groundwater of 57,600 gallons or more of water in any 24-hour period at a single property or place of business"); N.H. CODE ADMIN. R. ANN. ENV-WS 388.02(l), 387.02(k) (2009) (both stating that "[l]arge withdrawal means any year-round or seasonal withdrawal of groundwater from a wellhead installed after July 1998, not associated with a temporary short-term use such as contaminated site remediation or construction de-watering, and where the maximum 24-hour withdrawal is 57,600 gallons or more.").

158. N.H. CODE ADMIN. R. ANN. ENV-WS 387.03(c) (2009) (requiring a minor groundwater withdrawal permit for all large withdrawals for which: "(1) The maximum 24-hour withdrawal is at least 57,600 gallons; (2) The maximum average-day withdrawal in a 30 day period is less than 144,000 gallons per day; (3) Available information indicates that the withdrawal does not result in adverse impacts as defined in Env-Ws 388 to water resources and other water users identified in Env-Ws 387.07"); N.H. CODE ADMIN. R. ANN. ENV-WS 388.03 (2009) (requiring a major groundwater withdrawal permit for all large withdrawals when: (a) The maximum average day withdrawal in a 30 day period is 144,000 gallons per day or more; and (b) The maximum, 24-hour withdrawal is 57,600 gallons per day or more, but the maximum average day withdrawal in a 30 day period is less than 144,000 gallons per day and the department has denied, suspended, or revoked minor withdrawal designation under Env-Ws 387.").

mits aim to protect surface water resources from groundwater withdrawals.[159] If an "adverse impact" is likely to result from a large withdrawal, the applicant must either reduce the withdrawal or mitigate the adverse impact to obtain a permit.[160] The NHDES defines an "adverse impact" in part as a "[r]eduction in surface water levels or flows that will, or does cause a violation of surface water quality regulations set forth in Env-Ws 1700" and "[a] reduction of river flows below acceptable levels established pursuant to [the River Management and Protection Act]."[161] Thus, the NHDES can refuse to issue groundwater withdrawal permits or condition their issuance on decreased groundwater pumping or other mitigation measures if pumping will adversely impact surface water flows.[162] While the permits are valid for ten years, the NHDES can modify or revoke them.[163] Additional surface water protections include permit application requirements that mandate preparation of "a water conservation management plan and description of need to demonstrate the efficient use of, and need for, the proposed withdrawal."[164]

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159. N.H. REV. STAT. ANN. § 485-C:21 (V-c(f), (h)(i)) (2008) (stating that "[i]n order to preserve the public trust, no large groundwater withdrawal shall cause an unmitigated impact as determined by . . . [r]educing surface water levels or flows that will, or do, cause a violation of surface water quality rules adopted by the department . . . [or r]educing river flows below acceptable levels established pursuant to RSA 483.").

160. N.H. CODE ADMIN. R. ANN. ENV-WS 388.04(c)(15) (2001) ("When an adverse impact as identified in Env-Ws 388.18 is anticipated to occur as a result of the withdrawal, the applicant or permittee shall complete the following: a. Reduce the proposed production volume of the withdrawal in accordance with Env-Ws 388.14(b) to a level where no adverse impacts are anticipated; or b. Design and implement mitigation measures in accordance with Env-Ws 388.21"); N.H. CODE ADMIN. R. ANN. ENV-WS 387.19 (2009) (The requirements for minor large withdrawals for mitigating the adverse impact are: "(a) An adverse impact that results from a minor large withdrawal shall be managed in accordance with Env-Ws 388. (b) The department shall, when requested in writing, review hydrologic data and make a determination on the validity of a claim of adverse impact. (c) The permittee shall conduct impact mitigation for all large withdrawals where adverse impacts have been identified pursuant to Env-Ws 388. (d) Where an adverse impact occurs, the department shall revoke the minor large withdrawal designation in accordance with Env-Ws 387.15.").

161. N.H. CODE ADMIN. R. ANN. ENV-WS 388.18(c)(6), (9)(2008) (Adverse Impact Criteria) *available at* http://des.nh.gov/organization/commissioner/legal/index.htm; *id.* at ENV WS 388.23 (Procedure and Criteria to Issue, Deny, or Suspend a Major Withdrawal Permit); *id.* at ENV-WS 387.12 (Procedures and Criteria to Approve, Deny, or Revoke a Minor Withdrawal Designation).

162. N.H. CODE ADMIN. R. ANN. ENV-WS 388.04(c)(15) (2008), *available at* http://des.nh.gov/organization/commissioner/legal/index.htm; *Id.* at ENV-WS 387.19.

163. N.H. CODE ADMIN. R. ANN. ENV-WS 388.23 (Procedure and Criteria to Issue, Deny, or Suspend a Major Withdrawal Permit); *id.* at ENV-WS 387.12 (2008) (Procedures and Criteria to Approve, Deny, or Revoke a Minor Withdrawal Designation), *available at* http://des.nh.gov/organization/commissioner/legal/index.htm.

164. N.H. CODE ADMIN. R. ANN. ENV-WS 387.05 (2008) (Conservation Management Plan and Description of Need) (2008) *available at*

Surface water flow protections in the Groundwater Protection Act are insufficient for three reasons. First, any withdrawal less than 57,600 gallons over a twenty-four hour period does not require notice to the local municipality, nor a large groundwater withdrawal permit.[165] Thus, the Act does not protect designated river flow regimes from withdrawals less than 57,600 gallons over a twenty-four hour period. This leaves the flow regimes of New Hampshire's rivers vulnerable to withdrawals less than 57,600 gallons per day that, in the aggregate within a watershed, can significantly deprive a river of its base flow. Second, only withdrawals greater than 144,000 gallons per day require major permits with more intensive hydrologic analysis and testing to determine withdrawal effects on surface waters.[166] Thus, new withdrawals between 57,600 and 144,000 gallons per day, in the aggregate, may have an adverse impact on a river's flow, but because the NHDES does not ascertain such impacts, permittees do not have to mitigate them. Finally, even if the Act could restrict all groundwater withdrawals, it is not sufficiently interconnected with other federal permit schemes to protect flow regimes, such as those limiting surface water withdrawals or imposing conditions in wetlands dredge and fill permits or in pollution discharge permits; in this way, it does not include enforcement and coordination mechanisms sufficient to protect flow regimes.

2. Water Quality Certifications in § 404 Dredge and Fill Permits and § 402 NPDES Permits

Aside from Groundwater Protection Act restrictions to protect surface water flows from groundwater withdrawals, the NHDES can also protect natural flow regimes using other regulatory tools;[167] that is, the NHDES can require federal wetland dredge and fill permits (CWA § 404)[168] and federal pollutant discharge permits (CWA § 402, National Pollution Discharge Elimination System ("NPDES") permits))[169] to in-

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http://des.nh.gov/organization/commissioner/legal/index.htm; *Id.* at ENV-WS 388.05 (Conservation Management Plan and Description of Need).

165. *See* N.H. REV. STAT. ANN. § 485-C:14-a (2008) (Notification of Large Groundwater Withdrawal Required); *see also* N.H. CODE ADMIN. R. ANN. ENV-WS 387.03(d) (2008) (Minor Withdrawal Designation), *available at* http://des.nh.gov/organization/commissioner/legal/index.htm.

166. N.H. CODE ADMIN. R. ANN. ENV-WS 388.04, 388.06 (2008) (Requirements for Major Withdrawals; Conceptual Hydrologic Model of the Withdrawal), *available at* http://des.nh.gov/organization/commissioner/legal/index.htm.

167. Water Quality Certification Regulations, N.H. ADMIN. R. ANN., N.H. Dept. of Envtl. Serv., Env 451.02 (Applicability) (1995), Env 452.02 (Discharge) (1995), *available at* http://des.nh.gov/organization/commissioner/legal/rules/index.htm.

168. 33 U.S.C. § 1344 (2007).

169. 33 U.S.C. § 1342 (2007).

clude conditions to protect flows.[170] CWA § 401 requires that an applicant for a federal permit or license who proposes any activity that may result in discharge into navigable waters first receive a state water quality certification that the applicant's discharge complies with state water quality standards.[171] Therefore, under CWA § 401, the NHDES can require conditions for § 404 permits,[172] which regulate the discharge of dredge or fill materials into navigable waters, or § 402 permits,[173] which regulate point source discharge into navigable waters, to prevent the discharge from violating New Hampshire's surface water quality standards.[174] New Hampshire's surface water quality standards require a maintenance of water quality that both protects a surface water's designated classification[175] and its "chemical, physical, and biological integrity . . . for the propagation of fish, shellfish, wildlife and recreation."[176] Therefore, because Env-Ws 1703.01(d) recognizes water flows as a component of water quality and requires that the permittee maintain surface flows at "levels adequate to protect existing and designated uses," the NHDES can condition CWA § 404 and § 402 permits to protect flow regimes.[177]

Flow conditions in CWA § 404(a)[178] dredge and fill permits under CWA § 401[179] water quality certifications apply to physical alternations of stream banks for water diversion because the alteration discharges

170. Water Quality Certification Regulations, N.H. ADMIN. R. ANN., N.H. Dept of Envtl. Serv., Env 451.02 (Applicability) (1995), Env 452.02 (Discharge) (1995), *available at* http://des.nh.gov/organization/commissioner/legal/rules/index.htm.

171. 33 U.S.C. § 1341 (2008).

172. *Id.*; 33 U.S.C. § 1344 (2008); N.H. CODE ADMIN. R. ANN. ENV-WS 451.02 (Applicability) (1995) *available at* http://des.nh.gov/organization/commissioner/legal/index.htm.

173. 33 U.S.C. § 1342 (2008).

174. 33 U.S.C. § 1341 (2008); Water Quality Certification Regulations, N.H. CODE ADMIN. R. ANN. ENV-WS 452.02 (Discharge) (1995), *available at* http://des.nh.gov/organization/commissioner/legal/index.htm.

175. N.H. CODE ADMIN. R. ANN. ENV-WQ 1703.01(a) (2008) (dividing all state surface waters into Class A or B under RSA 485-A:8 and requiring that the class of surface waters identifies its most sensitive use in need of protection), *available at* http://des.nh.gov/organization/commissioner/legal/index.htm. The DES determines whether a classification of A or B is best for the "interest of the public giving consideration to the health, industrial, economic, geographical and social factors involved"; N.H. REV. STAT. ANN. § 485:A-9 (2008) (Classification Procedure).

176. N.H. CODE ADMIN. R. ANN. ENV-WQ 1703.01(b), (c) (2008) (Water Use Classifications), *available at* http://des.nh.gov/organization/commissioner/legal/index.htm ("All surface waters shall be restored to meet the water quality criteria for their designated classification including existing and designated uses, and to maintain the chemical, physical, and biological integrity of surface waters.").

177. *Id.* at ENV-WS 1703.01(d) (Protection of Water Quantity); 33 U.S.C. § 1341 (2008).

178. 33 U.S.C. § 1344 (2008).

179. 33 U.S.C. § 1341 (2008).

dredged sediment into the stream.[180] Since state water quality standards explicitly protect flows, the NHDES can use CWA § 401[181] water quality certifications to refuse or condition dredge and fill permits to protect flows.[182] While § 401 water quality certifications apply to new water users on all of New Hampshire's surface waters[183] who physically alter stream banks to divert water, they offer inadequate guarantees of instream flow protection to support a stream's ecological integrity.[184] For instance, if a new water user uses a pump and hose to withdraw water from streams, the user need not obtain a § 404(a) permit with conditions that are protective of natural flow regimes.[185] Further, diverters who dug diversion channels before they needed to obtain water quality certifications do not have permits with conditions that allow the NHDES to protect flows. Additionally, without statutory protection of scientifically determined instream flows needed to protect the ecological integrity of New Hampshire's rivers, the NHDES only can limit the withdrawals of § 404(a) permit holders using only the ABF method[186] or Draft November 2000 method[187] of flow protection. As discussed in Section iii below, the use of the ABF method or the Draft November 2000 method to protect instream flows are inadequate policy tools to protect the natural flow regimes, the ecological integrity, and the designated uses of New Hampshire's streams.

In addition to conditions included in CWA § 404(a)[188] dredge and fill permits to protect instream flows, the NHDES can protect flows from surface water withdrawers by using CWA § 401[189] water quality certifications to impose conditions in CWA § 402[190] National Pollution Discharge Elimination System (NPDES) permits regulating the discharge of pollutants into navigable surface waters.[191] Water quality cer-

180. N.H. CODE ADMIN. R. ANN. ENV-WS 451.02 (1995) (Applicability); *id.* at ENV-WS 452.02 (Discharge) (1995), *available at* http://des.nh.gov/organization/commissioner/legal/index.htm.

181. 33 U.S.C. § 1341 (2008).

182. N.H. CODE ADMIN R. ANN. ENV-WS 453.01 (1995) (Certification Required); *id.* at ENV-WS 451.02 (Applicability); N.H. REV. STAT. ANN. § 485-A:13 (2008) (Water Discharge Permits); *Id.* § 485-A:3 (Water Pollution and Waste Disposal Policies).

183. N.H. CODE ADMIN R. ANN. ENV-WS 451.02 (1995) (Applicability); *id.* at ENV-WS 452.09 ("'Surface waters of the state' means 'surface waters of the state' as defined in N.H. REV. STAT. ANN. § 485-A:2, XIV, namely 'streams lakes, ponds, and tidal waters within the jurisdiction of the state, including all streams, lakes, or ponds bordering on the state, marshes, water courses, and other bodies of water, natural or artificial.'"); N.H. REV. STAT. ANN. § 485-A:2 (XIV) (2008) (Surface Waters Defined).

184. *See* N.H. CODE ADMIN R. ANN. ENV-WS 451.02 (1995) (Applicability).

185. *See id.*

186. *See infra* Part IV.B.iii.

187. *See infra* Part IV.B.iii.

188. 33 U.S.C. § 1344 (2008).

189. 33 U.S.C. § 1341 (2008).

190. 33 U.S.C. § 1342 (2008).

191. N.H. REV. STAT. ANN. § 485-A:13 (2008) (Water Discharge Permits).

tifications protecting flows can apply to dischargers of pollutants who withdraw surface waters because a discharge of pollutants qualifies as a discharge that requires a CWA § 401 state water quality certification.[192] Since state water quality standards explicitly protect flows, the NHDES can use CWA § 401[193] water quality certifications to condition CWA § 402 pollutant discharge permits to protect flows by curtailing withdrawals by water users who discharge pollutants into navigable waters.[194] Upon a finding of just cause to ensure flow water quality standards, the DES can also revise, modify, suspend, or terminate the CWA § 402 NPDES permits.[195] Additionally, the NHDES can condition discharge permits to limit diversions by requiring the same amount of flow to be returned to the stream that was withdrawn or by limiting consumptive diversions.[196]

However, like the CWA § 404(a) dredge and fill permits, which can also contain conditions allowing the NHDES to limit withdrawals to protect flows, the conditions included in § 402 NPDES permits fail to effectively protect natural flow regimes. Section 402 NDPES permits fail to encompass water withdrawals that do not pollute or discharge into surface waters or that do not return withdrawals back into a surface waters.[197] Additionally, the NHDES's use of either the ABF method[198] or the Draft November 2000 method[199] to protect flows by limiting NPDES permit holder's withdrawals are inadequate to protect the natural flow regimes, ecological integrity, and designated uses of New Hampshire's streams.

3. The ABF and Draft November 2000 Method of Protecting Flows

NHDES's protection of flows via conditions in § 404(a) and § 402 permits are also inadequate because the ABF method[200] and the Draft November 2000 method[201] fail to adequately protect the natural flow regimes of New Hampshire's rivers. Using its best professional judg-

192. 33 U.S.C. §§ 1341, 1362 (2008).
193. 33 U.S.C. § 1341 (2008).
194. *See* N.H. REV. STAT. ANN. § 485-A:13 (2008) (Water Discharge Permits); *see also* 33 U.S.C. §§ 1341-42 (2008).
195. N.H. REV. STAT. ANN. § 485-A:13 (2008) (Water Discharge Permits).
196. *See* N.H. CODE ADMIN. R. ANN. ENV-WQ 1703.01(d) (2008) (Water Use Classifications) (Protection of water quantity), *available at* http://des.nh.gov/organization/commissioner/legal/index.htm; *see also* N.H. REV. STAT. ANN. § 485-A:13 (2008) (Water Discharge Permits); *see also* 33 U.S.C. §§1341-42 (2008).
197. N.H. REV. STAT. ANN. § 485-A:13 (2008) (Water Discharge Permits); 33 U.S.C. § 1342 (2008).
198. *See infra* pp. 36-37 and note 201.
199. *See infra* pp. 37-38 and note 205.
200. *See infra* pp. 36-37 and note 201.
201. *See infra* pp. 37-38 and note 205.

ment, the NHDES can utilize either the ABF method, the Draft November 2000 method, or the Instream Flow Incremental Method ("IFIM") to protect flows via conditions that allow them to curtail water use in § 404(a) dredge and fill permits and § 402 NPDES permits.[202] Under the ABF method,[203] the NHDES maintains flow above the median flow of the lowest flow month of the year for basins that are larger than fifty square miles.[204] In smaller watersheds, ABF only requires minimum flows of 0.5 cubic feet per second.[205] Thus, unlike the instream flow regulations that mimic natural flow regimes, flow protections under the ABF method do not preserve the natural varying seasonal flows and high flows that maintain the ecological integrity of streams.

An alternative to using the ABF method that is more protective of the high flows and seasonal varying flows of a stream, but can be less protective of low flows, is the NHDES draft November 14, 2000, instream flow rules.[206] These rules protect streams from consumptive uses[207] by curtailing these uses with increasing intensity as flow conditions drop below median monthly flows.[208] Under this policy, the commissioner calculates the historic monthly median flow for a stream and uses it as a benchmark relative to current flow conditions to determine when withdrawal limitations on CWA § 404(a) or § 402

202. *See* VERNON LANG, U.S. FISH & WILDLIFE SERV., QUESTIONS AND ANSWERS ON THE NEW ENGLAND FLOW POLICY (1999), *available at* http://des.nh.gov/organization/divisions/water/wmb/rivers/instream/documents/lang_policy.pdf); N.H. DEP'T OF ENVTL. SERVS., WORKING DRAFT RULES FOR THE PROTECTION OF INSTREAM FLOW IN DESIGNATED RIVERS, ENV-WS 1900 (2000), *available at* http://des.nh.gov/organization/divisions/water/wmb/rivers/instream/documents/11142kifr.pdf. *See also* 33 U.S.C. §§ 1342, 1344(a).

203. LANG, *supra* note 202, at 1 (defining ABF as "a set of chemical, physical and biological conditions that represent limiting conditions for aquatic life and wildlife in stream environments. In hydrological terms, it means median August flows").

204. *Id.* at 4.

205. *See id.* at 2 (describing how the median August default compares to optimal flow). *See also id.* at A-2 ("The ABF criterion of 0.5 cfsm and the spawning and incubation flow criteria of 1.0 and 4.0 cfsm were derived from studies of 48 USGS gaging stations on basically unregulated rivers throughout New England. Each gaging station had a drainage area of at least 50 square miles, negligible effects from regulation, and a minimum of 25 years of good to excellent flow records. On the basis of 2,245 years of record, 0.5 cfsm was determined to be the average median August monthly flow.").

206. *See* N.H. DEP'T OF ENVTL. SERVS., WORKING DRAFT RULES FOR THE PROTECTION OF INSTREAM FLOW IN DESIGNATED RIVERS (2000), *available at* http://des.nh.gov/organization/divisions/water/wmb/rivers/instream/documents/11142kifr.pdf.

207. *Id.* ENV-WS 1903.01 (defining consumptive use as "the difference between the measured withdrawal flow and the measured return flow credited to the withdrawal, on an instantaneous basis").

208. *See id.* ENV-WS 1901.02, 1905.03.

NPDES permit holders should be activated.[209] Q60 is the assigned value when the median monthly flow is equal to or greater than the mean seasonal flow 60 percent of the day.[210] When flows fall below the Q60 value for four consecutive days, the regulations limit aggregate consumptive use 4 percent of the total flows for all CWA § 404(a) or § 402 NPDES permit holders.[211] When flows fall below the Q80 value for four consecutive days, aggregate consumptive use is limited to 2% of the total flows for all CWA § 404(a) or § 402 NPDES permit holders.[212] When flows fall below the Q90 value for four consecutive days, the regulations prohibit withdrawals by CWA § 404(a) or § 402 NPDES permit holders.[213] Thus, the November 14, 2000, method still permits withdrawals when a stream's flow reaches a point where the minimum flows are exceeded 80% of the time. During the summer months, allowing a withdrawal at Q80 can allow stream flow to drop significantly below the floor that the ABF method establishes. However, unlike the ABF method, the November 14, 2000, method protects flows according to the season of withdrawal, and thus is more protective of high flows.[214] Additionally, the November 14, 2000, method protects flows based on median seasonal flows, which are imprecise indicators of the varying flows that require protection to maintain the natural flow regimes vital to their organisms' survival and reproduction.[215]

An alternative to the ABF method and the November 14, 2000 method exists in the Instream Flow Incremental Method ("IFIM"), which is available when the water user agrees to fund site-specific habitat and natural flow regime studies, similar to those conducted under the current instream flow regulations for designated rivers, to determine the instream flows necessary to protect the aquatic wildlife on a given river segment.[216] However, because the expenditures and time to complete instream flow studies for all rivers are burdensome absent specific instream flow legislation or funding from water withdrawers, it

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209. *See id.* ENV-WS 1905.02, 1905.03(a)-(d), (i), 1905.05. Note that the draft rules apply to all consumptive users, not just the permit holders mentioned.

210. *Id.* ENV-WS 1907.03(a)(1).

211. *Id.* ENV-WS 1905.03(b), 1905.05(a), 1907.03(a)(1). Note that the actual consumptive use limitation is the lesser of "(1) The user's proportion of the total normal withdrawal by all affected water users in the basin multiplied by 4% of the basin phase I trigger flow; or (2) Estimated phase I flow at the user's withdrawal point, less upstream withdrawals at the allowed rate, multiplied by 4%."

212. *Id.* ENV-WS 1905.03(c), 1905.05(b), 1907.03(a)(2). Note that the actual consumptive use limitation is the lesser of "(1) The user's proportion of the total normal withdrawal by all affected water users in the basin multiplied by 2% of the basin phase II trigger flow; or (2) Estimated phase I flow at the user's withdrawal point, less upstream withdrawals at the allowed rate, multiplied by 2%."

213. *Id.* ENV-WS 1905.03(d), 1905.05(c), 1907.03(a)(3).

214. *Id.* ENV-WS 1905.5.

215. *Id.* ENV-WS 1907.03(a) (Proposed Trigger Flows and Minimum Releases).

216. LANG, *supra* note 202, at 5.

is seemingly more probable that the NHDES would use the ABF method or its draft November 14, 2000, rules to protect instream flows, both of which fall short of protecting a stream's natural flow regime and ecological integrity. Even if the ABF method or the November 14, 2000, rules adequately protected instream flows, the inability of CWA § 401-conditioned § 402 and § 404 permits and the rest of New Hampshire's regulations to regulate all surface water and groundwater withdrawers within a watershed would render the ABF method and November 2000 rules ineffective in protecting the natural flow regimes of New Hampshire's rivers absent adequate and comprehensive instream flow regulations.

C. SUMMARY: THE INSUFFICIENCY OF NEW HAMPSHIRE'S COMMON LAW AND STATUTES TO PROTECT THE NATURAL FLOW REGIMES OF ITS RIVERS AND STREAMS ABSENT ADEQUATE INSTREAM FLOW REGULATIONS

As demonstrated in the preceding sections, New Hampshire needs regulations, in addition to common law and statutes, to adequately protect New Hampshire's natural flow regimes. Without studies that credibly establish instream flows necessary to protect natural flow regimes, the public trust doctrine, the Groundwater Protection Act, and conditions in CWA § 402 NPDES permits and § 404(a) dredge and fill permits cannot effectively curtail surface and groundwater withdrawals that disturb the natural flow regime. Even if flows that sufficiently mimic New Hampshire's rivers' natural flow regime, and thereby protect the ecological integrity of New Hampshire's rivers, are established, the inability of the Groundwater Protection Act, the CWA § 402 NPDES and § 404(a) permits to reach, control, and coordinate all water users that affect instream flows requires the promulgation of additional regulations to protect these flows.

V. NEW HAMPSHIRE'S INSTREAM FLOW REGULATION AND ITS THREE INADEQUACIES

A. NEW HAMPSHIRE'S INSTREAM FLOW REGULATION

New Hampshire's regulatory answer to sufficiently protect the flow regimes of its rivers and streams is its promulgation of instream flow legislation under the statutory authority of the Rivers Management and Protection Program ("RMPP").[217] Enacted in 2003, New Hampshire's pilot instream flow legislation, Env-Ws 1900 *et seq.*, specifies how protected instream flows shall be established and enforced for its designated rivers.[218] The pilot legislation applies to two of New Hampshire's

217. N.H. REV. STAT. ANN. § 483:1 (2008).
218. N.H. CODE ADMIN. R. ANN. ENV-WS 1901.01 (2008).

fifteen rivers that the RMPP designated for protection, and sets procedures for the adoption and implementation of the instream flow regulations.[219] Under the instream flow legislation, after the regulations undergo a year long test run following the determination of protected flows and the regulation's implementation, the NHDES is charged with submitting a report[220] to the state legislature to aid in its determination of whether to enact similar protected instream flow regulations for all of the rivers the RMPP designates for protection.[221] For purposes of analyzing the sufficiency of New Hampshire's instream flow regulations in protecting the ecological integrity of its surface waters, the assumption will be made that the pilot instream rules will apply to the remaining designated rivers under the RMPP, as currently promulgated under Env-Ws 1900.[222]

The instream flow legislation provides detailed procedures for the establishment of protected flows sufficient to safeguard the designated river's outstanding characteristics, the designated resources of the river, and its instream public uses.[223] It requires the NHDES to conduct a protected instream flow study that identifies and catalogues the designated river's outstanding characteristics, the resources for which the river is designated, and the instream public uses by compiling relevant reports[224] and stream surveys.[225] The instream flow study identifies and documents methods for establishing the protected instream flow standards and recommends scientifically-based instream flows that conserve and protect the river's instream public uses, designated uses, the

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219. 2002 N.H. Laws, ch. 278:2(I) (HB 1449-A) (establishing a pilot program in the department of environmental services to study and establish protected instream flows and water management plans for the Lamprey River and the Souhegan River). *See also* N.H. CODE ADMIN. R. ANN. ENV-WS 1901.01; N.H. REV. STAT. ANN. § 483:9-c (Establishment of Protected Instream Flows); *Id.* § 483:15 (Rivers Designated for Protection).

220. 2002 N.H. Laws, ch. 278:3(III) (HB 1449-A) (Instream Flow Technical Review Committees; Establishment; Duties). This report details the results of the pilot program including "the projected impacts of the protected instream flows and water management plans to be implemented on water users, wildlife, recreation, and other interests along the rivers and any recommendations for proposed legislation." The report shall also include a summary of public comments received and the completed instream flow studies and the adopted protected instream flow levels and water management plans.

221. *Id.*

222. *See* N.H. CODE ADMIN. R. ANN. ENV-WS 1900, *et seq.*

223. *Id.* ENV-WS 1905.02 (2008) (Protected Instream Flow Study); N.H. REV. STAT. ANN. § 483:9-c (2008) (Instream public uses include "navigation; recreation; fishing; storage; conservation; maintenance and enhancement of aquatic and fish life; fish and wildlife habitat; wildlife; the protection of water quality and public health; pollution abatement; aesthetic beauty; and hydroelectric energy production.").

224. *Id.* ENV-WS 1905.02. These reports and documents include, but are not limited to, designated river nomination reports, river corridor management plans enacted by the NHDES under the RMPP, water quality studies, national heritage inventories, fishery and aquatic resource studies, and environment assessments and impact statements.

225. *Id.*

aquatic life, resources and uses identified from the on-stream survey, and outstanding characteristics.[226]

Once a protected flow regime is in place for different times of the year that is sufficient to protect the flow dependent entities, the protected flow regime becomes part of the "water quality criteria for the purpose of administration of water quality standards" under the CWA.[227] To ensure that the protected flow regime is maintained, the instream flow regulations mandate the use of water management plans that the NHDES develops.[228] Water management plans include conservation plans, water use plans, and dam management plans.[229] Water management plans apply to affected water users, who must comply with the management plan's provisions.[230] Affected water users are ground and surface water withdrawers who are required by law to register[231] and who also withdraw surface water or ground water within five hundred feet of a designated river or its tributary, and dam owners with impoundments of more than ten acres in the watershed of a designated river.[232] When a withdrawer must curtail its withdrawal or alter its flow releases as the Water Management Plan requires, failure to comply with the Plan results in a violation of water quality flow standards, and triggers liability under the Clean Water Act.[233]

The first step in the water management plan is the development of conservation plans for all registered water users in the planning area.[234] The conservation plan identifies and reports the amount of water that affected water users withdraw and return to the river, the timing intervals and patterns of the water user's withdrawals and returns, the affected water user's needs, and the potential for conservation.[235] After detailing the water user's water usage, the conservation plan identifies conservation measures and best management practices applicable to each type of affected user, while considering the economic effects on the user.[236] The last step of the conservation plan is to establish an implementation schedule that contains quantitative water use reduction

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226. *Id.*
227. *Id.* ENV-WS 1907.02 (Protected Instream Flows and Water Quality Criteria).
228. *Id.* ENV-WS 1906.01 (Procedures for the Adpotion of Water Management Plans).
229. *Id.*
230. *Id.* ENV-WS 1906.1(c) (1), 1907.01.
231. N.H. REV. STAT. ANN. § 488:3 (2008) (stating that water users required to register their water uses are all ground or surface water withdrawer that withdraw "a cumulative amount of more than 20,000 gallons of water per day, averaged over any 7-day period, or more than 600,000 gallons of water over any 30-day period, at a single real property or place of business").
232. N.H. CODE ADMIN. R. ANN. ENV-WS 1902.02, 1902.03.
233. *Id.* ENV-WS 1907.01, 1907.02.
234. *Id.* ENV-WS 1906.02 (a).
235. *Id.* ENV-WS 1906.02 (b)(3).
236. *Id.* ENV-WS 1906.02 (b)(2), (b)(3)(f).

targets.[237] The implementation schedule is a product of the results of the findings, meetings, economic assessment and discussions with the water user.[238] Thus, the conservation plan is a compromise between the water users and NHDES that sets forth a plan to achieve the protected instream flow over a reasonable period.

Used along with conservation plans, NHDES water use plans that define the allowable withdrawals of registered water users, and dam management plans, coordinate the water use and flow release of all affected water users and dam owners to maintain adequate instream flows.[239] NHDES water use plans, guided by conservation plans, define the allowable withdrawals for each registered water user within the water management planning area, which encompasses surface water users in designated rivers and their tributaries.[240] The net effect of implementing the water use plans and the dam management plans aims to maintain the protected instream flow levels for each river segment of the designated river.[241] The plans also include implementation schedules for affected water users to meet the water use plan, describe potential for water use modification and sharing, include an economic assessment of the implementation costs of individual plans, and assigns the NHDES the responsibility to coordinate negotiations among dam owner and waters users to help meet the protected instream flow requirements.[242]

The dam management plans include data on the potential water available for release to maintain protected instream flows, the potential for the dam management plan to help meet instream flow requirements, and the ambit of "ecological and other impacts to the impoundment and downstream river reaches which might restrict the use of such waters for augmentation flows."[243] Like the water use plans, the dam management plans contain an implementation schedule, an economic assessment of the cost to implement the plan, and are coordinated so that the net effect of implementation of the dam management plans and water use plans maintain the protected instream flows for each river segment on the designated river.[244]

237. *Id.* ENV-WS 1906.02 (b)(4).
238. *Id.* ENV-WS 1906.02 (c), (f).
239. *Id.* ENV-WS 1906.03 (b)(1), (4).
240. *Id.* ENV-WS 1906.03 (b)(1), (2), 1902.03.
241. *Id.* ENV-WS 1906.03 (b)(4).
242. *Id.* ENV-WS 1906.03 (c)(1), (2).
243. *Id.* ENV-WS 1906.04 (b)(2)(a)-(c).
244. *Id.* ENV-WS 1906.04 (b)(3)(4), (d).

B. THE THREE REASONS WHY NEW HAMPSHIRE'S INSTREAM FLOW REGULATIONS ARE INSUFFICIENT TO MAINTAIN AND ENHANCE THE ECOLOGICAL INTEGRITY OF ITS RIVERS AND STREAMS

Three overarching reasons render New Hampshire's instream flow regulation insufficient to maintain and enhance its streams' aquatic, fish, and wildlife habitats. First, the administrative scheme protecting instream flows is not sufficiently comprehensive, because it is disjointed and limited in regulating all flow sources within a watershed. The administrative scheme is disjointed in regulating flow sources because it does not adequately regulate ground and surface water withdrawals within a watershed under a unified and cohesive regulatory scheme. To achieve the protected flow regime on a designated river, the instream flow regulation can only coordinate and curtail the water use of "affected water users."[245] "Affected water users" encompass ground and surface water withdrawers who are required by law to register their water use,[246] and who have a "withdrawal or return location within 500 feet of a designated river or within 500 feet of a river or stream in its tributary drainage area."[247] Affected water users also consist of dam owners with impoundments "greater than 10 acres in the watershed area of a designated area."[248] Thus, the instream flow regulation is not interconnected or coordinated with other New Hampshire laws that regulate water withdrawals more than five hundred feet from a designated river or its tributaries. Although, under the Groundwater Protection Act,[249] the NHDES can curtail the water usage of permitted groundwater users withdrawing greater than 57,600 gallons per day to protect the ecological integrity of surface waters,[250] the instream flow legislation imposes no legally enforceable mandate for the NHDES to

245. *See id.* Env-Ws 1901.02.

246. N.H. REV. STAT. ANN. §§ 488:2-488:3 (2006) (The water users, required by law to register their water uses, are all ground or surface water withdrawers that withdraw "a cumulative amount of more than 20,000 gallons of water per day, averaged over any 7-day period, or more than 600,000 gallons of water over any 30-day period, at a single real property or place of business.").

247. N.H. CODE ADMIN. R. ENV-WS 1901.02(b) (2003) (applicability to "affected water users"); *id.* ENV-WS 1902.03 (definition of "affected water user").

248. *Id.* ENV-WS 1901.02(c) (applicability to "affected dam users"); *id.* ENV-WS 1902.02 (definition of "affected dam user").

249. Groundwater Protection Act, N.H. REV. STAT. ANN. §§ 485-C:1 to C:22 (2006).

250. N.H. CODE ADMIN. R. ANN. ENV-WS 301.02(b) (2007) (An applicant for a new source of water for a new small community water system with a design flow and source capacity requirement that exceed 57,600 gallons per day must comply with Env-Dw 302, Env-Ws 387, and Env-Ws 388); *Id.* ENV-WS 388.18(a), (c)(6), (c)(9) (2001) (Adverse impacts include a "reduction in surface water levels or flows" which disrupts the surface water quality and/or reduces the river flows below acceptable levels.); *Id.* ENV-WS 388.23 (Procedure and Criteria to Issue, Deny, or Suspend a Major Withdrawal Permit); *Id.* ENV-WS 387.12 (2001) (Procedures and Criteria to Approve, Deny, or Revoke a Minor Withdrawal Designation).

coordinate permitted groundwater withdrawals with the "affected water users" under its instream flow legislation for the protection of flow regimes of designated rivers.[251] Thus, the lack of an administrative mechanism that coordinates the affected water users with the permitted groundwater withdrawers withdrawing farther than five hundred feet from a designated river or its tributaries fails to take advantage of a potential administrative efficiency vital to protecting flow regimes.

Aside from the disjointedness of the instream flow regulation's administrative scheme in regulating flow sources, the limited nature of its administrative structure in regulating flow sources raises concerns regarding the ability of the regulation to protect the natural flow regimes of designated rivers. The instream flow regulation's administrative scheme is limited in regulating flow sources in that it does not regulate ground water withdrawals beyond five hundred feet of the designated rivers and their tributaries.[252] Additionally, the regulations fail to manage groundwater withdrawers that withdraw greater than 57,600 gallons per day farther than five hundred feet from a designated river or its tributaries.[253] Even if the instream flow regulation regulated all permitted groundwater withdrawers under the Groundwater Protection Act withdrawing further than five hundred feet from a designated river or its tributaries within the river's watershed, the regulations would not be able to regulate groundwater users withdrawing less than 57,600 gallons per twenty-four hour period whose aggregate withdrawals can adversely impact the rivers' flow regimes.[254] Furthermore, the instream flow regulation does not regulate surface water withdrawers, including separate entities engaging in bulk water transfers, that divert less than 140,000 gallons of water per week or less than 600,000 gallons per month, within or beyond five hundred feet from a

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251. *See id.* ENV-WS 1901.02(b), (c) (2003) (applicability to affected water users and affected dam users); *see id.* ENV-WS 1902.02-.03 (definitions of affected water users and affected dam users).

252. *See id.* ENV-WS 1901.02(b) (applicability to affected water users); *see id.* ENV-WS 1902.03 (definition of affected water users only includes users who have a "withdrawal or return location within 500 feet of a designated river or within 500 feet of a river or stream.").

253. *See id.* ENV-WS 1902.03 (The definition of affected water users only includes users who have a "withdrawal or return location within 500 feet of a designated river or within 500 feet of a river or stream." Any users beyond 500 feet are not designated as affected water users.); *see generally id.* ENV-WS 1900 *et seq.*

254. N.H. CODE ADMIN. R. ENV-WS 387.03(c) (2001) (List of departmental requirements for designating a large withdrawal as a minor withdrawal. One requirement is that the maximum 24-hour withdrawal is at least 57,600 gallons); *see id.* Env-Ws 387.04 (Minor Large Withdrawal Approval Process and Requirements); *see id.* ENV-WS 388.03 (2001) (A large withdrawal constitutes a major withdrawal when the maximum 24-hour withdrawal is 57,600 gallons per day or more.); *see id.* ENV-WS 388.04 (Requirements of Major Withdrawals); *see also* N.H. REV. STAT. ANN. § 485-C:2 (IX-a) (2006) ("'Large groundwater withdrawal' means any withdrawal from groundwater of 57,600 gallons or more of water in any 24-hour period at a single property or place of business.").

designated river or its tributary, whose aggregate withdrawals can have adverse affects on natural flow regimes.[255] Lastly, the instream flow regulation has limited reach because it completely ignores the protection of baseflow through land use regulations that promote recharge and that limits the percentage of impervious surfaces that can accompany urban development.[256] As discussed in Section III, baseflow is often a substantial and sustainable year round source of flow to a stream, and thus land use activities that reduce baseflow should be treated as a water withdrawal under a regulatory regime that curbs water use to protect instream flows. Without protecting all of a stream's flow sources within its watershed, or at least closing the major loopholes that contribute to flow impairment, the instream flow regulations may very well be ineffective in protecting natural flow regimes, and will place unfair burdens on registered surface water users and groundwater withdrawers five hundred feet from rivers designated for protection under the RMPP. Thus, the failure of the instream flow legislation to coordinate and regulate all permitted and registered water users within a watershed, and its failure to regulate all important contributions to surface water flows, leaves its natural flow unprotected and the ecological integrity of its rivers and streams threatened.

The second reason why New Hampshire's instream flow regulation is insufficient to maintain and enhance its streams' ecological integrity is that the lotic geographic scope of the instream flow regulation is inadequate. The piecemeal protection of New Hampshire's streams does not preserve the ecological integrity of tributaries or coastal sections of its streams, which serve as vital organs in a river ecosystem. While the instream flow regulations protect designated river segments on the designated rivers, these regulations are not concerned with protecting the undesignated segments, such as the RMPP-designated rivers' tributaries and coastal reaches. The tributary flows are protected in the sense that a tributary's flows must adequately contribute sufficient flows to maintain a designated reach's ecological integrity.[257]

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255. *See generally* N.H. CODE ADMIN. R. ENV-WS 387.01 (2001); *id.* ENV-WS 388.01 (2001); *id.* ENV-WS 1900 *et seq.* (2003) (These regulations do not regulate surface water withdrawers, but rather regulate ground water withdrawals.); *id.* ENV-WS 1901.02(b); *id.* ENV-WS 1902.03.

256. *See generally* N.H. CODE ADMIN. R. ENV-WS 387.01 (2001); *id.* ENV-WS 388.01 (2001); *id.* ENV-WS 1900 *et seq.* (2003) (These regulations do not protect baseflow through land use regulations.).

257. *See* N.H. CODE ADMIN. R. ENV-WS 1901.02(a) (2003) (Requirements set forth in Env-Ws 1900 apply to designated segments "on the Lamprey and Souhegan Rivers and their tributary drainage areas."); *id.* ENV-WS 1902.03 ("Affected water users" are users who have a "withdrawal or return location within 500 feet of a designated river or within 500 feet of a river or stream in its tributary drainage area."); *id.* ENV-WS 1903.02 (a)-(c) (The department must report the aggregate water use and streamflow of each designated river with or without established protected instream flows. There are four

However, the regulations protect only the total tributary outflows, which allows a registered surface water diverter to dewater segments of tributaries by returning their withdrawals downstream from their points of diversion.[258] Similarly, coastal reaches of designated rivers are not protected from dewatering from differing points of diversions and return flows, nor are they protected from consumptive uses that do not return flows to the designated river.[259] The dewatering of river segments and the accompanying ecological destruction of biota and wildlife can disturb a river's food chain, creating a trophic cascade with disastrous rippling effects throughout a designated river's system.[260] Thus, the instream flow regulations are not protecting the designated river system as a whole or the ecological integrity of a river's vital habitat for reproduction and fish migration, thereby effectively threatening the designated river's public uses under the RMPP and instream flow regulations. Furthermore, because the RMPP does not designate the Androscoggin Basin for protection, the instream flow regulation does not protect the flow regime of the one hundred seventy-mile long Androscoggin River, whose headwaters begin in New Hampshire before entering into Maine.[261]

The third reason why New Hampshire's instream flow regulations are insufficient to maintain and enhance its streams' ecological integrity is that it fails to provide its streams with interim flow protections while it develops and establishes the protected flows. The extensive MesoHabitat Simulation Model ("MesoHABSIM")[262] method, which determines sufficient protected instream flows, is seemingly adequate to determine the necessary flows to protect all riparian wildlife during their differing bioperiods[263] in all of their habitats such as riffle, pools,

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occasions when designated rivers with protected instream flows are not in compliance with the general standard.).

258. *See generally id.* ENV-WS 1900 *et seq* (ENV-WS 1900 *et seq.* fails to regulate (or prohibit) a water user who returns withdrawals downstream after diverting segments of a tributary upstream.).

259. *See generally id.* (ENV-WS 1900 *et seq.* fails to protect coastal reaches from diversions and consumptive uses.).

260. *See generally* Tiffany M. Knight, Michael W. McCoy, Jonathan M. Chase, Krista A. McCoy & Robert D. Holt, *Trophic Cascades Across Ecosystems,* 437 NATURE 880 (2005) ("Trophic cascades arise when predators reduce prey abundance, indirectly relaxing consumption on lower trophic levels." Refer to article for an example of a trophic cascade occurrence.).

261. N.H. REV. STAT. ANN. § 483:15 (2006) (Rivers Designated for Protection); Androscoggin River Watershed Council, *Androscoggin River Watershed Council,* http://www.avcnet.org/arwc/intro.html (last visited Oct. 30, 2008).

262. *See* Northeast Instream Habitat Program, MesoHABSIM, http://www.mesohabsim.org/mesohabsim/index.htm (last visited Feb. 04, 2009), for an explanation of the MesoHASBIM method.

263. Parasiewicz, *Habitat Time, supra* note 62 at 441 (explaining that an organism's bioperiod is that organism's critical intra-annual seasons with specific biological functions, such as certain flows existing during certain season to enable biological functions

and runs with different geomorphology, land cover, and hydrological characteristics in varying times of the year. The MesoHABSIM method maps mesohabitats[264] under a range of flow conditions at extensive sites along a large spatial segment of a river.[265] The method includes data collection from fish and fish habitat surveys in randomly distributed mesohabitats along the large selected spatial segment of the river.[266] This allows modeling of available fish habitats at a range of flows, "creat[ing] the framework for integrative analyses of many aspects of the [river] ecosystem . . . [and] allow[ing] managers to recreate reference conditions and evaluate possible instream and watershed restoration measures or alterations, such as dam removals or changes in water withdrawals."[267] Proponents of the MesoHABSIM method believe that "habitat and fish measurements at larger spatial units are more practical, more relevant to river management, and more conducive to habitat modeling" than methods that base the determination of flows necessary to protect critical river organisms' bioperiods on habitat and fish data within distinct macrohabitats on a limited reach of a river.[268]

While the MesoHABSIM method used to determine sufficient instream flows is seemingly sufficient to protect all riparian wildlife during different their differing bioperiods, the determination and regulatory establishment of protected flows under the MesoHABSIM method takes time, exposing riparian wildlife to anthropogenically-induced, ecologically-threatening low flow events and disturbances in natural flow regimes.[269] Regulators enacted the pilot instream flow regulation

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such as spawning or rearing and growth); *see* NEW HAMPSHIRE DEP'T OF ENVTL. SERV'S, INSTREAM PROTECTED FLOWS FOR THE SEGMENTS OF THE SOUHEGAN RIVER DESIGNATED AS PROTECTED PURSUANT TO RSA 483:15, XIII (2008), *available at* http://des.nh.gov/organization/divisions/water/wmb/rivers/instream/souhegan/documents/pisf_table1.pdf for an example of a protected bioperiod: May 1 – Jun 14 for Shad spawning.

264. Piotr Parasiewicz, *MesoHABSIM: A Concept for Application of Instream Flow Models in River Restoration Planning*, 26 FISHERIES 6, 7 (2001), *available at* http://des.nh.gov/organization/divisions/water/wmb/rivers/instream/souhegan/documents/mar2204_meso_habsim.pdf (Mesohabitat types are defined by their hydromorphological units (HMUs), such as pools and rapids, geomorphology, land cover and other hydrological characteristics. The mesohabitats mapped along long spatial reaches of a river multiple times generally include all riffles, rapids, cascades, glides, runs, fast runs, pools, plunge pools, backwaters, and side arms within the spatial reach sampled.).

265. Northeast Instream Habitat Program, MesoHABSIM, http://www.mesohabsim.org/mesohabsim/index.htm (last visited Feb. 04, 2009).

266. *Id.*

267. *Id.*

268. *Id.*

269. *See* THOMAS BURACK, NEW HAMPSHIRE DEP'T OF ENVTL. SVC.S, DECLARATION OF THE ESTABLISHMENT OF PROTECTED INSTREAM FLOWS FOR THE SOUHEGAN DESIGNATED RIVER 4 (2008), *available at* http://des.nh.gov/organization/divisions/water/wmb/rivers/instream/souhegan/documents/pisf_signed.pdf.

mandating the determination of protected flows on two of New Hampshire's fifteen rivers designated for protection under the RMPP in 2002.[270] The use of the MesoHABSIM method has taken more than three years to determine protected instream flows on all the designated river segments on these two rivers.[271] Given limited economic resources and the time necessary to determine an adequate protected flow regime for a designated river, the instream flow regulation should demand that interim instream flow protections are established that can at least sustain a streams ecological integrity until protected flow regimes exist on the remaining thirteen designated rivers. Additionally, the RMPP has designated only fifteen rivers for protection.[272] While these fifteen rivers encompass 822 miles of rivers and streams, the 822 miles of protected designated river segments account for less than 1 percent of New Hampshire's river and stream miles, leaving the natural flow regimes of these watercourses unprotected until the RMPP or other legislation sets forth regulations that require protection of their instream flows.[273]

VI. CONCLUSION

New Hampshire's instream flow regulations are insufficient to maintain, restore, and enhance its streams' ecological integrity from the ambit of increasingly severe anthropogenic impacts[274] to flows that are accompanying its population growth and urban developments.[275] New Hampshire's citizens are diverting more and more water from streams for consumptive, non-returnable uses.[276] They are pumping water from the ground in increasing quantities, lowering water tables, and thus reducing or eliminating baseflow contributions to streams in many watersheds.[277] Compounding the effects of groundwater pumping on baseflow contribution, the water that percolates into the ground during precipitation events that sustainably feeds a river on a year

270. *Id.* at 2.

271. *Id.* at 10; *see* Des.nh.gov, Souhegan River, http://des.nh.gov/organization/divisions/water/wmb/rivers/instream/souhegan/pisf.htm (last visited Feb. 02, 2009) (stating that the Souhegan Protected Instream Flow report, describing "the scientific methods and results of the study to define protected flows on the Souhegan Designated River," was completed February 26, 2008).

272. *See* N.H. REV. STAT. ANN. § 483:15 (2008).

273. LAKES MGMT. ADVISORY COMM. AND THE RIVERS MGMT. ADVISORY COMM., NEW HAMPSHIRE DEP'T OF ENVTL. SVC'S, THE SUSTAINABILITY OF NEW HAMPSHIRE'S SURFACE WATERS 4 (2008), *available at* http://des.nh.gov/organization/divisions/water/wmb/lakes/documents/sustainability_initiative.pdf.

274. *See supra* Part III.

275. *Id.*

276. *See supra* Part III.B.

277. *See supra* Part III.

round basis via baseflow is increasingly being swept away over impervious surfaces into stormwater runoff systems that empty directly into steams.[278] The natural flow regimes of New Hampshire's rivers are in need of policy and legal protections that protect and provide flows.[279] These protective flows at least need to mimic the natural flow regimes of rivers so that all of their fish and wildlife have enough water for their critical bioperiods and to sustain their year round existence.[280] Not only do the threatened and healthy populations of native fish and wildlife that thrive in New Hampshire's rivers and streams need adequate flows, but so do New Hampshire's citizens also. Whether New Hampshire's residents value nature and species, the aesthetic value of rivers, the ecological integrity of rivers and streams, flow dependent recreational activities on rivers, spiritual values provided by ecologically sound rivers, or the statewide economic benefits from ecologically healthy rivers and streams, all residents have an interest in ensuring that New Hampshire's rivers have enough water flowing through them to support their ecological integrity.[281] Implementing water conservation, water efficiency, and groundwater recharge and infiltration measures at the household, municipal, agricultural, and industrial levels sufficient to maintain natural flow regimes without government command and control would be ideal. However, these measures do not happen absent regulatory intervention because of societal free riding problems, the rush to divert and use a limited open access resource under a riparian rights system, and people's differing valuations of the worth of a stream's ecological integrity.

New Hampshire's instream flow regulations attempt to protect natural flow regimes.[282] Although, the MesoHASBIM method of determining sufficient flows appears to be an adequate method to determine the annual varying flows that require protection for each species' critical bioperiods in a given stream system,[283] the administrative scheme in the instream flow regulation is seemingly insufficient to protect the natural flow regimes once they are established.[284] As discussed in section V.B. above, the administrative scheme is disjointed in regulating all of a river's flow sources because it does not regulate ground and surface water withdrawals under a common permitting scheme.[285] The administrative structure is also limited in protecting all of a river's flow sources in that it does not cover small withdrawals that on an aggregate remove a significant amount of water from streams, it does not

278. *See supra* Part III.A.
279. *See supra* Part III.B.
280. *See supra* Part III.
281. *See supra* Part I-III.
282. *See supra* notes 217-218 and accompanying text.
283. *See* Parasiewicz, *Habitat Time*, *supra* note 62.
284. *See supra* Part V.B.
285. *Id.*

have the authority to curb groundwater withdrawals more than five hundred feet from a protected river, and it completely ignores protecting baseflow through land use regulations that promote recharge and curb the expansion of impervious surfaces.[286] Additionally, the piecemeal protection of New Hampshire's streams does not protect the ecological integrity of tributaries or coastal sections of its streams, which serve as vital organs in a river ecosystem, and omits protection of the Androscoggin River basin that originates in New Hampshire.[287] Lastly, the determination of adequate flows using the MesoHASBIM method takes about three years per stream, and water management plans protecting flows are not implemented until the protected flows are determined and established in an instream flow regulation.[288] The NHDES does not have an adequate interim protective flow policy in place to protect the thirteen more rivers designated for protection under the RMPP that are awaiting the determination of their protected flows via the MesoHASBIM method. The absence of an interim protective flow policy leaves riparian wildlife on these rivers exposed to anthropogenically induced low flow events that are ecologically threatening.[289]

One can cure the deficiencies in New Hampshire's instream flow regulations with statutory fixes, and a combination of sufficiently stringent interim flow protections and increased funding. An increase in funding could speed up the determination of protected flow regimes and could allow the NHDES to hire more staff to monitor and regulate all water users in a watershed. Including the seemingly easy fix of bringing all registered surface and ground water users under one administrative scheme to protect flows, many of the statutory fixes would require seemingly politically unpopular policy choices. These politically unpopular policy choices would also include limiting the amounts of water users can withdraw, imposing mandatory water conservation and efficiency measures, and imposing impervious cover restrictions and groundwater recharge requirements on developers and municipalities. However, these policy choices become more politically acceptable when citizens become informed about the economic importance of ensuring the protection of natural flow regimes in their rivers. They also become more politically feasible when citizens become educated about the importance of baseflow contributions to streams, and about how all water users and entities effecting natural flow regimes should share the burden of maintaining their river's the natural flow regimes, instead of just the ground and surface water withdrawers that withdraw their water fifty feet from a river and its tributaries.

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286. *See supra* notes 252-256 and accompanying text.
287. *See supra* notes 258-261 and accompanying text.
288. *See supra* notes 268-273 and accompanying text.
289. *Id.*

Aside from amending the instream flow legislation to ensure adequate comprehensiveness in regulating all entities effecting flow and to plug the administrative inefficiencies and gaps, and aside from increasing spending to develop protective flows and implement the legislation, there are additional and complementary legal and policy avenues that can be utilitzed to protect flows. The public trust doctrine can be a litigation tool or legislative tool to adequately protect natural flow regimes because it protects New Hampshire's rivers "for the use and benefit of all [of New Hampshire's public], for all useful purposes," including the protection of water quality and public health, water storage, navigation, travel, swimming and other forms of recreation, bathing, fishing, skating, fowling, cutting ice, and aesthetics.[290] The paramount right of New Hampshire to reasonably protect its rivers for public trust public purposes, extends to the protection of groundwater and surface water contributions, because protected natural flow regimes are critical components of water quality, fishing, recreation, and current and future public needs such as economic welfare.[291]

As demonstrated by New Hampshire's ability to use the public trust doctrine to enact its instream flow and groundwater legislation without legally taking a property interest or having to justly compensate water users,[292] the state could, and should attempt to use the public trust doctrine to impose statewide impervious surface regulations on new and existing urban developments, and to impose statewide recharge and infiltration regulations on municipality stormwater systems and urban areas. Theoretically, under a watershed approach to protecting natural flow regimes, both water users and municipalities with impervious surface cover are water users in that their behavior and activities impact natural flow regimes. Thus, the state could and should regulate both via the public trust doctrine to adequately reduce their impacts on the flows necessary to protect public trust resources. Although one could make legal arguments to impose these impervious surface restrictions and recharge requirements on municipalities under the public trust doctrine, litigation would seemingly be a last resort due to a number of factors including: political pressures on the courts; the case by case costs of hydrological models and studies to demonstrate baseflow contributions to streams from urban areas before and after impervious surface and recharge zone requirements; and the fact that protected flows do not exist for thirteen rivers.

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290. Concord Mfg. Co. v. Robertson, 25 A. 718, 721 (N.H. 1890). *See also* Sundell v. Town of New London, 409 A.2d 1315, 1319 (1979); Hartford v. Town of Gilmanton, 146 A.2d 851, 853 (1958); State v. George C. Stafford & Sons, Inc., 105 A.2d 569, 572 (1954); State v. Sunapee Dam Co., 50 A. 108, 108 (N.H. 1901).

291. Stafford & Sons, 105 A.2d at 573. *See also* In re Town of Nottingham, 904 A.2d 582, 589 (2006).

292. N.H. REV. STAT. ANN. §481:1 (2008); Opinion of the Justices, 649 A.2d 604, 609 (1994)..

Other policy options exist in addition to using the public trust doctrine to fix the current gaps in New Hampshire's instream flow regulations and to help maintain flow regimes through restoring baseflow contributions stolen by impervious urban development. The state should explore the use of CWA NPDES permits for municipalities and industrial stormwater discharge as a means to promote baseflow recharge through best management practices ("BMPs") in developments.[293] Some of these BMPs include designing urban developments to limit impervious surfaces, using grassy swales in place of curbs, and constructing stormwater retention ponds and groundwater recharge zones.[294] Another possible avenue to force municipalities to restore baseflow contributions from groundwater, would be for the NHDES to establish and incorporate a total maximum daily load ("TMDL")[295] for stormwater runoff from urban areas in basin plans under the CWA, which could it could incorporate into CWA § 402 NPDES stormwater permits.[296] The TMDL would limit the storm water flow that could enter streams, and the basin plans designed to achieve the TMDL would leave it up to municipalities to find creative and cost efficient BMPs to curb stormwater runoff and promote groundwater recharge.

Whether the state adequately addresses administrative deficiencies in the instream flow regulations or uses additional legal or policy tools to protect the natural flow regimes, one or the other, or a combination of both are necessary to protect the ecological integrity of New Hampshire's rivers and streams. Not only is New Hampshire's wildlife, fishermen, citizens who recreate on the rivers, and its naturalists relying on the establishment of flow regulations that are protective of the natural flow regimes necessary to sustain a river's organisms during their critical bioperiods, but all of New Hampshire's citizens have a significant economic stake in ensuring that its rivers receive flows to maintain its stream's ecological integrity. The standalone fact that a significant part of New Hampshire's economy relies on the ecosystem services that healthy and functioning river ecosystems provide[297] should provide the New Hampshire legislature with strong enough policy considerations and political support to plug the holes in its instream flow regulations, or to take other measures that sufficiently protect and restore the natural flow regimes of its rivers.

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293. *See* 33 U.S.C. § 1342(p) (2008). *See also* 33 U.S.C. § 1314(e) (2000).

294. *See generally* UNITED STATES ENVTL. PROT. AGENCY, REDUCING STORMWATER COSTS THROUGH LOW IMPACT DEVELOPMENT (LID) STRATEGIES AND PRACTICES 2-3 (2007), *available at* http://www.epa.gov/owow/nps /lid/costs07/documents/reducingstormwatercosts.pdf.

295. 33 U.S.C. § 1313(d)(1)(D) (2000).

296. *Id.* § 1342(p).

297. *See supra* Part II.