The greening of water law:

Managing Freshwater Resources for People and the Environment

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United Nations Environment Programme

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1 UNESCO – International Hydrological Programme is UNESCO's international scientific cooperative programme in water research, water resources management, education and capacity-building.

List of Acronyms

CBD	Convention on Biological Diversity
CMS	Convention on the Conservation of Migratory Species
DALYs	Disability-adjusted Life Years
EIA	Environmental Impact Assessment
GWD	Groundwater Directive
IGRAC	International Groundwater Resources Assessment Centre
IIL	Institute of International Law
ILC	International Law Commission
MDGs	Millennium Development Goals
MEAs	Multilateral Environmental Agreements
POPs	Persistent Organic Pollutants
SADC	Southern African Development Community
UNCCD	United Nations Convention to Combat Desertification
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNESCO-IHP	United Nations Educational, Scientific and Cultural Organization — International Hydrological Programme
UNFCCC	United Nations Framework Convention on Climate Change
UN-HABITAT	United Nations Human Settlements Programme
WFD	Water Framework Directive
WHO	World Health Organization

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Foreword

One of the central challenges facing many governments, communities and companies is how to bring sustainability to the management of freshwater resources in order to meet the needs of a growing global population while sustaining flows to the 'ecological infrastructure' that often supplies that water in the first place.

Freshwater resources are among the 11 sectors being addressed under UNEP's Green Economy Initiative which are central to the delivery of resource-efficient, 21st century economies within the goal of sustainable development. They also form a central pillar in The Economics of Ecosystems and Biodiversity (TEEB) which UNEP hosts and which dovetails with the Green Economy work.

Transforming laws and policies to reflect the multiple benefits of more intelligent freshwater management will be among the keys to addressing the challenges and realising the opportunities.

This publication, *The Greening of Water Law: Managing Freshwater Resources for People and the Environment*, cites many examples at both the national and international level that others may wish to consider.

Namibia's Water Resources Act requires consideration of environmental effects during the application for water abstraction and effluent discharge permits. The Act also empowers the country's water minister to establish 'safe yields' when determining the use of aquifers.

Paraguay's Water Resources Act ranks the water needs of aquatic ecosystems as second only to humans and ahead of water for agriculture, power generation and industrial uses.

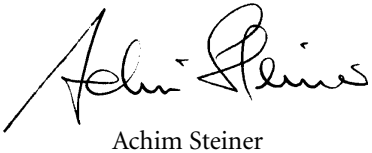
In California, the State's Director of Fish and Game is obligated to prepare stream flow requirements to maintain the viability of fish and wildlife resources.

The Swiss Water Protection Act prescribes water protection targets and minimum flow figures for different average flow rates, which take into account the geographic and ecological function of the water bodies.

The Armenian Water Code highlights the protection of aquatic ecosystems and addresses both current but and future human freshwater needs.

Costa Rica has mandatory payments for ecosystem services structured within its water legislation.

The ability of six billion people, rising to over nine billion by 2050, to thrive let alone survive will depend in no small part on how freshwater resources are managed over the coming years and decades. The greening of water law is in many ways the first step towards realising these essential and decidedly urgent goals.



Achim Steiner
Executive Director,
United Nations Environment Programme

Executive Summary

A central challenge facing nations today is how to ensure that both people and the natural environment have adequate freshwater to sustain and nourish their existence. In many parts of the world, communities actually compete with nature for dwindling supplies, to the detriment of both. Most often, though, water for the environment is not a priority in water management practices, the result of which has gravely impacted the natural environment, especially the aquatic environment.

Water is an inseparable component of life, both human and environmental. It forms a relationship based on the intricacies of both the hydrologic cycle and the interdependencies of all life on Earth. When water resources are degraded, they can impact every form of life, including human life. The challenge, therefore, is to overcome the need for competition and to find ways to harmonize the water requirements of people with those of the natural environment.

'The Greening of Water Law' explores the notion and the benefits of greening water law by presenting and assessing a variety of legal, procedural and policy mechanisms, for both national and international arenas, that can help to elevate the status and importance of environmental concerns in relation to other societal interests and harmonize the water needs of both people and the natural environment.

Potentially, the most effective means for achieving such harmonization is to integrate environmental concerns into national and international water laws and policies. The goal of such integration is to ensure that the water needs of both people and the natural environment are considered collectively and balanced in a way that will further the sustainable use of freshwater resources while maintaining ecosystem integrity.

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other societal interests and harmonize the water needs of both people and the natural environment.

The greening of water law is both a theoretical and practical effort to modernize legal regimes governing the management and allocation of freshwater resources. It is based on the recognition that the life and well-being of people and the natural environment are interrelated and even interdependent and that the coordination of the needs of these two water-dependent stakeholders will further the sustainable use of freshwater resources for both. It is also founded on the notion that by ensuring adequate supplies of clean freshwater for the environment, people, communities, and nations, the human condition can be enhanced through improved health and more sustainable resource exploitation and economic development.

The benefits of incorporating environmental considerations into greening water law at the national level can be manifold and range from economic advantages and social and health benefits, to the more obvious environmental benefits. Moreover, the ability to green water laws is an indispensable tool in realizing the objectives and in meeting the obligations of international agreements and overarching policy agendas such as those expressed in the Millennium Development Goals and in multilateral environmental agreements.

Freshwater ecosystems and their services have been experiencing rapid and tremendous degradation and loss in the past 50 years, destroyed by overuse, pollution and other human activities. This being said, there is mounting evidence that a clean and healthy aquatic environment is advantageous for people and nations in all facets of life, including in economic terms. Nearly 1.8 million children under the age of 5 die annually from diarrheal diseases (such as cholera, typhoid, and dysentery) attributable to a lack of safe drinking water and basic sanitation options. Water pollution also affects the capacity of wetlands to provide significant aesthetic, educational, cultural, and spiritual benefits, as well as a vast array of opportunities for recreation and tourism. There are many examples of the economic value of intact wetlands exceeding that of converted or otherwise altered wetlands. It is therefore evident that a

Freshwater ecosystems and their services have been experiencing rapid and tremendous degradation and loss in the past 50 years, destroyed by overuse, pollution and other human activities.

clean and healthy environment is essential for ensuring not only the integrity of species, habitats, and other aspects of the natural environment, but also for the sustainability and continued progress of people and human communities.

International water law has evolved beyond its people-focused and commerce-based origins and has expanded to address environmental protection issues. It is internationally recognized that cooperation between nations is not only essential for the environmentally sound management of freshwater resources traversing political boundaries, but also an extremely valuable tool for dispute prevention and resolution for riparian States engaged in disagreement over shared waters. There are many examples of internationally accepted legal principles and norms that combine this twofold purpose of environmental protection and peaceful management and allocation of freshwater resources. These include the principle of equitable and reasonable utilization, as well as the general obligation not to cause significant harm across international watercourses and its corollary duty to conduct transboundary environmental impact assessments.

Today, the process of greening water law is also underway at the national level. Although most water laws around the world are still primarily geared towards satisfying human water demand and insufficiently, if at all, address the protection and sustainable use of freshwater resources, an increasing number of countries have taken a different approach to balancing socio-economic development and environmental protection when drafting or reviewing their water related legislation. There is a broad array of examples of mechanisms being employed to strengthen the environmental dimension of domestic laws and regulations. These include environmental criteria for water permit and licenses, pollution prevention and abatement standards, environmental impact assessments requirements, prioritization of water allocations for environmental purposes, minimum instream and environmental flow criteria for rivers, reserved water requirements for specific purposes, groundwater exploitation controls for ensuring the viability of dependant ecosystem, environmentally-sensitive trading systems for water rights, ecosystem services payment schemes, protected areas for water-related purposes, and general environmental perspectives in the overall water legal scheme.

There is a broad array of examples of mechanisms currently employed to strengthen the environmental dimension of domestic laws and regulations.

These examples suggest that a trend in the integration of environmental considerations into water laws and policies is well on its way and that many nations are experiencing the benefits of incorporating environmental considerations into their water laws to realize their developmental and environmental aspirations. However, it is far from universal or comprehensive. Many nations, in both the developed and developing world, have yet to embrace the fundamentals of greening their water laws and many more have yet to recognize the considerable advantages that may emanate from a more integrated and balanced approach to water management. Moreover, because the green approach to water regulation does not always result in immediate societal benefits, governments also face political and economic obstacles in seeking to realign medium and long-term water management strategies rather than providing for the immediate needs of their citizens.

However, many nations, in both the developed and developing world, have yet to embrace the fundamentals of greening their water laws and many more have yet to recognize the considerable advantages that may emanate from a more integrated and balanced approach to water management.

Introduction

According to Pindar, the Greek philosopher, the best of all things is water. It cleanses and soothes, transports and conveys, energizes and delights. Most of all, it nourishes and sustains. Water is also the soul of humanity. Both physically and spiritually, it serves as the foundation upon which people exist. It is truly the best of all things; for in the absence of water, life vanishes.

The state of global freshwater resources is in crisis. Rivers, lakes, aquifers, wetlands, and other water bodies are being strained as human populations swell and economies expand. Both surface and groundwater resources are being depleted and polluted to an extent never before witnessed. And species, habitats, and ecosystems, as well as people and communities around the globe are increasingly suffering for it.

The principal challenge facing nations today is how to ensure that both people and the natural environment have adequate freshwater to sustain and nourish their existence. In many parts of the world, communities actually compete with nature for dwindling supplies, to the detriment of both. Most often, though, water for the environment is a secondary or even non-priority in water management practices, the result of which has gravely impacted the natural environment, especially the aquatic environment.

The principal challenge facing nations today is how to ensure that both people and the natural environment have adequate freshwater to sustain and nourish their existence.

Water is an inseparable component of life, both human and environmental. It forms a relationship based on the intricacies of both the hydrologic cycle and the interdependencies of all life on Earth. When water resources are degraded, they can impact every form of life, including human life. The challenge, therefore, is to overcome the need for competition and to find ways to harmonize the water requirements of people with those of the natural environment.

Potentially, the most effective means for achieving such harmonization is to integrate environmental concerns into national and international water laws and policies. The goal of such integration is to ensure that the water needs of both people and the natural environment are considered collectively and balanced in a way that will further the sustainable use of freshwater resources while maintaining ecosystem integrity.

To stimulate and further this integration, the United Nations Environment Programme (UNEP) has developed this publication to address the status of and process for the incorporation of the environmental dimension of freshwater resources into national and international water laws. It also endeavours to explore the interaction between water law and policy and depict the role of water law as a driver of change with respect to water related environmental policies.

This publication — The Greening of Water Law: Managing Freshwater Resources for People and the Environment — is premised on the notion that water law should become more "green" and that the integration of environmental concerns in national and international water laws and policies will further the sustainable use of freshwater resources while maintaining ecosystem integrity. While described in some detail in the pages that follow, the logic and potential benefits of "greening" water law are not difficult to comprehend and in many cases can even be expressed in economic terms. For example, "the global economic importance of wetlands is highly variable, with an upper value of US$15 trillion,"[2] which, among other ecosystem services, includes purifying water and detoxifying wastes, sequestering carbon, buffering against weather events and climatic changes, and producing fish, wild game, fruits, and grains.[3] Moreover, federal regulations initiated by the Environmental Protection Agency of the United States of America in the area of water have consistently been found to yield much higher annual benefits compared to their annual cost to the economy.[4]

Potentially, the most effective means for achieving such harmonization is to integrate environmental concerns into national and international water laws and policies.

2 Millennium Ecosystem Assessment, Ecosystems and Human Well-Being: Wetlands and Water — Synthesis, World Resources Institute (2005), at p. 34.

3 *Ibid*., at pp. 1-3.

4 See for example the 2010 White House Report to the US Congress on the benefits and costs of federal legislation, available at http://www.whitehouse.gov/omb/inforeg_regpol_reports_congress/.

The purpose of this publication is to serve as a policy tool for decision makers. It is offered as a guide for their use during legislative drafting and development processes and as a resource when they debate policy development and implementation related to freshwater resources. The book, however, is not meant as a detailed "how to" manual. Rather, it offers guidance through examples and recommendations that can be tailored to the unique circumstances at hand.

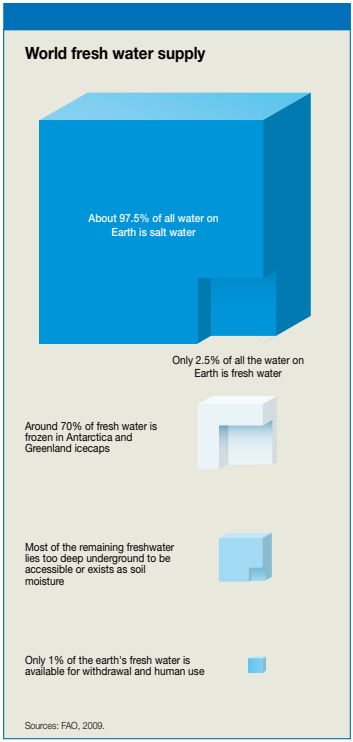
The publication explores the notion of "greening water law" as a means of implementing a more balanced approach for meeting the water needs of both human communities and species and their habitats. It does so by describing the greening process and by assessing the expected advantages and outcomes of integrating environmental concerns into national and international water laws and policies. It aims at presenting and assessing a variety of legal, procedural, and policy mechanisms, for both the national and international arenas, that are designed to elevate the status and importance of environmental concerns in relation to other societal interests competing for water resources. Significantly, the following pages offer a broad array of examples where such devices have already been employed and assess their merits as mechanisms for securing water for both human and environmental purposes. Consequently, many of the mechanisms identified here are based on actual examples that have already been implemented.

Chapter 1:

Water in Crisis: of People and the Environment

Water is an extraordinary resource. It serves multiple sectors, from agriculture to sanitation, industry to households, and, of course, the environment. It drives turbines, irrigates crops, forms habitats, provides recreation, and quenches thirst for every life form on Earth. It crosses frontiers, linking users, communities, and species across both intra-national and international borders in a system of hydrological interdependence, encompassing surface and groundwater resources, glaciers, lakes, and streams, and waters of varying types, qualities, and origins. Found in every ecosystem and biome on the planet, water forms the most fundamental building blocks of life itself.

Freshwater, however, is also a unique and finite resource, and its sustained availability poses one of the most critical modern challenges facing people and the environment globally. Of the 1.4 billion cubic kilometers of water found on Earth, only 2.5%, approximately 37 million cubic kilometres, constitutes freshwater.[5] While still a relatively huge amount, the vast majority of freshwater, around 90 percent, is locked up in the polar ice caps and in deep groundwater reservoirs that, for economic or



Water is the life force of our planet, but only 1 per cent of all the freshwater on Earth (or 0.07% of all water found on the planet) is readily available for human use. Graphic obtained from E. Corcoran, et.al., (eds). *Sick Water? The central role of wastewater management in sustainable development.* A Rapid Response Assessment. UNEP, UN-HABITAT, GRID-Arendal (2010).

5 E. B. Weiss, *The Evolution of International Water Law*, *in* Collected Courses of the Hague Academy of International Law 2007 (2009), at p. 177.

technological reasons, are presently inaccessible. That leaves less than 1/3 of one percent of all water found on Earth to sustain terrestrial life—some 4.3 million cubic kilometres of readily usable groundwater (*i.e.*, accessible and not saline), and a mere 127,300 cubic kilometres of water that is contained in all of the lakes, streams, wetlands, and other surface bodies of freshwater on Earth.[6] Consequently, as voluminous as the supply of Earth's water resources may be, the amount available in a sustained pattern to human societies and the natural environment is relatively minute.

To complicate matters, global freshwater resources are not naturally distributed equitably or in proportion to local populations and growth rates. The accepted poverty line for access to freshwater is 1,000 cubic meters per person per year while a flourishing society is described as enjoying a minimum of 1,700 cubic meters per person per year.[7] Countries whose water resources fall between 1,700 and 1,000 cubic meters per person per year are described as suffering from "water stress" while countries that fall below the 1,000 line are described as experiencing "high water stress" or "chronic water scarcity." The latter category is characterized by chronic water shortages that negatively impact human health, economic development, and general well-being. Below 500 cubic meters per person per year, the level of water stress is considered a serious constraint on human life and development.[8]

More than 40% of the world's population now lives in river basins suffering from moderate water stress; by 2025, that figure will rise to nearly 50%.

As a result of the unequal distribution of global freshwater resources in relation to the location of human settlements, more than 40% of the world's population now lives in river basins suffering from moderate water stress; by 2025, that figure will rise to nearly 50%.[9] Canada, for example, enjoys an enviable annual availability of 91,420 cubic meters of water for each of its

6 H. Bouwer, Groundwater Hydrology (1978), at pp. 2-3; S. McCaffrey, *Seventh Report on the Law of the Non-Navigational Uses of International Watercourses*, at 14, UN Doc. A/CN.4/436 (1991), *reprinted in* [1991] 2 Y.B. Int'l L. Comm'n 13 UN Doc. A/CN.4/SER.A/1991/Add.1 (Part 1).

7 M. Falkenmark, *The Massive Water Shortage in Africa: Why isn't it Being Addressed?* Ambio, Vol. 18 (1989), at pp. 115-116; *see also* M. Falkenmark & C. Widstrand, *Population and Water Resources* Population Bulletin, Vol. 47 (1992), at pp. 2, 19, 25.

8 M. Falkenmark, *Ibid.*, at pp. 115-116; *see also* M. Falkenmark & C. Widstrand, *Ibid.*, at pp. 2, 19 and 25.

9 C. Revenga, et.al., Pilot Analysis of Global Ecosystems: Freshwater Ecosystems, World Resources Institute (2000), at p. 26, *available at* http://pdf.wri.org/page_freshwater.pdf.

32 million citizens, while Algeria, which has a similar sized population, has a mere 440 cubic meters of freshwater per year for each of its citizens.[10] Just nine countries—Brazil, Canada, China, Colombia, Congo, India, Indonesia, Russia, and the United States—account for 60% of the world's freshwater supplies. Moreover, while countries in the Middle East and North Africa are home to 5% of the world's population, they possess less than 1% of the world's usable freshwater resources.[11] By 2030, nearly one-half of the world's population will live in areas suffering from high water stress, most of which will be found in the developing world.[12]

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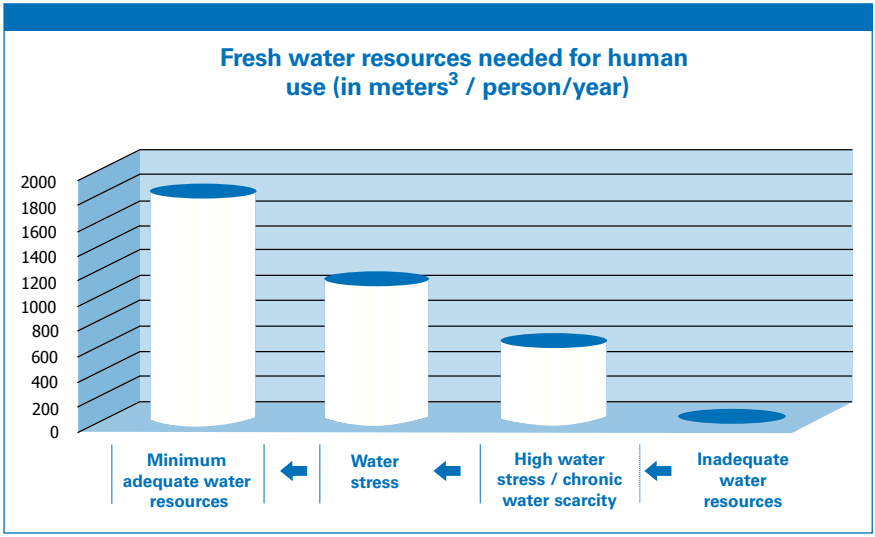


Water Needed to Support Human Life (based on the Falkenmark Water Stress Index).

10 United Nations, Water: A Shared Responsibility—The United Nations World Water Development Report 2 (2006), at p. 132.

11 N.P. Gleditsch, et.al., *Conflicts over shared rivers: Resource scarcity or fuzzy boundaries?* Political Geography, Vol. 25 (2006), at pp. 361-382, 363.

12 D. Michel, *A River Runs Through It: Climate Chance, Security Challenges, and Shared Water Resources*, *in* Troubled Waters: Climate Change, Hydropolitics, and Transboundary Resources (D. Michel and A. Pandya eds., 2009), at pp. 73, 76.

The per capita availability of freshwater globally has declined precipitously as a result of increasing demand due to economic development and growing populations. Between 1800 and 1995, the global per capita availability of water dwindled from an annual 40,000 cubic meters per person to 6,840 cubic meters per person merely as a function of population growth;[13] by 2025, that figure is estimated to decrease to less than 5,100 cubic meters per person.[14]

Regional and local depletion of freshwater resources, however, are also occurring widely. The Nubian Sandstone Aquifer, a fossil aquifer in northern Africa, is being drained at a relatively rapid rate,[15] as are aquifers along the Mexico-United States border.[16] Many countries are exhausting their local resources, including Yemen, a country with meagre freshwater supplies where current water management practices are expected to fully expend the economically viable water resources of the capital city of Sana'a by 2017, and the rest of the country within 50–100 years.[17]

In addition, the Intergovernmental Panel on Climate Change (IPCC) has made it very clear that climate change will have impacts on water and that some of the major challenges to adaptation are related to water resources development and management. Many countries, especially those in the sub-tropics and mid-latitude areas of Central America, southern Europe, northern and southern Africa, and Australia, are projected to experience increased water scarcity.[18] One-sixth of the world population, currently living in snowmelt-fed river basins, will experience increased water shortages due to the reduction of snow cover and subsequent run-off. In Africa, crop yields on rain-fed lands

13 N.P. Gledistch et al., *supra*, n.11, at pp. 361, 363, and United Nations Environment Programme, Vital Water Graphics (2008), *available at* http://www.unep.org/dewa/vitalwater/article28.html.

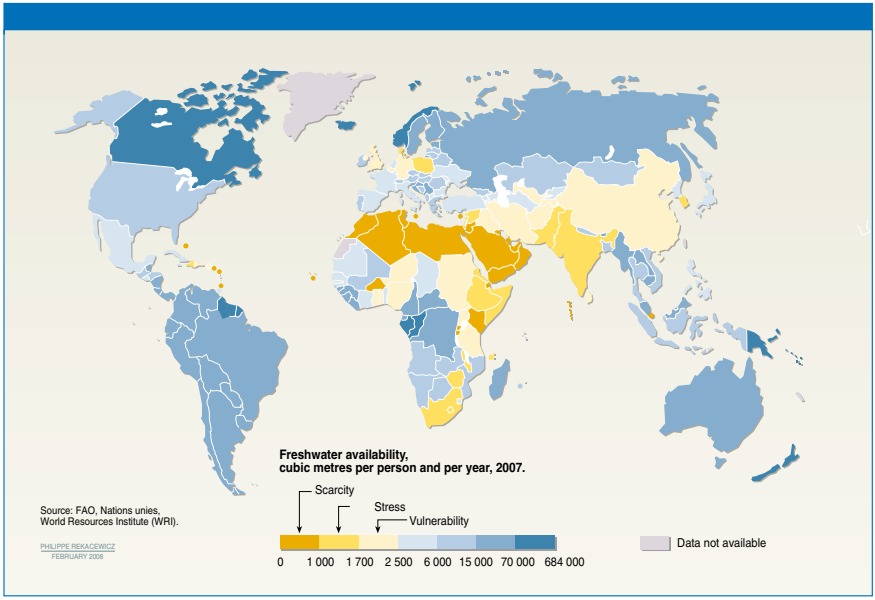
14 N.P. Gledistch et al., *Ibid*., at pp. 361, 363, and United Nations Environment Programme, Vital Water Graphics (2008).

15 A.M. Ebraheem, et. al., *Simulation of Impact of Present and Future Groundwater Extraction from the Non-Replenished Nubian Sandstone Aquifer in Southwest Egypt*, Environmental Geology, Vol. 43 (2002), at p. 188.

16 M. Black and J. King, *The Atlas of Water: Mapping the World's Most Critical Resource*, at p. 26.

17 Hugh Macleod in Wadi Dahr and John Vidal, Yemen threatens to chew itself to death over thirst for narcotic qat plant, The Guardian (26 February 2010), *available at* http://www.guardian.co.uk/environment/2010/feb/26/yemen-qat-water-drought; K. Hudges, *Groundwater Management in Yemen: Legal and Regulatory Issues*, *in* Groundwater: Legal and Policy Perspectives, Proceedings of a World Bank Seminar (Salman M.A., Salman ed., 1999), at p. 133.

18 Intergovernmental Panel on Climate Change [IPCC], Technical Paper on Climate Change and Water, at 32, Doc. IPCC-XXVIII/Doc.13 (8.IV.2008) (Apr. 10, 2008).



Global water stress and scarcity. Graphic obtained from UNEP (2008), Vital Water Graphics - An Overview of the State of the World's Fresh and Marine Waters. Sources: FAO, United Nations, World Resource Institute (WRI), Designer: Philippe Rekacewicz (Le Monde diplomatique), February 2006, http://maps.grida.no/go/graphic/global-waterstress-and-scarcity.

are projected to decline by as much as 50%.[19] In contrast, the IPCC has also warned that the tropics and regions in higher latitudes, such as northern Europe and northern North America, are expected to experience an increase in precipitation.[20]

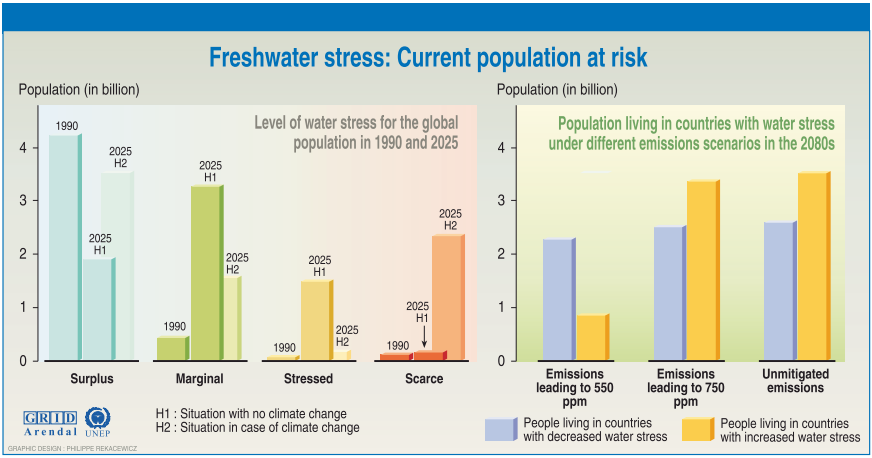
At the same time, scientists predict that the magnitude, frequency, and intensity of the changes in precipitation levels will become more extreme; in other words, floods will become more frequent and violent while droughts will endure for longer periods of time.[21] For example, precipitation in many

19 IPCC, 2007: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, at p. 435.

20 Intergovernmental Panel on Climate Change [IPCC], *supra*, n. 18.

21 Bernhard Lehner et al., *Estimating The Impact of Global Change on Flood and Drought Risks in Europe: A Continental, Integrated Analysis*, 75 Climatic Change 273, 274 (2006); Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, Eds., 2008: Climate Change and Water. Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, at p. 3.

of the regions likely to dry out—including the Mediterranean region and the subtropical western coasts of each continent—will decline by up to 20% and will fall with longer bouts of dry spells between rain events.[22] Moreover, these regions are likely to experience more intense, more frequent, and longer-lasting heat waves.[23] The result will be protracted droughts in many of the world's most populated areas affecting agricultural production, economic development, the environment, human health, population growth, and power generation.[24]



Source: Impacts, adaptations and mitigations of climate change: scientific-technical analyses, contribution of working group 2 to the second assessment report of the Intergovernmental Panel on Climate Change, UNEP and WMO, Cambridge Press University, 1996; Climate change and its impacts, stabilization of CO_2 in the atmosphere, Hardley Centre for Climate Prediction and Research, the meteorological office, London, 1999.

On the other hand, many of the regions expecting an upsurge in precipitation—such as the monsoon region of southern Asia, eastern Africa and the equatorial Pacific Ocean—are projected to endure an annual increase of more than 20% over current rainfall levels.[25] These rains will likely fall in more volatile and intense events over shorter periods of time.

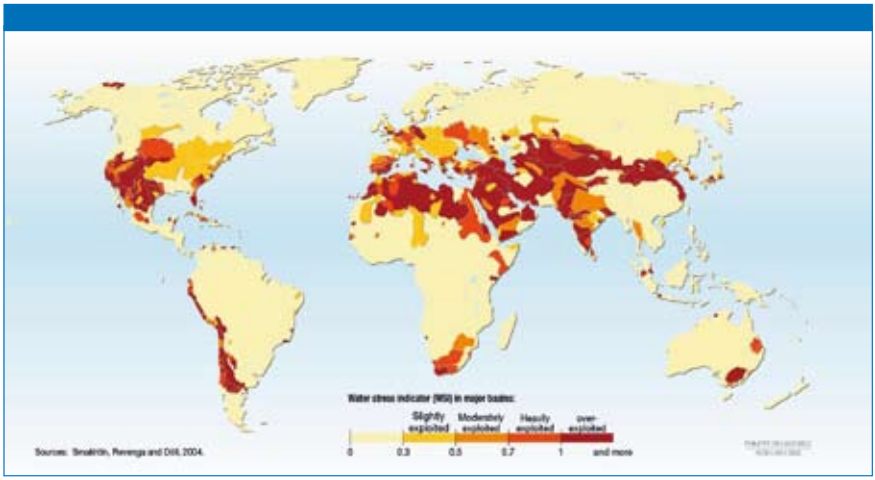
22 Gabriel Eckstein, Water Scarcity, Conflict, and Security in a Climate Change World: Challenges and Opportunities for International Law and Policy, 27 Wisconsin Int'l Law Journal 409 (2010), at pp. 410-412; Intergovernmental Panel on Climate Change [IPCC], Technical Paper on Climate Change and Water, *supra*, n. 18, at p. 33.

23 Gerald A. Meehl et al., Global Climate Projections, in Climate Change 2007: The Physical Science Basis 747 (Susan Solomon et al. eds., 2007), at p. 783.

24 Gabriel Eckstein, Water Scarcity, *supra*, n. 22, at pp. 410-412.

25 Intergovernmental Panel on Climate Change [IPCC], *supra*, n. 18, at p. 33.

Like the drought events noted above, these scenarios also could have serious consequences for agricultural production, economic development, the environment, human health, population growth, and power generation.[26]

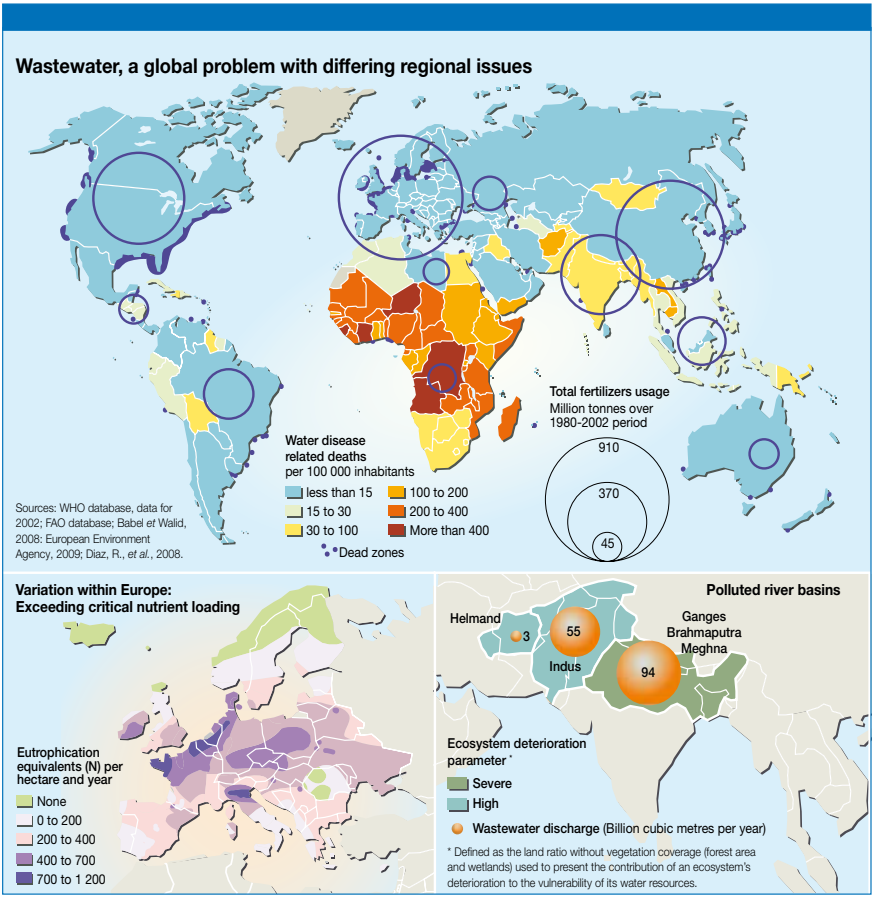


Water Scarcity Index. Graphic obtained from UNEP (2008), Vital Water Graphics - An Overview of the State of the World's Fresh and Marine Waters. Sources: Smakhtin, Revenga and Doll, 2004, Designer: Philippe Rekacewicz (Le Monde diplomatique), February 2006, http://maps.grida.no/go/graphic/water-scarcity-index.

Depletion, however, is not the only threat endangering freshwater resources. As development and populations continue to expand, the integrity of fresh surface and ground water resources globally is being compromised at an astonishing rate as a result of pollution, overuse, and various human activities. Recent data indicates that in most developing countries, a staggering 90% of sewage and 70% of industrial wastes are discharged untreated into watercourses.[27] In northern China, agricultural activities have polluted the region's aquifers, contaminating drinking water supplies with nitrates at levels that, in some areas, exceed the World Health Organization's drinking water guidelines by more than six times.[28] In 2000, 100,000 cubic meters of cyanide-contaminated wastewater spilled into Romania's Szamos and Tisza Rivers, tributaries to the Danube River in Central Europe. Referred

26 Gerald A. Meehl et al., Global Climate Projections, *supra,* n. 23, at pp. 768, 783.
27 M. Black and J. King, *supra,* n.16, at p. 75.
28 P. Sampat, *Deep Trouble: The Hidden Threat of Groundwater Pollution*, Worldwatch Paper No. 154 (J. Peterson ed., 2000), at p. 19, *available at* http://www.worldwatch.org/node/836.

to by scientists as the "wave of death," the pollution plume flowed through Hungary and Serbia and into the Black Sea, destroying 70-80% of flora and fauna along the contaminated rivers, including an endangered European otter population.[29] Unfortunately, these are but a few of the numerous examples of the contamination of global freshwater resources.



Graphic obtained from E. Corcoran, et.al., (eds). *Sick Water? The central role of wastewater management in sustainable development.* A Rapid Response Assessment. UNEP, UN-HABITAT, GRID-Arendal (2010), at p. 18. Sources: WHO database, data for 2002; FAO database; Babel et Walid, 2008: European Environment Agency, 2009; Diaz, R., et al., 2008, Designer: UNEP/GRID-Arendal, http://maps.grida.no/go/graphic/wastewater-a-global-problem-with-differing-regional-issues.

29 J.S. Ferguson, *Hazardous Material and Energy: Cyanide Disaster in Romania Pollutes Eastern European Freshwater,* Colorado Journal of International Environmental Law and Policy, Vol. 12 (2001), at pp. 252-253.

The result of the depletion and degradation of freshwater resources worldwide is now a recognized global crisis. This predicament, which is especially evident in the developing world, has two distinct components, the first affecting people and human development and a second impacting the natural environment.

Water is a fundamental and inseparable component of the environment. It is a natural resource that, even when removed artificially from nature through human endeavor, tends to find its way back to the environment. Hence, when water resources suffer degradation in quality or quantity, they can have profound consequences for the environment. Those impacts, however, do not stop with nature; they impact all life and water-dependent habitats, including people and human societies.

The global water crisis has also had a significant impact on the natural environment and has ecologically stressed numerous species and ecosystems dependant on the availability of water of adequate quantity and quality. Today, nearly 60% of the world's major watercourses have been dammed, effectively fragmenting rivers, blocking their natural flow, and altering or destroying ecosystems and habitats that had depended on the flowing waters for eons.[30] Even in average years, adequate volumes of fresh water no longer reached the deltas of many rivers around the world, including those of the Colorado, Amu Darya and Syr Darya, the Tigris and Euphrates, the Nile, and the Yellow. The lack of flows has resulted in nutrient depletion, shoreline erosion, and the loss of aquatic and riverine habitats for native fisheries and other flora and fauna.[31] In some cases, such as the marshlands of Southern Iraq and the Aral Sea, reduced flows have destroyed once richly diverse and globally unique habitats and spurred desertification.[32]

Today, nearly 60% of the world's major watercourses have been dammed, effectively fragmenting rivers, blocking their natural flow, and altering or destroying ecosystems and habitats that had depended on the flowing waters for eons.

The modification and loss of biodiversity and ecosystems and the propagation of invasive species are some of the most frequent environmental impacts of

30 M. Black and J. King, *supra*, n. 16, at p. 36.

31 P. Gleick, *Global Freshwater Resources: Soft-Path Solutions for the 21st Century*, Science, Vol. 302 (28 November 2003), at pp. 1524-1528.

32 T. Bissell, *Eternal Winter: Lessons of the Aral Sea Disaster*, Harper's Magazine (1 April 2002), at p. 41.

freshwater habitat modification. Most land-based activities, such as agriculture and human settlements, generate pollution, land erosion (causing siltation) and nutrient runoff (causing eutrophication), all of which exert their impacts on inland waters. Nutrient loading is projected to become an increasingly important driver in the next 50 years. Rivers carry most land-based impacts into coastal areas and the oceans, thereby threatening other important ecosystems.33 Chemical pollution, which refers primarily to persistent organic pollutants (POPs) (s.a. mercury and cadmium), also poses especially significant health risks to human and wildlife as these toxins are ubiquitous because of their ability to dissolve in water and travel long distances, adhere to sediments, and be transmitted through the food chain.[34]

The unsustainable use of water is an especially important driver of biodiversity loss, particularly because there are significant competing demands placed on water that are set to increase. Increased human use of freshwater has reduced the amount available to maintain the ecological character of many inland water ecosystems. Over-harvesting of inland waters, including fisheries for food, recreation or trade, is also a major threat and leads to the decline of indigenous species population.

While habitat loss is the primary cause of extinction of freshwater species, the introduction of non-native invasive species is the second most important cause of decline. As exotic species are introduced, for fisheries or for pest control purposes, the productivity and the nutrient cycling of the invaded inland water ecosystem are both altered. Moreover, the invasive species often compete with the indigenous life, resulting in the disruption of the food web.[35]

Of the more than 950 wetland-dependent bird species found around the world, 203 are now threatened with extinction as a result of depleted wetlands and degraded fresh waters.[36] In North America, around 27% of continental freshwater fauna populations are now threatened with extinction as a result of depleted and contaminated freshwater resources. Moreover, in comparison with the fossil record,

33 Leadley, P., Pereira, H.M., Alkemade, R., Fernandez-Manjarrés, J.F., Proença, V., Scharlemann, J.P.W., Walpole, M.J. (2010) Biodiversity Scenarios: Projections of 21st century change in biodiversity and associated ecosystem services. Secretariat of the Convention on Biological Diversity, Montreal. Technical Series no. 50, at p. 29.

34 Guidelines on best available techniques and provisional guidance on best environmental practices relevant to Art. 5 and Annex C of the Stockholm Convention on Persistent Organic Pollutants, 2006, Stockholm Convention Secretariat, Geneva.

35 Revenga, C. and Y. Kura. 2003. Status and Trends of Biodiversity of Inland Water Ecosystems. Secretariat of the Convention on Biological Diversity, Montreal, Technical Series no. 11, at p. 21.

36 M. Black and J. King, *supra*, n. 16, at p. 83.

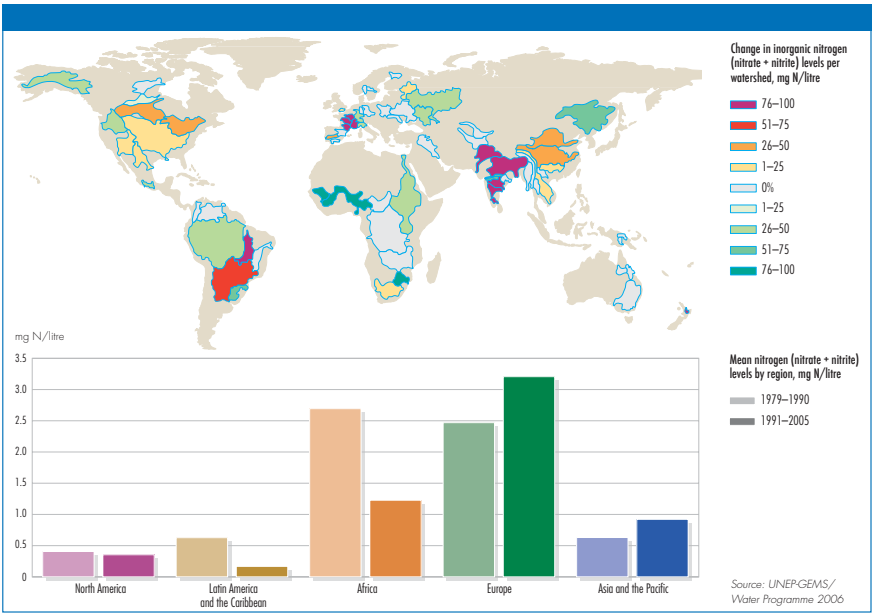
the current extinction rate of North American freshwater fish is 1,000 times the background rate.[37]

Number of Threatened Freshwater Fish in Selected Countries			
	Total Species	Threatened Species	% Threatened
United States	822	120	15
Mexico	384	82	21
Australia	216	27	13
South Africa	94	24	26
Croatia	64	22	34
Turkey	174	22	13
Greece	98	19	19
Madagascar	41	13	32
Canada	177	12	7
Papua New Guinea	195	11	6
Romania	87	11	13
Italy	45	11	24
Bulgaria	72	11	15
Hungary	79	10	13
Spain	50	10	20
Moldova	82	9	11
Portugal	28	9	32
Sri Lanka	90	9	10
Slovakia	62	9	15
Japan	150	9	6

The countries listed here have the greatest number of globally threatened freshwater fish species, and are ordered by threatened species number. The fish faunas of these twenty countries have been evaluated completely, or nearly so. This table was extracted from: Water for People, Water for Life: United Nations World Water Development Report 1 (2003), p. 141.

In so many cases, the state of the environment is directly related to human development and the consequences that economic progress and exponential population growth has inflicted on species and their habitats. Forests have been razed, aquifers have been depleted, and species have been exterminated, all in the name of human progress. The state of the environment, however, is also a function of the competition between people—who need water for drinking, sanitation services, food production, and economic development—and species and ecosystems, which rely on water for their sustained existence. While neither the needs of people or of the environment are necessarily unreasonable, the

37 M. Black and J. King, *Ibid.*, at p. 393, and A. Ricciardi and J.B. Rasmussen, *Extinction Rates of North American Freshwater Fauna*, Conservation Biology, Vol. 13(5) (1999), at pp. 1220-1222.



Organic nitrogen levels per watershed by region, 1979–1990 and 1991–2005. Graphic obtained from 2007 UNEP Global Environment Outlook: environment for development (GEO-4), p.133.

challenge is how to manage and allocate existing freshwater resources in order to meet the needs, and possibly the wants, of both.

The extent of the relationship between the human species and the state of the environment is far better understood today than ever before. There is now increasing appreciation for the complex association between the needs of people and nature as well as the interaction between human activity and the integrity of the natural environment. Nations and communities around the world are recognizing that functioning and healthy ecosystems can provide humanity with a dazzling array of services—foods, medicines, recreational amenities, shoreline protection, waste processing, and carbon sequestration, among others. Hence, there is a growing consensus by people and communities worldwide that the water needs of the natural environment must be considered in societal water management programs and that a minimum amount of freshwater must be set aside to ensure the viability of species, habitats, and ecosystems.

The advantages resulting from ensuring water quality and quantity for the environment can be calculated in both eco-centric and anthropocentric terms. An eco-centric approach to evaluating freshwater resource benefits considers

the resulting impacts from a purely environmental perspective. That perspective regards water as an intrinsic component of the natural environment and assigns humanity no greater claim to clean and freshwater than any other species on the planet.[38] While the soundness and ethical bases of this perspective have been challenged,[39] the recognition that the natural environment greatly benefits from clean and adequate freshwater resources becomes a rather obvious exercise and necessitates no further elaboration.

The advantages resulting from ensuring water quality and quantity for the environment can be calculated in both eco-centric and anthropocentric terms.

Calculating the benefits of ensuring freshwater for the environment from an anthropocentric perspective, however, can be a far more challenging undertaking, requiring clarification, amplification and even the quantification of results in terms that often seem foreign to the characterization of the environment. Under this people-centered approach, the fundamental question is: what advantages will human societies derive by providing clean and adequate freshwater to the surrounding environment? While such an assessment is best pursued on a case-by-case basis in light of unique local factors and characteristics, anthropocentric advantages can be qualified and quantified in relation to, *inter alia*, sustainable development, intergenerational equity, human health, basic human water needs, and even free-market economics.

Sustainable development, for example, is generally described as development that provides for the human needs of both present and future generations while preserving the state of the environment.[40] Expanding on this notion, water management activities—procedures and programs that encompass the use, allocation, conservation, and regulation of freshwater resources—are expected to provide adequate clean freshwater for people and the environment today, as well as ensure the same for generations to come. In practice, it means implementing mechanisms and policies that improve water management and use efficiency, reduce leaks and delivery losses, protect water

38 G. Eckstein, *Precious, Worthless or Immeasurable: The Value and Ethic of Water,* Texas Tech Law Review, Vol. 38 (2005), at pp. 963, 966.

39 For example, see A. Agrawal & K. Redford, *Conservation and displacement: An overview*, Conservation and Society, Vol. 7 (2007), at pp. 1, 8, who assert that "There is no easy way for conservation professionals and organizations to defend conservation when it leads to forcible displacement of humans from areas that are to be protected, even if it is to stave off extinction of several species."

40 The World Commission on Environment and Development (Brundtland Commission 1987).

resources from contamination and overexploitation, and manage and minimize human demand for clean freshwater. Advantages, from the anthropocentric perspective, are evaluated by assessing the extent to which both present and future generations are able to achieve a sustainable rate of development while ensuring the water resources necessary for that continued progress.

To the extent that sustainable development focuses on fairness to both present and future generations in resource management and allocation, the principle is strongly related to the concept of intergenerational equity. This notion essentially mandates equity among all generations, including those yet unborn, in the administration and distribution of natural resources, including freshwater resources. In the context of water and the environment, sustainable development instructs people and societies to relate to and utilize the natural environment, and especially freshwater resources, in ways that do not compromise the potential benefits ensuing to different generations of humanity.

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During the late 1990s, the city of Houston in the United States of America implemented a multi-point conservation program that included retrofitting older buildings with water-efficient fixtures, implementing leak detection systems, increasing block rate fee structures for consumers, and developing an educational campaign that distributed over 10,000 "Water Wise and Energy Efficient" conservation kits. It also implemented a pilot-program to install low-flush toilets and faucet aerators and repair leaks in a low-income housing development in Houston. By 2006, the 12-year program was slated to reduce overall water demand by more than 17 percent and save the city US$262 million. In addition, it was expected to decrease water consumption in participating households by 72 percent and reduce average monthly water and wastewater bills by nearly 80 percent.[41] This latter goal is especially noteworthy because it sought to decrease participants'

There is an undeniable correlation between the availability of freshwater and the quality of human health.

41 U.S. Environmental Protection Agency, Office of Water, Cases in Water Conservation: How Efficiency Programs Help Water Utilities Save Water and Avoid Costs (2002), at pp. 21-23.

compulsory expenses for adequate quantities of clean freshwater while securing their access to life's most basic resource. Although not specifically crafted on principles of sustainable development or intergenerational equity, the program certainly furthered the objectives of both by improving water use efficiency, reducing system losses, reducing the demand for freshwater (thereby saving water for other uses), and expanding access to all generations of Houston's citizens.

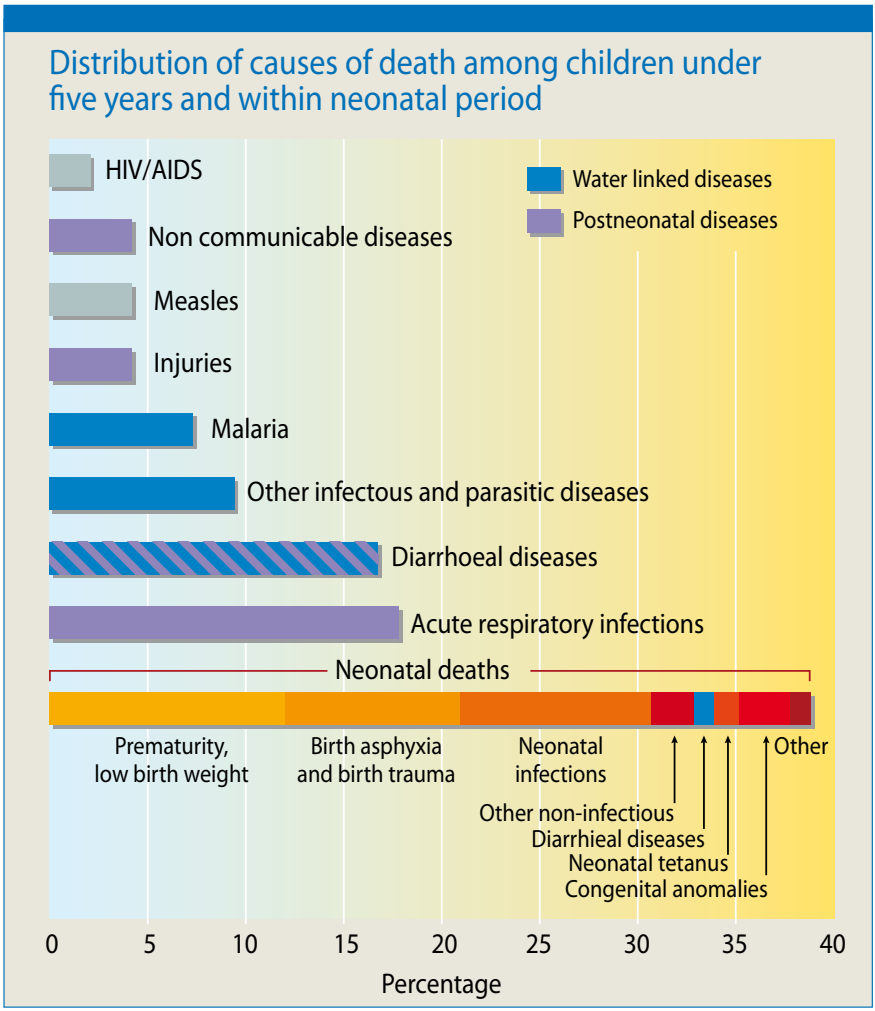

Figure from WHO, 2008. Graphic obtained from E. Corcoran, et.al., (eds). *Sick Water? The central role of wastewater management in sustainable development.* A Rapid Response Assessment. United Nations Environment Programme, UN-HABITAT, GRID-Arendal (2010). Sources: WHO, 2008, Designer: UNEP/ GRID-Arendal, http://maps.grida.no/go/graphic/distribution-of-causes-of-death-among-children-under-five-years-and-within-neonatal-period.

As indicated above, there is an undeniable correlation between the availability of freshwater and the quality of human health.[42] In the Millennium Development Goals (MDGs) adopted by the United Nations General Assembly in the year 2000,[43] the international community has set itself the goal of halving by 2015 the number of people globally without sustainable access to safe drinking water and basic sanitation.[44] While the world appears on track for meeting this goal, many nations continue to struggle to provide clean water for their citizens. Moreover, despite the numerical success, nearly 900 million people today continue to rely on unimproved water sources for their drinking, cooking, and other basic needs.[45] In addition, the figures for clean water for sanitation purposes may be of greater concern. Between 1990 and 2006, an average of 68.75 million people around the world annually gained access to toilets, latrines and other forms of improved sanitation. In order to meet the MDGs, that annual rate will have to more than double to 155.55 million between 2006 and 2015. Today, approximately 2.5 billion people around the world—approximately half the developing world—are unserved by improved sanitation conditions.[46]

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As a result, nearly 1.8 million children under the age of 5 die annually from diarrhoeal diseases (such as cholera, typhoid, and dysentery) attributable to a lack of safe drinking water and basic sanitation options.[47] An additional 37 million are afflicted with onchocerciasis, which can cause severe skin disease, visual impairment and blindness, and can shorten life expectancy by up to 15 years; 50 million suffer from dengue, which results in fever, rashes, and muscle and joint pain; 120 million succumb to lymphatic filariasis, which causes chronic swelling and recurrent secondary bacterial infections; 200 million are infected with schistosomiasis, which damages internal organs, impairs growth and development, and kills 200,000 annually.[48] These human illnesses can all

42 M.A. Montgomery and M. Elimelech, *Water and Sanitation in Developing Countries; Including Health in the Equation*, Environmental Science & Technology, Vol. 41(1) (1 January 2007), at pp. 17-24.

43 United Nations Millennium Declaration, UNGA Resolution A/Res/55/2 (2000).

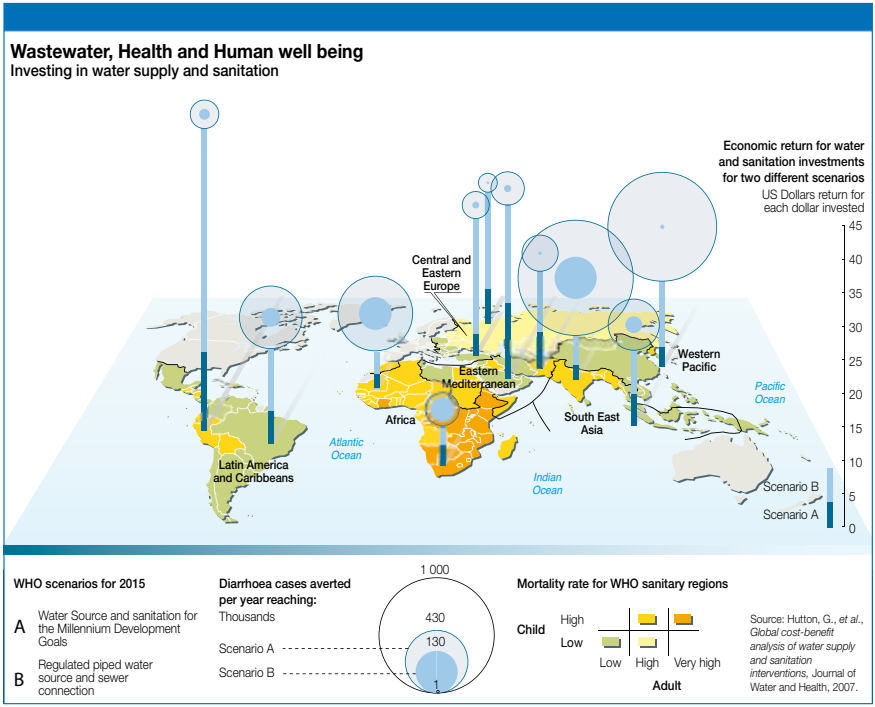
44 Road map towards the implementation of the United Nations Millennium Declaration Report of the Secretary-General, A/56/326, Annex: Millennium Development Goals September 2000 (September 2001), at Goal 7, Target 10, *available at* http://www.unmillenniumproject.org/documents/a56326.pdf.

45 United Nations, The Millennium Development Goals Report 2009, at p. 46, *available at* http://mdgs.un.org/unsd/mdg/Resources/Static/Products/Progress2009/MDG_Report_2009_En.pdf.

46 *Ibid*.

47 UN Development Programme, Human Development Report 2006: Beyond Scarcity: Power, Poverty and the Global Water Crisis (2006), at p. 42.

48 M. Black and J. King, *supra*, n. 16, at pp. 54-55.



Graphic obtained from E. Corcoran, et.al., (eds). *Sick Water? The central role of wastewater management in sustainable development.* A Rapid Response Assessment. United Nations Environment Programme, UN-HABITAT, GRID-Arendal (2010). Sources: Hutton, G., et al., Global cost-benefit analysis of water supply and sanitation interventions, Journal of Water and Health, 2007, Designer: UNEP/GRID-Arendal, http://maps.grida.no/go/graphic/wastewater-health-and-human-well-being-investing-in-water-supply-and-sanitation.

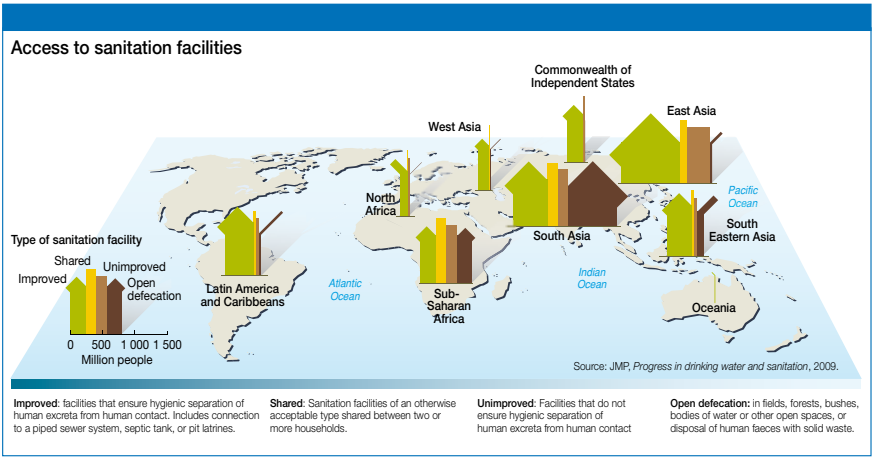
be traced back directly to the inadequate supply of freshwater for drinking and basic hygiene.

The global death burden with respect to water, sanitation, and hygiene related deaths is estimated at 2,213,000 annually, while the global disease burden from the same causes accounts for 82,196,000 DALYs (disability-adjusted life years).[49] By 2020, if nations and the international community fail to take action to improve the availability of freshwater for drinking, sanitation, and hygiene purposes, as many as 135 million preventable deaths are expected to occur.[50] Clean freshwater is therefore critical for ensuring human health into the future.

49 A. Prüss, et al., *Estimating the Burden of Disease from Water, Sanitation, and Hygiene at a Global Level*, Environmental Health Perspectives, Vol. 110(5) (May 2002), at p. 541.

50 P. Gleick, Dirty Water: Estimated Deaths from Water- Related Diseases 2000–2020, Pacific Institute (2002).

Billions of people worldwide, however, have no access to treated water for drinking or for maintaining personal hygiene because of socio-economic barriers or because of local or regional water scarcity. Rather, they rely on water found naturally in rivers, lakes, aquifers, and other sources. Unfortunately, many of these sources are incredibly polluted with human and industrial waste as a result of untreated effluent and unregulated discharges into those water bodies. They can also be tainted by animals and people who walk through, bath in, and even defecate in the water and thereby transmitting diseases into the water and creating a haven for disease-bearing vectors. People downstream of these pollution sources who rely on that particular water body for their daily needs are thereby regularly threatened with serious health problems and even death.



Today, approximately 2.5 billion people around the world lack access to improved sanitation facilities. Graphic obtained from E. Corcoran, et.al., (eds). *Sick Water? The central role of wastewater management in sustainable development.* A Rapid Response Assessment. UNEP, UN-HABITAT, GRID-Arendal (2010). Sources: JMP, Progress in drinking water and sanitation, 2008, Designer: UNEP/GRID-Arendal, http://maps.grida.no/go/graphic/access-to-sanitation-facilities.

Accordingly, the anthropocentric correlation between the health of human societies and adequate clean water for the environment—for example, in the form of secured freshwater flows and the treatment of effluents discharged into rivers, lakes, aquifers and other water bodies—is an easy association to make. Where an adequate flow of clean freshwater is ensured for the environment, it benefits people and communities by enhancing their health and well-being.[51] Minimal flow

51 M.A. Montgomery and M. Elimelech, *Water and Sanitation in Developing Countries; Including Health in the Equation*, Environmental Science & Technology, Vol. 41(1) (1 January 2007), at p. 19.

regimes help to flush rivers and other water bodies and, thereby, take away water-borne bacteria, parasites, and other contaminants that proliferate in standing and slow-moving waters. A recent case study in Indonesia demonstrated that households downstream from watersheds protected by upstream conservation projects experience lower rates of diarrhea compared to households without such watershed services.[52] By ensuring the health of the aquatic environment, populations living along those water bodies are benefiting from improved health and well-being as well as economic potential.

Where an adequate flow of clean freshwater is ensured for the environment, it benefits people and communities by enhancing their health and well-being.

To the extent that ensuring water for the natural environment also provides benefits to people and communities, considerable progress could be made toward accomplishing agreed development objectives. Greater environmental flows will improve conditions for food production as increased flows will allow for the expansion of agricultural activities, such as aquaculture. The state of the environment has, at any given stage, effects on food production through its role in water, nutrients, soils, climate and weather as well as on insects that are important for pollination and regulating infestations. The state of ecosystems also influences the abundance of pathogens, weeds and pests — all factors with a direct bearing on the quality of available cropland, yields and harvests. Without these services, there would be no production. Ecosystem services enhance agro-ecosystem resilience and sustain agricultural productivity. Environmental degradation due to unsustainable human practices and activities now seriously endangers the entire production platform of the planet. The experts argue that, unless more sustainable and intelligent management of production and consumption are undertaken, food prices could, indeed, become more volatile and expensive in a world of six billion rising to over nine billion by 2050 as a result of escalating environmental degradation. Up to 25% of the world food production may become 'lost' during this century as a result of climate change, water scarcity, invasive pests and land degradation.[53]

Greater environmental flows will also reduce the incidence of various water-related diseases — such as cholera, typhoid, malaria, and dengue

52 S. Pattanayak and K.J. Wendland, *Nature's care: diarrhea, watershed protection, and biodiversity conservation in Flores, Indonesia*, Biodoversity Conservation, Vol. 16 (2007), at p. 2814.

53 Nellemann, C., MacDevette, M., Manders, T., Eickhout, B., Svihus, B., Prins, A. G., Kaltenborn, B. P. (Eds). February 2009. The environmental food crisis – The environment's role in averting future food crises. A UNEP rapid response assessment. United Nations Environment Programme, GRID-Arendal, at pp.33 and 34.

fever — thereby enhancing the overall health of communities and decreasing mortality, especially for children and pregnant mothers. In addition, securing a dependable amount of water in watercourses for the environment will allow for the long-term management and more sustainable uses of environmental and natural resources. Finally, by ensuring minimal environmental flows, people and communities along the watercourse could gain greater access to drinking water. A mutually beneficial correlation between water for people and for the environment is also evident in that supplying adequate water resources for one could automatically provide for the other. For example, by ensuring minimal environmental flows in watercourses, governments (whether intentionally or inadvertently) may be able to supply needed freshwater to thirsty communities along the watercourse. Likewise, where the purpose of securing minimum flows is to ensure adequate freshwater for downstream human populations, such as may be required under legal rights to water, it could have a secondary benefit of providing necessary flows for the environment. Regardless of the purpose, the result could be measured in lives saved or, at least, improved human conditions.

Given that capitalism has become the most widely accepted economic model for managing production and distributing wealth globally, free-market economics may serve as the ultimate anthropocentric test for the benefits derived from providing freshwater to the natural environment. The difficulty, until recently, has been in quantifying environmental benefits in monetary terms. Recent progress in environmental economics, including assessment of ecosystem services, has led to the understanding that investing in environment-related projects can produce considerable returns for both investors and the public at large. For example, wetlands have been calculated to provide as much as US$15 trillion in ecosystem services that include water purification and detoxification benefits through their ability to extract and absorb pollutants and harmful substances from contaminated waters.[54] A recent Canadian study of a proposed agricultural project that would have drained freshwater marshes to expand agricultural productivity, revealed a net loss in calculated benefits. The proposal would have yielded private benefits

Wetlands have been calculated to provide as much as US$15 trillion in ecosystem services that include water purification and detoxification benefits through their ability to extract and absorb pollutants and harmful substances from contaminated waters.

54 V. Carter, Technical Aspects of Wetlands: Wetland Hydrology, Water Quality, and Associated Functions, *in* National Water Summary on Wetlands Resources, United States Geological Survey Water Supply Paper 2425 (J.D. Fretwell, et al., Compilers 1996).

for the developers. However, when social benefits of retaining the wetlands, arising from sustainable hunting, angling, and trapping, were calculated, those benefits far exceeded those derived from farming the land, an average of US$5,800 per hectare of wetlands left intact versus US$2,400 per hectare of wetland converted to agriculture.[55]

Water pollution also affects the capacity of wetlands to provide significant aesthetic, educational, cultural, and spiritual benefits, as well as a vast array of opportunities for recreation and tourism. There are many examples of the economic value of intact wetlands exceeding that of converted or otherwise altered wetlands. For instance, recreational fishing can generate considerable income: 35–45 million people take part in recreational fishing (inland and saltwater) in the United States, spending a total of $24–37 billion each year on their hobby. Much of the economic value of coral reefs—with net benefits estimated at nearly $30 billion each year—is generated from nature-based tourism, including scuba diving and snorkeling. Wetlands provide many non-marketed and marketed benefits to people, and the total economic value of unconverted wetlands is often greater than converted wetlands.[56]

As a result of the recognized benefits, municipal governments in various jurisdictions have artificially constructed wetlands to utilize their natural processes for treating wastewater and meeting water quality objectives.[57] In Canicattini Bagni, a Sicilian town in Italy, a recent scientific study recommended replacing an existing waste water treatment plant's secondary treatment section (percolation beds and biofilter) with a constructed wetland. Among others, the benefits revealed by the study included lower electricity consumption, because of the reduced reliance on technology-based treatment processes, and enhanced quantity of recycled freshwater resources available for both human and environmental purposes.[58]

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55 Millennium Ecosystem Assessment, Ecosystems and Human Well-Being: Wetlands and Water — Synthesis, World Resources Institute (2005), at p. 34, *available at* http://www.millenniumassessment.org/documents/document.358.aspx.pdf.

56 Millennium Ecosystem Assessment, Ecosystems and Human Well-Being: Wetlands and Water — Synthesis, World Resources Institute (2005), at p. 2.

57 Constructed Wetlands for Wastewater Treatment and Wildlife Habitat: 17 Case Studies, United States Environmental Protection Agency (1993), *available at* http://www.epa.gov/owow/wetlands/pdf/ConstructedWetlands-Complete.pdf.

58 G. Siracusa and A.D. La Rosa, *Design of a constructed wetland for wastewater treatment in a Sicilian town and environmental evaluation using the emergy analysis*, Ecological Modelling, Vol. 197(3-4) (25 August 2006), at pp. 490-497.

Another example where positive economic results can ensue from ensuring natural freshwater resources pertains to groundwater resources. In addition to providing good quality water through natural and biochemical purification processes, well-functioning aquifers can also serve as storage reservoirs for future use, prevent land subsidence, control and minimize erosion and flooding by absorbing runoff, and serve as medium for waste and other by-products of human economic activity.[59] The city of El Paso for example, which lies in one of the most arid regions of the United States, has for many years used the underlying Hueco Bolson aquifer for storage of municipal effluent water. The effluent is partially treated using modern technologies at the city's wastewater treatment facility and then injected into the aquifer for additional natural purification. As it slowly flows down-aquifer, clean, fresh water again becomes available for withdrawal.[60]

In addition to the economic costs of water-borne illnesses, water pollution incurs significant direct economic costs, from accessing ever-deeper groundwater and improving water treatment facilities, to consumers paying more to buy water from private suppliers.

Pollution generally reduces the availability of water for human use. Chemical pollutants, microbial contamination, increased concentrations of organic matter and elevated nitrates in drinking water can result in health problems, higher water treatment costs, freshwater shortages and loss of large areas of valuable ecosystems, such as the ones supporting fisheries. In addition to the economic costs of water-borne illnesses, water pollution incurs significant direct economic costs, from accessing ever-deeper groundwater and improving water treatment facilities, to consumers paying more to buy water from private suppliers.[61]

In addition, but no less important, there is another potential benefit of securing freshwater for the environment: the possibility of preventing and minimizing conflicts within nations and across international borders. The link between water and nations' security has long been argued as a likely source

59 J.S. Herman, et.al., *Groundwater Ecosystems and the Service of Water Purification*, Stanford Environmental Law Journal, Vol. 20 (2001), at p. 482.

60 Z. Sheng, *An aquifer storage and recovery system with reclaimed wastewater to preserve native groundwater resources in El Paso, Texas*, Journal of Environmental Management, Vol. 74(4) (June 2005), at pp. 368-370.

61 UNEP, 2006. Challenges to International Waters – Regional Assessments in a Global Perspective, United Nations Environment Programme, Nairobi, Kenya, p. 26. see also V. Ratna Reddy and Bhagirath Behera, Impact of water pollution on rural communities: An economic analysis, in Ecological Economics, Volume 58, Issue 3, 25 June 2006, pp. 520-537.

of conflict. In January 2008, while addressing business leaders at the World Economic Forum at Davos, Switzerland, UN Secretary General Ban Ki-moon cautioned that water scarcity could spell an increase in future conflicts, and added that "population growth will make the problem worse. So will climate change. As the global economy grows, so will its thirst. Many more conflicts lie just over the horizon."[62] Similar pronouncements were also made by both of the current Secretary General's immediate predecessors.[63]

Another potential benefit of securing freshwater for the environment: the possibility of preventing and minimizing conflicts within nations and across international borders.

While these assertions should not be accepted as undeniable fact or equated with statistical certainty, conventional wisdom suggests that all peoples and nations have breaking points and may resort to violence when faced with significant water depletion and scarcity.[64] As a result, any action that ensures for people and communities a supply of water that is at least adequate for their basic consumptive and sanitation needs is likely to lessen both human and environmental water stress and, thereby, reduce the likelihood of conflict.

Regardless of the perspective employed for assessing the advantages of ensuring adequate freshwater for the environment, there is a growing acceptance that human societies will accrue benefits from such actions. And where people and communities enjoy an increased quality of life that accompanies improved health and sanitation conditions as well as a reduction in daily water stress, there is hope that other societal circumstances, such as poverty and general conflicts, also will improve.

62 UN News Centre, *At World Economic Forum, Ban Ki-moon Pledges Action on Water Resources*, Jan. 24, 2008, *available at* http://www.un.org/apps/news/story.asp?NewsID=25398&Cr=davos&Cr1.

63 In 2001, Kofi Annan warned that "fierce competition for freshwater may well become a source of conflict and wars in the future." David Michel, *A River Runs Through It: Climate Chance, Security Challenges, and Shared Water Resources*, *in* Troubled Waters: Climate Change, Hydropolitics, and Transboundary Resources, at pp. 73 and 76 (D. Michel and A. Pandya eds., 2009), *available at* http://www.stimson.org/rvproto/partner.cfm?SN=RV200902021934. And in 1985, while serving as Egypt's Minister of State for Foreign Affairs, Boutros Boutros-Ghali presaged that "[t]he next war in the Middle East will be fought over water, not politics." P.J. Vesilind, *Water—The Middle East's Critical Resource*," National Geographic (May 1993), at p. 47. Additionally, Ismail Serageldin, former vice president of The World Bank and first chair of the Global Water Partnership, bluntly declared in 1995 that "If the wars of this century were fought over oil, the wars of the next century will be fought over water." Philip Hirsch, *Governing Water as a Common Good in the Mekong River Basin: Issues of Scale*, 1 Transforming Cultures eJournal 104 (2006), http://epress.lib.uts.edu.au/journals/index.php/TfC/article/view/256/254.

64 Ashok Jaitly, *South Asian Perspective on Climate Change and Water Policy*, *in* Troubled Waters: Climate Change, Hydropolitics, and Transboundary Resources 17 (David Michel & Amit Pandya eds., 2009), at p. 27, *available at* http://www.stimson.org/rvproto/partner.cfm?SN=RV200902021934.

Chapter 2:
The Foundations for a Greening of Water Law

Law and law-making in general cannot be seen in isolation from the particular legal system (e.g. common law or civil law). Importantly, however, legislation cannot be seen in isolation from the present day societal and policy agendas, for it is an essential tool to transform these into action. With regards to water related legislation the effect of unprecedented pressures on the natural environment caused by human activity towards the end of the last century has reshaped these agendas with lasting impact.

Recently, the General Assembly of the United Nations affirmed the "right to safe and clean water and sanitation as a human right that is essential for the full enjoyment of life and all human rights."[65] While the legal impact and value of this Resolution will be debated, it is clear from the statements made by Governments surrounding the vote on the Resolution that the postulate of water as a human right has to be seen against the increasing reality of water scarcity and degradation of water quality in many parts of the world.

Governments and decision-makers are coming under increasing pressure from the public to institute new and innovative policies and strategies to improve the management of freshwater resources.

People, cities, and nations worldwide are now facing growing water crises on both the human and environmental tracks. As a result, governments and decision-makers are coming under increasing pressure from the public to institute new and innovative policies and strategies to improve the management of freshwater resources. In particular, there is a growing sense that people, communities, and nations must learn to live within the natural hydraulic constraints imposed by nature and to develop a more harmonious water relationship with

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65 Draft Resolution A/64/L.63/Rev.1 adopted by the General Assembly on 28 July 2010, at p. 3.

the environment. Decision-makers, however, are also increasingly under pressure to meet the objectives and obligations they have agreed to through the adoption of multilateral environmental treaties and global policy instruments, which have seen an unprecedented development over the past four decades. Aside from the fact that national water legislation must reflect these commitments, it can serve as a powerful tool in meeting them as well. In order to do so, however, it must depart from a focus on supply side regulation and move towards a more holistic form of law making.

One prime example of broad international objectives against which national water legislation can be measured are the Millennium Development Goals (MDGs). These goals constitute international aspirational targets and deadlines intended to improve the human condition globally, especially in the developing world. Among others, these include:

- eradicating extreme poverty and hunger by halving, between 1990 and 2015, the proportion of people who suffer from hunger (Goal 1, Target 2);
- decreasing child mortality by reducing by two-thirds, between 1990 and 2015, the under-five mortality rate (Goal 4, target 5);
- improving maternal health by reducing by three quarters, between 1990 and 2015, the maternal mortality ratio (Goal 5, Target 6);
- combating malaria and other diseases by halting by 2015 and starting to reverse the incidence of malaria and other major diseases (Goal 6, Target 8);
- ensuring environmental sustainability by integrating the principles of sustainable development into country policies and programmes and reversing the loss of environmental resources (Goal 7, Target 9); and
- halving by 2015 the proportion of people without sustainable access to safe drinking water (Goal 7, Target 10).[66]

While the MDGs are all highly interrelated, the majority of them are substantially associated with the availability of adequate and clean freshwater as we have also seen in the preceding chapter.

The objectives of the MDGs also include an affirmation of human rights and sustainable development. Moreover, they correlate with the realization

66 Road map towards the implementation of the United Nations Millennium Declaration Report of the Secretary-General, A/56/326, Annex: Millennium Development Goals September 2000 (September 2001), at Goal 7, Target 10, *available at* http://www.unmillenniumproject.org/documents/a56326.pdf.

of goals and objectives expressed by nations in Multilateral Environmental Agreements (MEAs) that have helped create an ever growing body of legal obligations and goals related to the environment, including water and associated ecosystems. Since the UN Conference on the Human Environment, held in 1972 in Stockholm, the international community has negotiated and adopted many important multilateral environmental agreements ranging from endangered species protection, biodiversity conservation, hazardous waste and chemicals regulation to combating desertification and climate change. Their effective implementation and success hinges, to a large extent, on adequate national legislation and regulation, and this extends to laws governing the use of freshwater resources.[67]

For example, the 1971 Ramsar Convention on Wetlands places an obligation on its 160 Contracting Parties to formulate and implement their planning so as to promote the conservation of wetlands and as far as possible the wise use of wetlands in their territory[68]. As defined by the Parties in a later resolution, wise use of wetlands is "the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development". [69]

Other MEAs also oblige contracting parties to take certain measures that can affect the aquatic environment. For example, the United Nations Convention to Combat Desertification (UNCCD) provides that Parties should work towards the sustainable use of land and scarce water resources and shall "promote cooperation among Parties affected by desertification in the fields of environmental protection and the conservation of land and water resources, as they relate to desertification and drought."[70] Similarly, the UN Framework Convention on Climate Change (UNFCCC) lists among the commitments of its Parties, the duty to cooperate in preparing for adaptation to the impacts of climate change and develop appropriate and integrated plans for coastal zone management, water resources and agriculture, and for the protection

67 See for example Manual on Compliance with and Enforcement of Multilateral Environmental Agreements, United Nations Environmental Programme (2006), available at http://www.unep.org/dec/docs/UNEP_Manual.pdf.

68 1971 Convention on Wetlands of International Importance Especially as Waterfowl Habitat, as amended by the 1982 Paris Protocol and 1987 Regina Amendments, done at Ramsar, on 2 February 1971, Art. 3.

69 Ramsar Resolution IX.1 of the 9th Meeting of the Conference of the Contracting Parties, A Conceptual Framework for the wise use of wetlands and the maintenance of their ecological character, Annex A, para. 23.

70 1994 United Nations Convention to Combat Desertification, done at Paris, on 17 June 1994, at Art. 4(d).

and rehabilitation of areas, particularly in Africa, affected by drought and desertification, as well as floods.[71]

The primary instrument for dealing with the continuing loss of global biodiversity, the Convention on Biological Diversity (CBD) obligates its 193 Parties *inter alia* "to integrate consideration of the conservation and sustainable use of biological resources into national decision-making and to adopt measures relating to the use of biological resources to avoid or minimize adverse impacts on biological diversity."[72] Parties to the Convention have launched an entire programme devoted to the biodiversity of inland waters[73] which states that:

> *inland water ecosystems are often extensively modified by humans, more so than marine or terrestrial systems, and are amongst the most threatened ecosystem types of all. Physical alteration, habitat loss and degradation, water withdrawal, overexploitation, pollution and the introduction of invasive alien species are the main threats to these ecosystems and their associated biological resources.*[74]

"Inland waters" was adopted as a CBD thematic area at the fourth meeting of the Conference of the Parties (COP) in Bratislava, Slovakia. The Convention's inland waters programme promotes the ecosystem approach, including integrated watershed management, as the best way to reconcile competing demands for dwindling supplies of inland waters. It is essential that the maintenance of biodiversity is seen as a critical demand for freshwater use and managed in coordination with other demands. The programme identifies the actions that Parties need to carry out to halt the trend of biodiversity loss, including monitoring, assessment and evaluation of biological diversity of inland water ecosystems, conducting environmental impact assessments of water development projects, development of pollution prevention strategies, choosing and using appropriate technology, and promoting transboundary cooperation, ecosystem-based management and the involvement of local and indigenous communities at all appropriate levels.

71 1992 United Nations Framework Convention on Climate Change, done at New York, on 9 May 1992, at Art. 4.1(e).

72 1992 United Nations Convention on Biological Diversity, done at Rio de Janeiro, on 5 June 1992, Art. 10.

73 Website of Inland Waters Biodiversity, Convention on Biological Diversity, *available at*: http://www.cbd.int/waters/.

74 *Ibid.*

In addition to the agreements listed above the global community has also adopted binding obligations relative to hazardous wastes and chemicals, such as those included in the 1989 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal and the 2001 Stockholm Convention on Persistent Organic Pollutants, all of which impact on the status of water resources as well as on efforts to ensure their sustainable utilization. Other important examples of species-related conventions that are relevant to the conservation of freshwater resources are the 1979 Bonn Convention on Migratory Species (CMS)[75] and the already mentioned Convention on Biological Diversity.

Overall, there is a broad consensus expressed in all these instruments that the management of freshwater resources must be pursued from a holistic approach in order to enhance efficiency, expand the benefits that result from water uses, and meet the objectives expressed in the various MEAs and overarching goals for human development. In large part, this more comprehensive approach considers environmental requirements alongside the interests and needs of people and communities and integrates environmental concerns into the water management decision-making process. Significantly, the approach corresponds to UNEP's Water Policy and Strategy, which endorses "a shift … away from supply-side policies to integrated supply- and demand-management approaches" through "the greater use of economic and social instruments and technological improvements to promote the efficient and equitable use of water." Notably, UNEP's preferred approach is to have nations and international institutions manage demand and "expand[] water services to the poor … with resultant improvements in health care, cost savings and, through environmentally sound management."[76] In short, a clean and healthy aquatic environment is crucial, not only for ensuring the integrity of species, habitats, ecosystems, and other aspects of the natural environment, but also for assuring the sustainability and continued progress of the human species.

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75 1979 Convention on the Conservation of Migratory Species of Wild Animals, done at Bonn, on 23 June 1979.

76 Water Policy and Strategy of UNEP (2007), at p. 22, available at http://www.unep.org/Themes/freshwater/Documents/Water_Policy_Strategy.pdf.

While this policy mandate may be clear, its achievement and sustained success is not effortless. Alternate and entrenched viewpoints, as well as competing priorities, must be overcome and, as always, funding must be secured. Ultimately, though, the linchpin in this effort will be to craft laws, statutes, regulations, and other normative rules for the management of freshwater resources that balance the health and protection of the aquatic environment with the needs and wants of people and societies. Given the historical focus of water management and allocation regimes on water for human endeavors, in most cases this will mean integrating environmental concerns into the water management priorities and decision-making practices. As used in this book, this process of integration can be termed as the "greening of water law".

The greening of water law is both a theoretical and practical effort to implement that harmony through modification of the legal regime governing the management and allocation of freshwater resources. It is based on the recognition that the life and well-being of people and the natural environment are interrelated and even interdependent and that the coordination of the needs of these two water-dependent stakeholders will further the sustainable use of freshwater resources for both. It is also founded on the notion that by ensuring adequate supplies of clean freshwater for the environment, people, communities, and nations, the human condition can be enhanced through improved health and more sustainable resource exploitation and economic development.

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The benefits of greening water law at the national level can be manifold and range from economic benefits to social and health as well as more obvious environmental benefits. The ability to green water laws is an indispensable tool in realizing the objectives and in meeting the obligations of international agreements and overarching policy agendas such as those expressed in the MDGs and in MEAs. It appears noteworthy in this context to highlight again not only the economic value of

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water related ecosystems and their service,[77] which certainly should be pursued but also the positive economic effects holistic environmental legislation can bring to nations' economies.

In practical terms, the greening of water law calls for the implementation of a more holistic approach to the drafting of water related legislation that integrates environmental issues into the decision-making process at both the national and international level of governance. Among other things, this can mean an expansion, or possibly a reinterpretation, of existing legal regimes governing water management and allocation to encompass all hydraulically related water resources. It may also entail implementing laws and regulations that take into account the impacts on the natural environment generally, and water resources specifically, arising from water-related decision-making, including water use administration, pollution management, and resource allocation and exploitation.

Furthermore, the greening of water law requires that decision-makers expand the scope and types of factors that they consider in making water management and allocations decisions. These factors include the hydraulic interdependence and causal relationships among all interrelated water resources, such as rivers, lakes, aquifers, wetlands, glaciers, and other freshwater features and resources. They also include the needs and demands of communities, ecosystems, peoples, and species that are dependent on specific bodies of water. In particular, the water needs of the environment should be considered alongside human-centered water-related needs and wants, such as those for human consumption, sanitation services, agricultural and industrial production, and even recreation and aesthetics.

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77 Ecosystem Services as defined by the Millennium Ecosystem Assessment are "the benefits that people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual religious and other non-material benefits." Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Current State and Trends, Vol. 1, at p. 27.

In addition, the greening of water law requires that the methodology used to assess benefits derived from water management practices be structured so as to recognize the multitude of advantages originating from allocations to the natural environment. Although the notion is conceptually broad enough to allow for both eco-centric and anthropocentric assessment methodologies, the latter approach is likely the more tenable to jurists and legislators in most jurisdictions around the world. As suggested above, implementing a greening process effectively requires that governments and legislatures expand or reinterpret existing legal regimes governing water management and allocation to include environmental concerns in the decision-making process. If pursued rigorously, this process should result in the legal recognition of the water requirements of the environment and even of water-dependent species and habitats. In eco-centric terms, the process could be perceived as affording legal standing to the environment, a notion that has yet to be widely accepted and that most communities and nations may regard as legally indefensible.

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From an anthropocentric perspective, though, the water requirements of the environment can be viewed as a function of the benefits derived for people and communities. To the extent that human beings can obtain advantages from providing freshwater for the environment, legal mechanisms that consider the water needs of the natural environmental become palatable and even desirable for governments and politicians. In contrast to the more egalitarian eco-centric perspective, though, evaluating the benefits from this approach prioritizes human-focused water needs above those of the environment since water is allocated to the environment in relation to the benefits expected to ensue to human societies. As a result, less water may be allotted for environmental purposes than would be provided under an eco-centric approach.

The water needs of the environment should be considered alongside human-centered water-related needs and wants, such as those for human consumption, sanitation services, agricultural and industrial production, and even recreation and aesthetics.

Nonetheless, by recognizing the considerable advantages originating from water management practices that include allocations to the natural environment, as well as by integrating them into the decision-making process related to freshwater management and allocation, species, habitats, and ecosystems would likely receive greater water allotments than they would under most current legal regimes. Moreover, and possibly more important (at least from an anthropocentric viewpoint), greater water allocations to the natural environment will most likely translate into measurable socioeconomic, health, and sustainability benefits for people at the local, regional, national, and global level.

The greening of water law is meant to serve as an approach to ensure the adequate balance of anthropocentric and eco-centric elements in water-related legislation. Some of the mechanisms explored in the following pages have already been commonly recognized as key principles of international law. Others are enjoying widening support across a diverse array of national legal and political landscapes, still others represent very current legal thinking and have only been successfully implemented in a few countries to date. What they all have in common, however, is that they offer means to harness the potential of more balanced water laws at all levels of civil society and thereby to serve as key pillars in humanity's efforts to realize economic and societal development objectives alongside those related to maintaining a healthy and functioning natural resource base for the present and future generations.

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Chapter 3:

The Integration of Environmental Considerations into International Water Law

Water is an international resource. It traverses borders without regard to politics or diplomacy, and in its natural state, abides by no laws other than those compelled by nature. When artificial partitions and management schemes are imposed on freshwater resources, the laws of nature can clash with those of man.

Worldwide, there are over 260 watercourses and more than 270 groundwater basins shared by two or more sovereign States.[78] International watercourses, alone, encompass the territory of at least 145 sovereign States.[79] Of these, twenty-one nations lie in their entirety within an international surface water basin and another thirty-three have more than 95% of their territory within such a basin. Nineteen international surface water basins are shared by five or more riparian (adjacent) sovereign States. For example, the Danube watercourse alone has seventeen riparian sovereign States, while the Congo, Niger, Nile, Rhine, and Zambezi basins are shared by between nine and eleven nations.[80] Similarly, international transboundary aquifers underlie the territory of nearly every non-island nation.[81] While the vast majority of these water bodies lie beneath the territory of two or three States, at least

Given the geographic scope and breadth of global freshwater resources, it is evident that with the exception of most island-nations, nearly every country in the world is hydrologically connected to its neighbor.

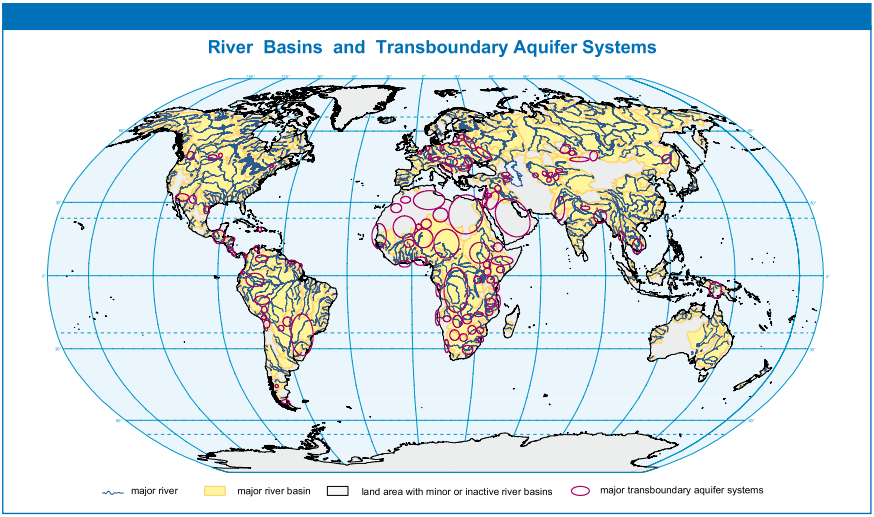
78 S. Puri and A. Aureli, Atlas of Transboundary Aquifers (UNESCO 2009); E. Almássy & Zs. Busás, *Guidelines on Transboundary Groundwater Monitoring, Volume 1: Inventory of Transboundary Groundwaters*, UNECE Task Force on Monitoring & Assessment (1999).

79 *Ibid*.

80 A. Wolf, *Development and Transboundary Waters: Obstacles and Opportunities:* Report submitted to the World Commission on Dams, July, 2000, at p. 30.

81 *Supra*, n. 78, at p. 21.

nine international transboundary aquifers underlie the territory of four to six sovereign States.[82] For example, the Guarani Aquifer in South America, one of the largest aquifers ever discovered, underlies parts of Argentina, Brazil, Paraguay, and Uruguay, while the Chad Basin Aquifer lies beneath portions of the Central African Republic, Cameroon, Chad, Niger, and Nigeria.[83] Given the geographic scope and breadth of global freshwater resources, it is evident that with the exception of most island-nations, nearly every country in the world is hydrologically connected to its neighbor.[84]



Worldwide, there are over 260 watercourses and more than 270 groundwater basins shared by two or more sovereign States. Basins selected, derived and adjusted by Global Runoff Data Centre (GRDC), Koblenz 2007, based on HYDRO1K by USGS; Rivers and lakes by GRDC & WHYMAP 2007; Transboundary Aquifer Systems by WHYMAP 2008. Data source: WHYMAP, (C) BGR Hannover and UNESCO Paris.

Transboundary watercourses and aquifers are today facing an increase in competing demands from both the human and environmental sectors. Nearly half of the world's population now lives within the geographic boundaries of a surface water basin that traverses an international boundary.[85] Approximately the same

82 *Ibid*.
83 *Ibid*., at pp. 153 and 253.
84 G. Eckstein & Y. Eckstein, *A Hydrogeological Approach to Transboundary Groundwater Resources and International Law*, American International Law Review, Vol. 19 (2003), at p. 205.
85 International Bureau of the Permanent Court of Arbitration (ed.), *Resolution of International Water Disputes: Papers emanating from the Sixth PCA International Law Seminar 8 November 2002* (2003), at p. xix.

numbers of people globally obtain their daily domestic freshwater needs from groundwater resources.[86] As a result, transboundary waters are being strained in an effort to meet ever-increasing demand for irrigation, power, navigation, flood control, and recreation, as well as the sustainable preservation of fish, plants, and wildlife. The challenge is to find a balance between water for human and economics-based demands and water for maintaining ecosystem integrity and environmental sustainability.

Although the stress on global water resources has become especially acute in recent generations, international rules for the use of transboundary waters have existed for centuries. Early civilizations, which settled along the world's major river basins, such as the Amazon, Indus, Mekong, Nile, Tigris and Euphrates, used these waters for irrigation and flood control, as well as for travel and transportation. As these societies forged relations with communities in other lands, they developed often complex systems to regulate the navigation, allocation, and use of shared waters among riparian communities and States.[87] These regimes formed the basis of modern international water law.

Today, international water law serves as a tool for nations to employ for the peaceful management and allocation of freshwater resources traversing international political boundaries. In particular, it is intended to serve as both a dispute prevention and dispute resolution mechanism for riparian States engaged in disagreement over shared waters. While substantive principles establish standards and guidelines by which States are to allocate and use transboundary waters, procedural rules offer means for encouraging cooperation and coordination in the management of shared water resources.

Significantly, international water law has also evolved beyond its people-focused and commerce-based origins and has expanded its attention to address other important issues, such as environmental protection. As early as the turn of the last century, a number of international resolutions and bilateral and regional agreements began employing environment-focused language and principles as a way to incorporate environmental concerns into

86 S. McCaffrey, *Seventh Report on the Law of the Non-Navigational Uses of International Watercourses*, at p. 14, UN Doc. A/CN.4/436 (1991), *reprinted in* [1991] 2 Y.B. Int'l L. Comm'n 45, 52 UN Doc. A/CN.4/SER.A/1991/Add.1 (Part 1).

87 G. Eckstein, *Development of International Water Law and the UN Watercourse Convention*, *in* Hydropolitics in the Developing World: A Southern African Perspective (Turton & Henwood, Eds. 2002), at pp. 81-82.

the transboundary legal regime. For example, the 1911 Madrid Declaration on International Regulations Regarding the Use of International Watercourses for Purposes other than Navigation, issued by the Institute of International Law (IIL), prohibited "[a]ll alterations injurious to the water [including] the emptying therein of injurious matter (from factories, etc.)."[88] Similarly, the 1909 Boundary Waters Treaty between Canada and the United States forbade the pollution of "boundary waters and waters flowing across the boundary … on either side to the injury of health or property on the other."[89]

Such notions were founded, in large part, on the recognition that transboundary waters can have implications for both domestic and transboundary habitats and ecosystems, and that the conduct of one State can affect people and the environment across national frontiers. However, these developments are also based on the understanding that in order to manage shared freshwater resources in ways that minimize negative cross-border consequences to both people and the environment, nations and communities must cooperate and coordinate their actions in relation to their transboundary waters.

Through cooperative mechanisms, combined with sincere efforts to integrate environmental concerns into cross-border water management and decision-making, nations sharing transboundary waters will be able to better manage their precious freshwater resources. More importantly, they will become better able to balance the water needs of their societal and economic interests with those of the natural environment. In so doing, they will enhance the health of their citizens and the surrounding environment, as well as further their goals of reducing poverty, increasing human access to freshwater resources, achieving sustainable levels of resource exploitation and economic development, and ensuring equity among the generations.

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88 Madrid Declaration on International Regulations Regarding the Use of International Watercourses for Purposes other than Navigation, Institute of International Law, 24 Annuaire de l'Institut de Droit International (1911), at Art. II.

89 Treaty Between the United States and Great Britain Relating to Boundary Waters, and Questions Arising Between the United States and Canada, 1909, at Art. IV.

The following sections offer examples of international legal principles and norms that either focus directly on ensuring water for the environment, or that incorporate environmental concerns into the implementation of the norm. They also offer recommendations for expanding this greening process and propose additional principles and norms that could appropriately become green. The advantages of integrating environmental considerations are addressed, as well as possible challenges to that process; where available, pertinent treaties and other international instruments are presented.

1. Equitable & reasonable utilization

The principle of equitable and reasonable utilization is broadly accepted as one of the cornerstone principles of international water law.[90] It is a utilitarian concept employing a cost-benefit analysis that seeks to maximize the beneficial uses of freshwater resources while minimizing the burdens.[91] Conceptually, the principle may be regarded as an important precursor of the greening of international water law.

First adopted by the International Law Association in its seminal 1966 Helsinki Rules on the Uses of the Waters of International Rivers (Helsinki Rules),[92] the principle has been formally codified in the 1997 Convention on the Law of the Non-Navigational Uses of International Watercourses (1997 Watercourses Convention),[93] the 2008 Draft Articles by the UN International

90 For example, see Case Concerning the Gabcikovo-Nagymaros Project (Hung. v. Slovk.), 1997 I.C.J. 7 (Sept. 25), at pp. 78, 85, 147 & 150; S. McCaffrey, The Law of International Watercourses 2nd (2007), at pp. 384-385, and J. Lipper, *Equitable Utilization, in* The Law of International Drainage Basins (Garretson, et. al. eds., 1967), at pp. 62–63.

91 J. Lipper, *Equitable Utilization, in* The Law of International Drainage Basins (Garretson, et. al. eds., 1967), at p. 43; *Cf.* D.J. Chenevert, Jr., *Application of the Draft Articles on the Non-Navigational Uses of International Watercourses to the Water Disputes Involving the Nile River and the Jordan River*, Emory International Law Review, Vol. 6 (1992), at p. 506.

92 International Law Association, Rules on the Uses of the Waters of International Rivers, Report of the Fifty-Second Conference, Helsinki, Aug. 20, 1966, at Art. V, *available at* http://www.internationalwaterlaw.org/IntlDocs/Helsinki_Rules.htm.

93 UN Convention on the Law of Non-navigational Uses of International Watercourses, G.A. Res. 51/229, UN GAOR, 51st Sess., UN Doc. A/RES/51/229 (1997).

Law Commission (ILC) on the Law of Transboundary Aquifers,[94] and numerous bi-national and regional agreements.[95]

As articulated in the 1997 Watercourses Convention, the principle of equitable and reasonable utilization requires riparian States to act in both an equitable and reasonable manner when utilizing, developing, or protecting an international watercourse.[96] "Equitable utilization" refers to the fair allocation of benefits that may be derived from the utilization of transboundary waters among the riparian nations.[97] "Reasonable utilization" relates to the proper management of the shared water resource and may be equated with notions of sustainable utilization.[98] What constitutes equitable and reasonable is determined by assessing various factors and circumstances relevant to the watercourse and to the different riparians, paying particular attention to the benefits derived by one acting State and the injury or disadvantage that the action might impose on other basin States.[99] Article 6 of the 1997 Watercourses Convention and Article 5 of the 2008 ILC Draft Articles on the Law of Transboundary Aquifers (ILC Draft Articles) provides non-exhaustive lists of factors that should be assessed when a State or tribunal undertakes such analyses—the former in the context of transboundary watercourses and the latter with regard to the utilization of transboundary aquifers.[100] Among others, factors common to both provisions include the population dependent on the shared water body, the social and economic needs of riparian States, the existing and potential uses of the shared water body, the effects of the utilization of the shared water body on other riparians, and the availability of alternatives to a particular use.

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94 United Nation General Assembly Resolution A/RES/63/124 on the Law of Transboundary Aquifers, adopted by the General Assembly on 11 December 2008.

95 For example, see 1992 UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes, done at Helsinki, 17 March 1992; 2000 Revised Protocol on Shared Watercourses in the Southern African Development Community, done at Windhoek, 7 August 2000; 1995 Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin, done in Chiang Rai, 4 April 1995; 1991 Protocol on Common Water Resources concluded between Argentina and Chile.

96 UN Convention on the Law of Non-navigational Uses of International Watercourses, *supra*, n. 93, at Art. 5.

97 C. Yamada, *Third report on Shared Natural Resources: Transboundary Groundwaters*, UN Doc. A/CN.4/551, at p. 20 (2004).

98 C. Yamada, *Ibid*., at pp. 19 and 21.

99 C.B. Bourne, *Freshwater as A Scarce Resource,* paper delivered at a Panel Discussion at the Canadian Council on International Law Conference, October 1989; X. Hanqin, Commentary-Relativity in International Water Law, Colorado Journal of International Environmental Law & Policy, Vol. 3 (1992), at p. 48, n. 7.

100 UN Convention on the Law of Non-navigational Uses of International Watercourses, *supra*, n. 94, at Art. 6; United Nation General Assembly Resolution A/RES/63/124 on the Law of Transboundary Aquifers, *supra*, n. 94, Annex, at Art. 5.

As originally conceived, the principle of equitable and reasonable utilization was not intended as an environmental mechanism or to produce environmentally-related outcomes. Rather, the focus of the principle was to ensure adequate freshwater flows and to protect freshwater resources for the benefit of humanity. Given the growing recognition that a sound environment can generate considerable advantages for people and communities, the scope of the principle may properly be expanded to incorporate environmental issues.

Such an expansion is especially appropriate for the "equitable utilization" component of the principle, which focuses on benefits derived from the utilization of transboundary waters and then allocated among riparian States. The implementation of equitable utilization, in effect, is an exercise in fairness and justice. Hence, when considering the non-exhaustive list of factors that States should consider when assessing whether a use is equitable, and taking into account notions of fairness and justice, the result could obligate one riparian nation—such as a more developed State—to allot a greater percentage of the waters of a transboundary water resource to another riparian—such as a less developed State—even where the majority of water in that water body originates in the allotting State. Moreover, in an environmental context, fairness and justice also may compel disproportionate allocations of freshwater among riparians to protect fragile or vulnerable species and habitats, as well as to ensure the sustainability of ecosystems, especially where such action will accrue benefits to people.

Given the growing recognition that a sound environment can generate considerable advantages for people and communities, the scope of the principle of equitable and reasonable utilization may properly be expanded to incorporate environmental issues.

The notion of "reasonable utilization" likewise can be understood in relation to environmental considerations and the need of nations to secure adequate amounts of freshwater for the environment. This is especially evident when evaluating the suitability of a particular use in relation to the sustainability of the use. The more likely a use is to be sustainable, the more reasonable the use becomes. Of course, sustainability cannot be interpreted absolutely or purely in terms of time. Rather, States must assess the sustainability of a particular use, *inter alia*, in relation to the projected duration of the use and of the need for the benefits, the availability of the water needed for the use, competing needs for the water, and the impact that the use may have on the

water body. For example, the exploitation of a fossil aquifer, which because of its non-recharging character could never be used sustainably in perpetuity, could be deemed sustainable where the uses and need for the aquifer's waters, as well as the projected lifespan of the aquifer, are determined to be reasonable and acceptable. As noted in Article 4(2) of the ILC Draft Articles, in utilizing a transboundary aquifer equitably and reasonably, aquifer States "shall aim at maximizing the long-term benefits derived from the use of water contained therein."[101] In addition, sustainability can and should be assessed in relation to the effect the use will have on the natural environment. The greater the harm that befalls a species or habitat, the less sustainable—and therefore less reasonable—the use should be deemed. Accordingly, whether a particular utilization of a shared water body is reasonable should also be measured in relation to whether the use is environmentally sound and sustainable.

In addition to the more evident environmental benefits that will ensue from the expansion of the scope of the equitable and reasonable utilization principle, the inclusion of environmental and ecological factors within its span will also result in derivative consequences that should be of interest to all nations, albeit especially to citizens of nations sharing the watercourse.

In addition to the more evident environmental benefits that will ensue from the expansion of the scope of the equitable and reasonable utilization principle, the inclusion of environmental and ecological factors within its span will also result in derivative consequences that should be of interest to all nations, albeit especially to citizens of nations sharing the watercourse. For example, where equity and reasonableness are defined in terms of current and future developmental and national interests (as is implicated by Article 6(1)(e) and (f) of the 1997 Watercourses Convention and Article 5(1)(e) and (f)of the ILC Draft Articles), application of the principle can serve as an important tool in the pursuit of development that is both sustainable and sustained, as well as in ensuring equity among the generations. Moreover, and in more practical terms, by balancing the needs of people in all of the riparian nations as well as with those of the surrounding environment, equitable and reasonable utilization of shared waters can lessen the consequences of water scarcity on human health, poverty, and the ability of communities to meet their basic freshwater requirements. In turn, this could lessen local and regional water

101 United Nation General Assembly Resolution on the Law of Transboundary Aquifers, *supra*, n. 94, Annex, at Art. 4

stress, thereby attenuating tensions related to the use, management, and allocation of transboundary waters.

The scope of equitable and reasonable utilization has, in fact, already been expanded in a number of international instruments to include environmental and ecological factors. The ILC Draft Articles, for example, require consideration of "the role of the aquifer or aquifer system in the related ecosystem" in determining whether a particular use of a transboundary aquifer or aquifer system is equitable and reasonable.[102] Both the 1997 Watercourses Convention and the ILC Draft Articles also oblige riparians to consider the conservation and protection of water resources that are to be utilized.[103] Moreover, in evaluating whether the utilization of a shared watercourse in the Southern African Development Community (SADC) is equitable and reasonable, the Community's 2000 Revised Protocol on Shared Watercourses obligates Watercourse States to consider, among other things, the "geographical, hydrographical, hydrological, climatical, ecological and other factors of a natural character," as well as the "social, economic and environmental needs of the Watercourse States concerned."[104] While the 1997 Watercourses Convention and the ILC Draft Articles include similar factors in their lists,[105] the latter instrument also requires consideration of the "natural characteristics of the aquifer or aquifer system."[106]

2. No significant harm

The general obligation to not cause significant harm across an international border is a fundamental principle of international law and an important norm of international water law.[107] It is based on the Latin maxim *sic utere tuo ut alienum*

102 *Ibid*., at Art. 5.

103 UN Convention on the Law of Non-navigational Uses of International Watercourses, *supra*, n. 94, at Art. 6; United Nation General Assembly Resolution on the Law of Transboundary Aquifers, *supra,* n. 94, Annex, at Art. 5.

104 2000 Revised Protocol on Shared Watercourses in the Southern African Development Community, *supra*, n. 95, at Art. 8.

105 UN Convention on the Law of Non-navigational Uses of International Watercourses, *supra*, n. 94, at Art. 6; United Nations General Assembly Resolution on The Law of Transboundary Aquifers, *supra,* n. 94, at Art. 5.

106 United Nations, United Nation General Assembly Resolution on the Law of Transboundary Aquifers, *supra*, n. 94,
Annex, at Art. 5.

107 S. McCaffrey, *supra,* n. 90, at pp. 406-407; G. Eckstein, *Commentary on the UN International Law Commission's Draft Articles on the Law of Transboundary Aquifers*, Colorado Journal of International Environmental Law & Policy, Vol. 18 (2007), at p. 569; Trail Smelter Arbitration (U.S. v. Canada), 3 R.I.A.A. 1911 (1941).

non laedas, which prohibits the use of one's property in a way that would harm the property of another.[108] Although its genesis as part of international water law can be traced to the origins of the nation-State system, one of the earliest articulations of the principle appeared in the Trail Smelter transboundary air pollution case between Canada and the United States. Convened to consider a dispute over transboundary air pollution, the *ad hoc* tribunal in this case concluded that international law prohibits States from using or permitting the use of their territory in ways that could injure the territory of another nation.[109]

While the harm described in the Trail Smelter case focused on injury from noxious fumes traversing a border, the prohibition against injuring the territory of another nation has been recognized more broadly as a basic principle of international environmental law.[110] It was articulated and described in Article 21 of the Stockholm Declaration of the United Nations Conference on the Human Environment[111] and Article 2 of the Rio Declaration on Environment and Development,[112] and was recognized by the International Court of Justice in its 1996 advisory opinion on the Legality of the Threat or Use of Nuclear Weapons.[113] Moreover, the principle is now regarded as an essential norm of international water law and its meaning and scope have received considerable attention in scholarly literature.[114]

Article 7 of the 1997 Watercourses Convention provides that "Watercourse States shall, in utilizing an international watercourse in their territories, take all appropriate measures to prevent the causing of significant harm to other watercourse States."[115] The Article also provides that in the event that harm is caused by the actions of one watercourse State to another, "the States whose use causes such harm shall, in the absence of agreement to such use, take all appropriate measures … in consultation with the affected State, to eliminate

108 S. McCaffrey, *Ibid*., at pp. 415-419.
109 Trail Smelter Arbitration (U.S. v. Canada), 3 R.I.A.A. 1911 (1941).
110 For example, see D. Hunter, et al., International Environmental Law and Policy 3rd (2007), at pp. 502-504.
111 United Nations Conference on the Human Environment, June 5-16, 1972, Stockholm Declaration of the United Nations Conference on the Human Environment, Principle 21, UN Doc A/CONF.48/14 (June 16, 1972).
112 UN Conference on Environment and Development, Rio de Janeiro, June 3-14, 1992, Rio Declaration on Environment and Development, UN Doc. A/CONF.151/26 (Aug. 12, 1992).
113 Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion, 1996 I.C.J. 226 (July 8), at pp. 29-30.
114 For example, see S. McCaffrey, *supra n.107*, at pp. 406-445, and P.K. Wouters, *An Assessment of Recent Developments in International Watercourse Law Through the Prism of the Substantive Rules Governing Use Allocation*, Natural Resources Journal, Vol. 36 (1996).
115 UN Convention on the Law of Non-navigational Uses of International Watercourses, *supra*, n. 93, at Art. 7.

or mitigate such harm and, where appropriate, to discuss the question of compensation."[116] In similar fashion, the ILC Draft Articles provide language pertaining to harm that may be caused to another aquifer State through the use of a transboundary aquifer.[117] Taking into account the unique characteristics of aquifers, though, the ILC Draft Articles expand the application of the no significant harm principle to activities unrelated to the utilization of the aquifer, but which "have, or are likely to have, an impact on that transboundary aquifer or aquifer system."[118] Examples of such unrelated activities include: industrial and agricultural operations in the recharge zone that might pollute the aquifer; mining activities that could destroy the aquifer matrix and, thereby, its functioning; and construction, forestry, and other activities that might deplete the aquifer by preventing normal recharge.[119]

The principle of no significant harm can be an especially useful tool in addressing and potentially preventing environmental harm related to the utilization of shared waters. Although there is no doubt that harm to people or property falls within the scope of the principle, there is also considerable support within the international community for extending the norm to cover harm befalling species, biological diversity, habitats, and even areas of aesthetic significance.[120] Hence, a number of other international obligations emanate from the no significant harm principle, including the obligation to prevent and abate transboundary water pollution, the obligation to undertake an environmental impact assessment for activities with the potential for transboundary consequences, and the obligation to protect ecosystems, all of which will be addressed separately below.

The principle of no significant harm can be an especially useful tool in addressing and potentially preventing environmental harm related to the utilization of shared waters.

Given the broad scope of the no significant harm principle, it is conceivable that a whole host of cross-border consequences could be actionable under

116 *Ibid*.
117 United Nation General Assembly Resolution on the Law of Transboundary Aquifers, *supra*, n. 94, Annex, at Art. 6.
118 *Ibid*.
119 G. Eckstein, *supra*, n. 107, at fn 135.
120 A. Boyle, *Reparation for Environmental Damage in International Law: Some Preliminary Problems*, *in* Environmental Damage in International and Comparative Law: Problems of Definition and Valuation (Bowman and Boyle, Eds. 2002), at pp. 16, 20-21.

the norm. Nonetheless, the principle's apparent latitude is tempered by the qualification that before an injury can be pursued under the principle, it must rise to the level of "significant" harm. Referring to harm in the context of a watercourse, the ILC asserted that significant harm occurs where the "harm exceed[s] the parameters of what was usual in the relationship between the States that relied on the use of the waters for their benefit."[121] It further described the threshold as "something more than 'measurable,' but less than 'serious' or 'substantial.'"[122] According to the 2000 SADC Revised Protocol, "significant harm" is defined as "non-trivial harm capable of being established by objective evidence without necessarily rising to the level of being substantial."[123] Whether a particular transboundary impact is non-trivial or more than measureable, therefore, will be very case-specific and will greatly depend on a dispassionately developed factual record evidencing the magnitude of the harm.

While not a trifling challenge, the principle of no significant harm can still be an effective green tool of international water law for providing adequate quantities of clean freshwater for the natural environment. In terms of water quantity, detrimental cross-border impacts can manifest in numerous ways. For example, harm to a downstream or adjacent State can be brought about by an upstream or adjacent riparian diverting water from a transboundary watercourse, thereby reducing the flow of water in the watercourse and diminishing the ability of the downstream or adjacent riparian to utilize the water for a particular purpose. The "purpose" in such case could be the use of the water by a riparian State for in-stream flows, ensuring aquatic habitats, or achieving other environmental objectives, as well as for human consumption, sanitation services, or economic development. Likewise, harm to an upstream or adjacent State could occur where a downstream or adjacent State impacts the volume and flow of a watercourse by damming the river just inside its border, thereby causing the resulting reservoir to inundate land of the upstream or adjacent riparian. Here, the negative impact on the environment and territory

121 Report of the Commission to the General Assembly on the Work of its Thirty-Second Session, The Law of the Non-Navigational Uses of International Watercourses, A/CN.4/SER.A/1993/Add.1 (Part 2), *reprinted in* [1993] Yearbook of the International Law Commission, Vol. 2, at 89, at p. 380.

122 *Summary Records of the 2322nd Meeting*, *The Law of the Non-Navigational Uses of International Watercourses*, UN Doc. A/CN.4/L.489, *reprinted in* [1993] Yearbook of the International Law Commission, Vol. 1 at p. 169 and p. 4, UN Doc. A/CN.4/SER.A/1993. The UN International Law Commission also suggested that an adverse effect or harm that is "not negligible but which yet did not necessarily rise to the level of 'substantial' or 'important'" is considered "significant." *Id*. at p. 89 and p. 379.

123 2000 Revised Protocol on Shared Watercourses in the Southern African Development Community, *supra*, n. 95, at Art. 8.

of the upstream or adjacent State may constitute prohibited harm. In addition, an aquifer State can be harmed by the action of another aquifer State where the former withdraws water from the aquifer to the extent that the latter is unable to utilize the aquifer's water for a particular purpose. Again, the "purpose" here could be environmental in nature, such as adequate water for aquatic habitats within an aquifer (as in the case of karst aquifers) or ensuring spring flows for aquifer-dependent ecosystems, to be actionable under the no significant harm principle. The purpose, of course, could also be human-focused as, for example, in the case of aquifer water used for human consumption, agricultural production, or industrial activity.

Yet, even where the purpose of a transboundary water body is identified as environmental in nature, considerable benefits can flow to human communities reliant on the watercourse. For example, the prohibition on significant harm to the natural environment of another national jurisdiction could secure water for downstream communities, if only through required minimum environmental flows, thereby ensuring environmental sustainability and possibly alleviating the human condition along the watercourse.

It is noteworthy that harm related to the natural environment can also be established in relation to changes in water quality. Detrimental cross-border impacts, for example, can occur where harmful contaminants traverse a border through a transboundary watercourse or aquifer, thereby impacting the environment, habitats, species, or dependent ecosystems of another riparian State. To the extent that such contaminants constitute pollution, the obligation to prevent the pollution of a transboundary water body would be captured under the more specific companion rule related to pollution prevention and abatement, discussed in the following section.

3. Pollution prevention and abatement

The pollution of freshwater resources is one of the greatest worldwide human and environmental tragedies today. Studies suggest that water pollution is the leading cause of death and disease worldwide killing as many as 1.7 million people annually.[124] Today, approximately 90% of sewage and 70% of industrial wastes

124 D. Briggs, Environmental pollution and the global burden of disease, British Medical Bulletin, Vol. 68 (2003), at p. 20.

produced in developing countries are discharged untreated into watercourses where they pollute the usable water supply.[125] Every day, some two million tons of human waste is disposed directly into rivers and lakes.[126] As a result, more than one-half of the world's major rivers are either heavily polluted and/or drying up in their lower reaches because of untreated effluent, overexploitation, and mismanagement.[127] In the United States, one of the most industrialized and environmentally-capable nations in the world, 45% of assessed stream miles, 47% of assessed lake acres, and 32% of assessed bay and estuarine square miles were classified as polluted in 2007.[128] Similarly, a 2001 study revealed that 55 of 69 European river stretches were in poor ecological conditions because of canalization, dams, pollution or altered flow regimes, while only the upper sections of the fourteen largest rivers in Europe retain "good ecological status" as required under the EU's Water Framework Directive.[129]

Pollution Type	Main Sources	Adverse Effects
Organic Matter e.g., excreta, food waste, carbon-based substances	Industrial wastewater and domestic sewage	Decomposition leads to oxygen depletion, stressing, or suffocating aquatic life
Toxic Organic Compounds and Micro-Organic Pollutants e.g., PCBs, pesticides, pharmaceuticals, solvents	Industrial, motor vehicles, agriculture, gardeners, municipal waste	Changes in oxygen levels and decomposition rate of organic matter in water, and in biodiversity.
Heavy Metals e.g., cadmium, lead, zinc, copper	Industries and mining sites	Persist in sediments and wetlands. They poison fish and pass down food chain to humans.
Pathogens and Microbes e.g., cryptosporidium, salmonella, shigella	Domestic sewage, livestock	Spread of infectious diseases and parasites.
Nutrients e.g., nitrogen and phosphorus	Run-off from agricultural lands and urban areas, industrial discharge	Over-stimulates growth of algae, which, when they decompose, use oxygen in water, stressing or suffocating aquatic life.

Overview of organic and non-organic pollutants typically found in freshwater systems. This table was derived from: M. Black and J. King, The Atlas of Water: Mapping the World's Most Critical Resource (2009), p. 76.

125 M. Black and J. King, *supra*, *n.16*, at p. 75.
126 Water for People, Water for Life: United Nations World Water Development Report 1 (2003), at pp. 10-11.
127 UNESCO, International Year of Freshwater 2003, *available at* http://www.unesco.org/water/iyfw2/ecosystems.shtml.
128 United States Environmental Protection Agency. The National Water Quality Inventory: Report to Congress, 2002 Reporting Cycle (October 2007), at pp. ES 2-3.
129 *Supra*, n. 126, at p. 144.

The obligation of riparian States to prevent and abate the pollution of transboundary water resources is a derivative principle and specific application of the no significant harm rule. It focuses on harm that traverses an international border solely in the form of pollution, and obligates riparian States to prevent, mitigate, and control this type of harm. To the degree that this norm protects both people and the natural environment from contamination originating from human activity, it can accurately be characterized as a green principle of international water law. Moreover, given its growing presence in dozens of treaties[130] and as the sole focus of many others,[131] the obligation to prevent and abate transboundary water pollution is an emerging, if not already established, customary international legal norm.[132]

The 1911 Madrid Declaration of the Institute of International Law (1911 Madrid Declaration), for example, prohibits "[a]ll alterations injurious to the water [including] the emptying therein of injurious matter (from factories, etc.)."[133] That obligation was substantially refined in the Institute's Athens Resolution of 1979, which focused specifically on pollution of international transboundary rivers and lakes and bound States to "ensure that their activities or those conducted within their jurisdiction or under their control cause no pollution in the waters of international rivers and lakes beyond their

130 For example, see 1992 UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes, *supra,* n. 95; 1994 Convention on Cooperation for the Protection and Sustainable Use of the Danube River, done in Sofia, 29 June 1994; 1994 Mongolia-China Agreement on Protection and Utilization of Transboundary Waters; 1990 Convention between the Federal Republic of Germany and the Czech and Slovak Federal Republic and the European Economic Community on the International Commission for the Protection of the Elbe, done at Magdeburg on 8 October 1990; 1973 Treaty between Uruguay and Argentina concerning the Rio de la Plata and the Corresponding Maritime Boundary, signed in Montevideo on 19 November 1973.

131 For example, see 1998 Convention on the Protection of the Rhine, done at Rotterdam, 22 January 1998; 1978 Great Lakes Water Quality Agreement, Canada & United States of America, 30 U.S.T.S. 1383, T.I.A.S. 9257, amended 1983, T.I.A.S. 10798 (1978); 1975 Swiss/Italian Convention Concerning the Frontier Waters Against Pollution, 1972. Rev. Gen. de Droit Int'l Publ. 265 (1975); 1962 Protocol concerning the establishment of an International Commission to Protect the Mosel against Pollution, done at Paris, 20 December 1961; 1960 Convention on the Protection of Lake Constance Against Pollution, UN Legislative Texts, UN Doc. ST/LEG/SER.B./12 438 (1960).

132 Customary international law refers to international law that is based on accepted State practice rather than codified rules. It emerges from the broad and consistent conduct of States that is justified by a belief that such behaviour is both legally appropriate and mandated. Ian Brownlie, Principles of Public International Law 5th (1998).

133 Madrid Declaration on International Regulations Regarding the Use of International Watercourses for Purposes other than Navigation, Institute of International Law, 24 Annuaire de l'Institut de Droit International (1911), at Art. II.

boundaries."[134] Article V of the latter Resolution further clarifies that "States shall incur international liability under international law for any breach of their international obligations with respect to pollution of rivers and lakes."[135]

Under the more recent articulation of the pollution prevention and abatement norm, the 1997 Watercourses Convention obligates watercourse States to:

> *prevent, reduce and control the pollution of an international watercourse that may cause significant harm to other watercourse States or to their environment, including harm to human health or safety, to the use of the waters for any beneficial purpose or to the living resources of the watercourse.*[136]

The same language is found in the ILC Draft Articles, however, taking into account the unique characteristics of groundwater and the state of knowledge surrounding many transboundary aquifers, the Articles also mandate that "Aquifer States shall take a precautionary approach in view of uncertainty about the nature and extent of a transboundary aquifer or aquifer system and of its vulnerability to pollution."[137]

While not explicitly invoking the pollution prevention and abatement principle, the 2006 decision in *Pakootas v. Teck Cominco Metals* is instructive. In that case, which was heard by the United States Ninth Circuit Court of Appeals, the court imposed U.S. law on a Canadian corporation for the pollution of the Columbia River. Teck Cominco, a smelter operation located in the city of Trail in British Columbia, about 10 miles north of the Canada-U.S. border, had for many decades released heavy metal-laden slag and mercury into the Columbia River, which then flowed down-river into the State of Washington. The court ruled that Teck Cominco's actions of knowingly transmitting the wastes into the Columbia River opened itself to liability under the U.S. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the

134 Athens Resolution on the Pollution of Rivers and Lakes and International Law, International Law Institute, 12 September 1979, at Art. II.

135 *Ibid*., at Art. V.

136 UN Convention on the Law of Non-navigational Uses of International Watercourses, *supra*, n. 93, at Art. 21.

137 United Nation General Assembly Resolution on the Law of Transboundary Aquifers, *supra*, n. 94, Annex, at Art. 12.

U.S. law regulating the cleanup of uncontrolled hazardous waste sites.[138] In so finding, the court actually deemphasized the transboundary character of the Columbia River and based its decision on the knowing release of hazardous pollutants into the watercourse. It asserted that allowing the pollutants to accumulate within the jurisdiction of the United States, Tech Cominco created a domestic pollution scenario that brought the company within the scope of CERCLA.[139] Ultimately, although the case involved a private defendant rather than a governmental actor, by recognizing that the release of pollutants into a watercourse constituted a legal wrong, the court evidenced the growing acceptance of the pollution prevention and abatement principle.

The two linchpins in the application of the pollution prevention and abatement principle are the degree of harm resulting from and the characterization of pollution. Since the pollution prevention and abatement norm is derivative of the no significant harm rule, the same evidentiary standard is typically required to establish the degree of harm resulting from the pollution. For example, both the 1997 Watercourses Convention and the ILC Draft Articles explicitly impose the "may cause significant harm" standard in their provisions related to the prevention, reduction, and control of pollution.[140]

Whether a particular situation of contamination constitutes pollution depends on the origin of the contaminant and whether its mobilization into another State was instigated by human activity. For example, under the 1911 Madrid Declaration, "pollution" is defined broadly to encompass "any physical, chemical or biological alteration in the composition or quality of waters which results directly or indirectly from human action and affects the legitimate uses of such waters, thereby causing injury."[141] Similarly, the 1997 Watercourses Convention refers to "pollution" as "any detrimental alteration in the composition or quality of the waters of an international watercourse which results directly or indirectly from human conduct."[142]

138 Pakootas v. Teck Cominco Metals, Ltd., 452 F.3d 1066 (9th Cir. 2006), *cert. denied*, 128 S.Ct. 858 (2008).
139 *Ibid*.
140 UN Convention on the Law of Non-navigational Uses of International Watercourses, *supra*, n. 93, at Art. 21; United Nation General Assembly Resolution on the Law of Transboundary Aquifers, *supra*, n. 94, Annex, at Art. 12.
141 Athens Resolution on the Pollution of Rivers and Lakes and International Law, *supra,* n. 134, at Art. I.
142 UN Convention on the Law of Non-navigational Uses of International Watercourses, *supra*, n. 93, at Art. 21.

An example of a particularly successful bilateral agreement utilizing the pollution prevention and abatement principle can be found in the 1978 Agreement between Canada and the United States on Great Lakes Water Quality (1978 Great Lakes Agreement). The Agreement provides a very intensive and detailed series of provisions on the prevention of pollution of the Great Lakes, which lie on the border between the two nations. Article II articulates that the purpose of the Agreement is "to restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystem."[143] It further states that to achieve this purpose, the Parties are obligated "to make a maximum effort" to take necessary action designed to "eliminate or reduce to the maximum extent practicable the discharge of pollutants into the Great Lakes System."[144] The treaty further defines general and specific objectives related to the protection of Great Lakes waters and defines water quality standards and programs and measures that must be implemented in furtherance of the objectives.[145]

An example of a particularly successful bilateral agreement utilizing the pollution prevention and abatement principle is the 1978 Great Lakes Agreement.

It is noteworthy, however, that while the Great Lakes are said to hold about 20% of the world's supply of fresh surface water, an important part of the region's water resources is stored underground. Groundwater under the Great Lakes represents a reservoir estimated to be equal in volume to Lake Michigan.[146] However, groundwater was not considered under the Boundary Waters Treaty between the USA and Canada. The treaty covered only surface waters. Groundwater makes a small and limited entry under the Great Lakes Water Quality Agreement, where it receives consideration under Article VI related to "Programs and other measures", in the last paragraph. In this Article and in Annex 16, only *contaminated* groundwater is considered because of the risk of pollution it may cause to the Great Lakes. The Parties are requested to cooperate in developing programs "to control contaminated groundwater affecting the boundary waters of the Great Lakes System" (Annex 16). The concern is therefore on the quality of the waters of the Great Lakes, and not on the groundwater itself. However, this first approach is already an acknowledgement

143 1978 Great Lakes Water Quality Agreement, Canada & United States of America, *supra*, n. 131, at Art. II.
144 *Ibid*.
145 *Ibid*., at Arts. III-VI.
146 Groundwater in the Great Lakes Basin, February 2010, available at http://www.ijc.org/php/publications/pdf/ID1637.pdf.

that surface water and groundwater are inextricably linked in terms of both quantity and quality. Despite these connections, groundwater has received less attention in the Agreement than it should. It is for this reason that the Commissioners of the International Joint Commission, in their 2006 advice to governments regarding the review of the Agreement, noted that groundwater signifies a larger input to the Great Lakes than previously recognized and recommended a number of actions for inclusion in a revised Agreement.[147] It is from the quality angle that groundwater received consideration under the Agreement between the US and Canada, and that its role in the whole Great Lakes system was recognized. The Great Lakes Water Quality Agreement is currently being renegotiated by the Governments of Canada and the United States.[148]

One of the chief mechanisms employed by many international instruments for implementing the pollution prevention and abatement principle is the formulation of water quality standards. Like other aspects of the principle, this mechanism is utilized to prevent the further degradation, as well as encourage the improvement in, the quality of transboundary water bodies. In light of the state of many rivers and lakes worldwide, a 1971 report submitted to the Committee of Natural Resources by the UN Secretary General asserted that "[i]n view of the increasing use of rivers as waste disposal agents ... it seems increasingly necessary that water quality standards for water users in the downstream regions of rivers be established."[149]

The inclusion of water quality standards in international instruments has a long history and has been used as a mechanism for ensuring the integrity of transboundary waters. The early agreements, many of which date back to the 1800s, primarily prohibited water pollution in order to protect fisheries. While they did not define water quality standards explicitly, they established criteria that effectively amount to such standards, such as measures to avoid harm to fish.[150] More recent agreements addressing water quality tend to use greater

147 *Ibid*., Commissioner's Preface.

148 Media Release, June 15, 2010 http://www.ijc.org/rel/news/2010/100615_e.htm.

149 Natural Resources Development and Policies, Including Environmental Considerations. Report of the Secretary-General. Addendum. River Discharges and Marine Pollution, E/C.7/2/Add.8/Rev. 1, 27 January 1971, at p. 329 and p. 335.

150 S. McCaffrey, *Fourth report on the law of the non-navigational uses of international watercourses,* Extract from the Yearbook of the International Law Commission 1988, vol. II(1), A/CN.4/412 and Add.1 & 2 at p. 220, *available at* http://untreaty.un.org/ilc/documentation/english/a_cn4_412.pdf.

details and definitions with regard to the standards, their objectives, and what and how pollutants are regulated.[151] The 1998 Convention on the Protection of the Rhine (1998 Rhine Convention) identifies sustainable development as one of its aims. This goal is to be implemented through:

> *maintaining and improving the quality of the Rhine's waters, including the quality of suspended matter, sediments and groundwater notably by preventing, reducing or eliminating as far as possible pollution caused by noxious substances and by nutrients from point sources (e.g. industry and municipalities) and diffuse sources (e.g. agriculture and traffic)—including that from groundwater—and pollution from shipping …*[152]

Toward this aim, the 1998 Rhine Convention provides that the Parties "shall be guided," *inter alia,* by the precautionary principle, the principle of preventive action, the polluter-pays principle, and the principle of not increasing damage.[153]

A more detailed and specific example, the 1978 Great Lakes Agreement establishes in its Annex 1 specific concentration standards for various pesticides including Aldrin and DDT, metals like arsenic and lead, water quality characteristics such as dissolved oxygen and pH, and a host of other organic, inorganic, radiological, and other pollutants.[154] Significantly, the treaty also provides Canada and the United States with a mechanism for implementing standards more stringent than those included in the Agreement, thereby allowing for the evolution of water quality standards and scientific information.[155]

4. Environmental impact assessment

The central premise underlying the no significant harm principle is the goal of preventing activities in one State, related to transboundary freshwater resources, from causing significant harm across a frontier. To facilitate implementation of the principle, a State proposing a particular project must gather information about the planned scheme and its potential for transboundary harm before the project is undertaken. Otherwise, the norm would only be valued as a rule of liability imposed

151 *Ibid*.
152 1998 Convention on the Protection of the Rhine, *supra,* n. 131, at Art. 3.
153 *Ibid., at Art. 4(a)*.
154 1978 Great Lakes Water Quality Agreement, Canada & United States of America, *supra,* n. 131, at Annex 1.
155 *Ibid*., at Art. IV(a) and Annex 7(2).

ex post facto, once an activity has already resulted in significant harm, rather than an *ex ante* rule for preventing a State's activity from causing significant harm. Accordingly, a corollary principle to the no significant harm rule is the obligation by States to prepare a transboundary Environmental Impact Assessment (EIA) for projects that may result in harmful consequences to fresh waters traversing an international border. Requiring the development of such assessments will enhance the role that environmental issues play in the decision-making process related to freshwater resources. Consequently, implementation of EIAs constitutes a greening of international water law.

The value of preparing an EIA at the international level is in the development of information related to the possible consequences of proposed activities on both the human and natural environments, including transboundary water resources. At the very least, such considerations enhance the decision-making process by providing decision-makers with important information related to the proposed activity. In addition, transboundary EIAs expand the realm of possible actions and consequences to the extent that they include consideration of alternatives and modifications that might minimize negative consequences. Ultimately, while the results of such assessments are rarely dispositive, they do allow for the development of information that might not have otherwise been generated. And information is often the key for developing constructive strategies for overcoming local, regional, and global challenges, such as those identified in the MDGs.

The value of preparing an EIA at the international level is in the development of information related to the possible consequences of proposed activities on both the human and natural environments.

In addition, the use of transboundary EIAs serves the additional advantage of enhancing the ability of decision-makers to assess the various costs and benefits of proposed activities, including the advantages and disadvantages that an activity might impose on shared freshwater resources. Accordingly, insofar as a transboundary EIA provides information on the benefits and impacts of a planned use of a transboundary water body, it also facilitates the implementation of the principle of equitable and reasonable utilization, which relies on a variety of relevant and often project-specific factors by which to judge the equitableness and reasonableness of the proposed utilization. As such, the principle has the potential to further the goals of sustainable development and inter generational

equity, as well as improvements in human health, poverty conditions, and human access to freshwater resources.

The general obligation to prepare an EIA is both well established at the national level and is a recognized doctrine of international law. In the Case Concerning the Pulp Mills on the River Uruguay, the International Court of Justice asserted that:

> *it may now be considered a requirement under general international law to undertake an environmental impact assessment where there is a risk that the proposed industrial activity may have a significant adverse impact in a transboundary context, in particular, on a shared resource.*[156]

The notion has also been incorporated into a number of important international agreements, most notably, in the UN Economic Commission for Europe's 1991 Convention on Environmental Impact Assessment in a Transboundary Context, also known as the Espoo Convention. That accord obligates all States to assess the transboundary environmental impacts of proposed infrastructure projects and to notify and confer with adjacent States about the possible impacts and potential mitigation measures.[157] Similar provisions are found in the Convention on Biological Diversity and the United Nations Convention on the Law of the Sea, albeit tailored to their specific subject matter,[158] as well as in various economic arrangements including the 1989 Lomé Convention,[159] 1993 North American Agreement on Environmental Cooperation, a side agreement to the North American Free Trade Agreement,[160] and project designs funded by multilateral development banks.[161]

While recognizing the imperative of preparing EIAs prior to the commencement of a project, in the Pulp Mills case the International Court of Justice also acknowledged that EIAs are not a one-time obligation but rather dynamic processes that can only be achieved through a series of assessments

156 Case Concerning the Pulp Mills on the River Uruguay, International Court of Justice, Judgment of 20 April 2010, at p. 204; *see also* Separate Opinion of Judge Weeramantry, Case Concerning the Gabcikovo-Nagymaros Project, International Court of Justice, Judgment of 25 September 1997, at p. 112.

157 1991 UNECE Convention on Environmental Impact Assessment in a Transboundary Context, done at Helsinki, 17 March 1992.

158 1992 Convention on Biological Diversity, *supra,* n. 72, at Art. 14; 1982 UN Convention on the Law of the Sea, done at Montego Bay, 10 December 1982, at Art. 206.

159 1989 Fourth Convention of Lomé concluded between the African, Caribbean, and Pacific States and the European Economic Community, at Art. 37.

160 1993 North American Agreement on Environmental Cooperation between the United States, Canada and Mexico, at Arts. 2(e) and 10(7).

161 World Bank Operational Directive 4.00, Annex A: Environmental Assessment (1989).

implemented throughout the life of the projects assessed. The Court stated that "once operations have started and, where necessary, throughout the life of the project, continuous monitoring of its effects on the environment shall be undertaken."[162] This pronouncement harkens back to Justice Christopher Weeramantry's separate opinion in the Case Concerning the Gabcikovo-Nagymaros Project in which Judge Weeramantry expounded on an emerging principle of continuing environmental impact assessment. In that opinion, Judge Weeramantry opined that "[a]s long as a project of some magnitude is in operation, [an environmental impact assessment] must continue, for every such project can have unexpected consequences; and considerations of prudence would point to the need for continuous monitoring.[163] Accordingly, under international law, the obligation to undertake an EIA must be regarded as a process that begins when a proposed activity is suspected of having the potential to cause transboundary environmental harm, and that does not cease until the activity is terminated.

Although an analogous obligation specific to transboundary freshwater resources has yet to appear explicitly in a binding international instrument, the 1992 United Nations Economics Commission for Europe (UNECE) Convention on the Protection and Use of Transboundary Watercourses and International Lakes (1992 UNECE Watercourses Convention) does reference the need for an EIA in Article 3. That provision states that:

> *[t]o prevent, control and reduce transboundary impact, the Parties shall develop, adopt, implement and, as far as possible, render compatible relevant legal, administrative, economic, financial and technical measures, in order to ensure, inter alia, that … environmental impact assessment and other means of assessment are applied.*[164]

Furthermore, the 1997 Watercourses Convention recognizes a number of foundational elements of such an obligation. Article 12 of the Convention requires States planning projects that may result in significant adverse effects on other riparian States to provide those other States with timely advance notification of the proposed activity. It also mandates that "[s]uch notification

162 Case Concerning the Pulp Mills on the River Uruguay, *supra*, n. 156, at p. 205.

163 Separate Opinion of Judge Weeramantry, Case Concerning the Gabcikovo-Nagymaros Project, International Court of Justice, Judgment of 25 September 1997, at p. 111.

164 1992 UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes, *supra*, n. 95, at Art. 3.

shall be accompanied by available technical data and information, including the results on any environmental impact assessment."[165]

Notwithstanding the absence of the obligation in specific water-related agreements, the more general requirements for assessing potential transboundary impact found in the general treaties, such as the Espoo Convention, are still applicable to States that are party to those instruments and that undertake projects related to transboundary freshwater resources. As noted in Annex I of the Espoo Convention, projects covered by the Convention's requirements include dams, reservoirs, large groundwater abstractions, and other activities that could negatively impact shared freshwater resources.[166]

5. Protection of ecosystems

It is now beyond dispute that human activity is posing a significant threat to the existence and sustainability of species and habitats, and overall biological diversity, around the world. Ironically, the loss of that diversity is creating new challenges for human societies as the bounty of nature is strained, polluted, and diminished. Rivers, lakes and aquifers that are contaminated with municipal and industrial waste not only harm susceptible species of animals and plants and biodiversity in general, but can also affect people and communities who are dependent on those resources to meet their freshwater requirements.

Accordingly, many nations and international institutions have justified the protection of various fauna and flora species, as well as their surrounding environments, both because of the intrinsic value of all life on Earth and as a means of ensuring the viability of human progress and development. Moreover, many nations have implemented measures and instruments that place greater importance on ecosystems, habitats, and species and that deemphasize the presence of international borders. This is an especially critical development since ecosystems and habitats rarely conform to political designations and boundaries on maps. For example, in 2000, Albania, Greece, and the Former Yugoslav Republic of Macedonia jointly created Prespa Park as a transboundary protected area encompassing the

165 UN Convention on the Law of Non-navigational Uses of International Watercourses, *supra*, n. 93, at Art. 12.
166 1991 UNECE Convention on Environmental Impact Assessment in a Transboundary Context, *supra*, n. 95, at Appendix I.

two Prespa Lakes and surrounding environment.[167] The main purpose of this action is "the environmental protection and sustainable development of the wider area for the benefit of nature conservation and for the prosperity of its inhabitants and future generations."[168] Similarly, the Great Limpopo Transfrontier Park—which will eventually link the Limpopo National Park in Mozambique, Kruger National Park in South Africa, Gonarezhou National Park, Manjinji Pan Sanctuary and Malipati Safari Area in Zimbabwe, as well as two areas between Kruger and Gonarezhou, totaling an area of 100,000 km^2—will be "managed to optimise benefits for sustainable economic development of local communities and biodiversity conservation."[169]

Other international efforts that focus on ecosystems, habitats, and species while diminishing the relevance of borders include the 1971 Convention on Wetlands of International Importance Especially as Waterfowl Habitat, also known as the Ramsar Convention,[170] the 1995 African-Eurasian Migratory Waterbird Agreement, and the 1979 Convention on the Conservation of Migratory Species of Wild Animals.[171]

As a result of these concerns and efforts, there is now emerging a principle of international law—the obligation of ecosystem protection—that can be regarded as a green international water law mechanism. In effect, the principle obligates States to ensure the viability and sustainability of ecosystems of transboundary freshwater resources. In other words, States must take affirmative steps to protect such ecosystems and to develop plans for protecting and sustaining the broader environment that encompasses transboundary waters. As a corollary, the obligation further requires that in undertaking activities related to transboundary waters, nations

In undertaking activities related to transboundary waters, nations must ensure that their projects and pursuits do not have a detrimental effect on the flora, fauna, and habitats found in transboundary freshwater resources.

167 2000 Declaration on the Creation of the Prespa Park and the Environmental Protection and Sustainable Development of the Prespa Lakes and their Surroundings.

168 Prespa Park page, Prespa Park Coordinating Committee website, at http://www.prespapark.org/pp_establishment .

169 Great Limpopo Transfrontier Park website, at http://www.greatlimpopopark.com/. *See also* 2002 Treaty on the Establishment of the Great Limpopo Transfrontier Park between the Governments of the Republic of Mozambique, the Republic of South Africa, and the Republic of Zimbabwe.

170 1971 Convention on Wetlands of International Importance Especially as Waterfowl Habitat, *supra,* n. 68.

171 1979 Convention on the Conservation of Migratory Species of Wild Animals, done at Bonn, 23 June 1979.

must ensure that their projects and pursuits do not have a detrimental effect on the flora, fauna, and habitats found in transboundary freshwater resources.

As was the case in the principles discussed above, the more obvious benefits of this measure are those ensuing to the natural environment, including environmental sustainability. Likewise, though, derivative benefits to human societies also arise especially where people and communities are reliant on certain ecosystems and species for their livelihood and survival. Hence, to the extent that ecosystems and habitats are preserved, such as through sustained environmental flows, aquaculture and other food production efforts will be enhanced, as will the availability of and access to freshwater for human consumption. This, in turn, will have considerable positive effects on human health and progress and, more generally, will further the realization of the MDGs.

Thus, for example, ecosystem protection provisions are found in Article 20 of the 1997 Watercourses Convention, which obligates riparian States to "protect and preserve the ecosystems of international watercourses,"[172] and in Article 22, which requires that riparian States "take all measures necessary to prevent the introduction of species, alien or new, into an international watercourse which may have effects detrimental to the ecosystem of the watercourse."[173] Similar protections can also be found in other international water-related instruments of significance.[174]

In the case of transboundary groundwater resources, the notion of ecosystem protection is defined in Article 10 of the ILC Draft Articles to reflect the distinctive characteristics of aquifers. Recognizing that the interior of certain aquifers, such as a karst aquifer, can serve as a habitat for unique species, and that some ecosystems may be hydraulically dependent on and yet separate from the aquifer, the provision obligates "Aquifer States [to] take all appropriate measures to protect and preserve ecosystems within, or dependent upon, their transboundary aquifers or aquifer systems."[175] Moreover, to emphasize the obligations and ensure the viability of such

172 UN Convention on the Law of Non-navigational Uses of International Watercourses, *supra*, n. 93, at Art. 20.

173 *Ibid*., at Art. 22.

174 For example, see 1990 Convention between the Federal Republic of Germany and the Czech and Slovak Federal Republic and the European Economic Community on the International Commission for the Protection of the Elbe, done at Magdeburg on 8 October 1990, at Art. 1(2); 1992 UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes, *supra,* n. 95, at Arts. 2(2) and 3(1); 1994 Convention on Cooperation for the Protection and Sustainable Use of the Danube River, *supra,* n. 130, at Arts. 2, 3, 7 and 9; 1998 Convention on the Protection of the Rhine, *supra,* n. 131, at Arts. 2, 3, and 5.

175 United Nation General Assembly Resolution on the Law of Transboundary Aquifers, *supra*, n. 94, Annex, at Art. 10.

ecosystems, the provision includes the commitment by States to "ensure that the quality and quantity of water retained in an aquifer or aquifer system, as well as that released through its discharge zones, are sufficient to protect and preserve such ecosystems."[176]

In addition, while not explicitly characterized as an ecosystem protective measure, Article 11 of the ILC Draft Articles does afford aquifer-dependent ecosystems an additional measure of protection. To the extent that an ecosystem external to an aquifer is dependent on that aquifer, it is actually critically dependent on the discharge process—the volume, flow, and quality of water emanating from the aquifer. Hence, the protections of Article 11 are critical since they require aquifer States to both identify the discharge zones of aquifers within their territory and to "take appropriate measures to prevent and minimize detrimental impacts on the … discharge processes."[177] In so doing, the provision enhances the safeguards afforded to species and habitats dependent on aquifers and, thereby, ensures the sustainability of ecosystems for both human and environmental purposes.

Offering a more explicit emphasis on the human-environment relationship, the Protocol on Water and Health to the 1992 UNECE Watercourses Convention obligates State Parties to:

> *take all appropriate measures for the purpose of ensuring ... effective protection of water resources used as sources of drinking water, and their related water ecosystems, from pollution from other causes, including agriculture, industry and other discharges and emissions of hazardous substances. This shall aim at the effective reduction and elimination of discharges and emissions of substances judged to be hazardous to human health and water ecosystems.*[178]

Developing this relationship in more detail, the 2003 Protocol for Sustainable Development of Lake Victoria Basin to the 1999 Treaty for the Establishment of the East African Community provides in Article 4 (2) that:

> *the management of the resources of the Basin shall be guided by the following principles:*

176 *Ibid*.
177 *Ibid*., at Art. 11.
178 1999 Protocol on Water and Health to the to the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes (1999), *supra*, n. 95, at Art. 4(2)(c)

i. The Principle of prevention, minimization and control of pollution of watercourses so as to minimize adverse effects on freshwater resources and their ecosystems including fish and other aquatic species and on human health;

j. The principle of the protection and preservation of the ecosystems of international watercourses whereby ecosystems are treated as units, all of whose components are necessary to their proper functioning and that they be protected and preserved to the extent possible.[179]

Thereafter, in Article 6 (1) on the Protection and Conservation of the Basin and Its Ecosystems, the Lake Victoria Basin Protocol details the steps that must be pursued:

> *The Partner States shall take all appropriate measures, individually or jointly and where appropriate with participation of all stakeholders to protect, conserve and where necessary rehabilitate the Basin and its ecosystems in particular by:*
>
> *a. Protecting and improving water quantity and quality within the Basin;*
> *b. Preventing the introduction of species, alien or new into the Basin's water resources which may have effects detrimental to the ecosystems of the Lake;*
> *c. Identifying the components of and developing strategies for protecting and conserving biological diversity within the Basin;*
> *d. Conserving migratory species of wild animals;*
> *e. Conserving endangered species of wild fauna and flora;*
> *f. Protection and conserving wetlands within the basin;*
> *g. Restoring and rehabilitating degraded natural resources; and*
> *h. Conserving fisheries resources.*[180]

Protection of ecosystems, and specifically of species and habitats, related to transboundary waters are also found in non-water law instruments that have direct relationship to shared freshwater resources. These documents, most often environmental treaties and related instruments, focus on environmental protection goals that apply directly to aquatic habitats, species, and ecosystems

179 2003 Protocol for Sustainable Development of Lake Victoria Basin, Kenya-Uganda-Tanz., LEX-FAOC041042, at Art. 4(2).

180 *Ibid*., at Art. 6(1)

dependent on surface and groundwater resources. For example, the 1995 African-Eurasian Migratory Waterbird Agreement, which covers 255 species of birds ecologically-dependent on wetlands for at least part of their annual cycle, obligates State Parties to "take co-ordinated measures to maintain migratory waterbird species in a favourable conservation status or to restore them to such a status."[181] Moreover, it requires State Parties to "ensure that a network of suitable habitats is maintained ... throughout the entire range of each migratory waterbird species concerned, in particular where wetlands extend over the area of more than one Party to this Agreement."[182] The Agreement covers wetlands and related ranges in 118 countries, including all of Africa and Europe and south-west Asia.[183]

The 1979 Bonn Convention on the Conservation of Migratory Species of Wild Animals is a framework agreement that encourages States that share the "range" of any migratory species to protect such species through domestic action and cooperation with other "Range States."[184] Under the Convention, a migratory species' "range" is defined as "all the areas of land or water that a migratory species inhabits, stays in temporarily, crosses or overflies at any time on its normal migration route."[185] Clearly, such ranges could include transboundary watercourses. Moreover, under Article III of the Convention, "Range States" must "endeavor … to the extent feasible and appropriate, to prevent, reduce or control factors that are endangering or are likely to further endanger the species …," while Article V encourages such States to conserve and restore "habitats of importance" to migratory species and to "prevent[], reduce[] or control the release into the habitat of the migratory species of substances harmful to that migratory species."[186]

Other noteworthy non-water law international instruments that directly relate to transboundary waters include the 1992 Convention on Biological Diversity[187] and the Ramsar Convention.[188]

181 1995 Agreement on the Conservation of African-Eurasian Migratory Waterbirds, done in The Hague, 16 June 1995, at Art. II.
182 *Ibid.*, at Art. III.
183 *Ibid.*
184 1979 Convention on the Conservation of Migratory Species of Wild Animals, *supra*, n. 171, at Arts. II and III.
185 *Ibid.*, at Art. I.
186 *Ibid.*, at Art. V.
187 1992 Convention on Biological Diversity, *supra*, n. 72.
188 1971 UN Convention on Wetlands of International Importance especially as Waterfowl Habitat, *supra*, n. 68.

6. Minimum instream or environmental flows

As human-kind places greater demands on freshwater resources, it will become more difficult to balance the water needs of human and economics-based demands and those for maintaining ecosystem integrity and environmental sustainability. This is especially true in the transboundary context where multiple jurisdictions often lay claims over frontier waters in excess of the available resource and where international law may be slow to address these competing claims of right. As a result, there is a growing sense among nations and international institutions that a formula must be established that, at the very least, maintains minimum water levels in rivers and lakes to protect the ecological, chemical, and physical integrity of riverine ecosystems. This is the notion of minimum instream or environmental flows.

The idea of ensuring a minimum volume of water in a watercourse is well-established in the domestic laws of many nations worldwide and is now emerging as an international principle of both international environmental and international water law. It recognizes the viability of the watercourse as a protectable interest, albeit often justified by economic and human health reasons as well as on intrinsic environmental principles. Regardless of the rationalization, policy makers at all levels of civil society have realized that, despite the competing demands, society can no longer allow rivers to be fully appropriated and, thereby, to run dry. Indeed, considerable benefits derive from the very existence of free-flowing rivers. In addition to environmental benefits, such as species and habitat protection, advantages can flow to water-borne commerce and transportation activities, commercial fishing ventures, tourism and recreational endeavors, and sewage and effluent treatment operations. These, in turn, can have significant impact on the human condition and the achievement of the MDGs. Accordingly, to ensure the viability of these water flow-dependent activities, watercourses must be assured minimum flows.[189]

The idea of ensuring a minimum volume of water in a watercourse is well-established in the domestic laws of many nations worldwide and is now emerging as an international principle of both international environmental and international water law.

189 A.E., Utton and J. Utton, International Law of Minimum Stream Flows, Colorado Journal of International Environmental Law and Policy, Vol. 10(1) (1999), at , pp. 7-37.

Historically, water flow in international watercourses, flowing between nations or along their borders, was regulated primarily for ensuring navigation, energy production, and commercial fisheries, as well as for preventing or minimizing flooding and floating logs. For example, the 1815 General Treaty of the Final Act of the Congress of Vienna provides in Article 113 that:

> *Each State bordering on the rivers shall be responsible for keeping in good repair the Towing Paths which pass through its territory, and for maintaining the necessary works throughout the same extent in the channels of the river, in order that no obstacle may be experienced to the navigation.*[190]

More directly, Article 3 of the 1964 Agreement Concerning Frontier Watercourses between the former Soviet Union and Finland provided that the "Parties shall ensure that the main fairways of frontier watercourses are kept open for the free flow of water and for transport, timber floating and the passage of fish."[191] This latter Agreement also included broader flow requirements intended to ensure that frontier watercourses were not harmed "by untreated industrial effluents and sewage, ... harmful changes in the composition of the water, damage to the fish stock or substantial scenic deterioration or [usages that] might endanger public health or have similar harmful consequences for the population and the economy."[192]

More recent arrangements, however, have recognized the importance of minimal flows for protecting the integrity of the natural environment. The 1995 Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin, for example, mandates minimum and acceptable natural flow requirements, in part, to "protect, preserve, enhance and manage the environmental and aquatic conditions and maintenance of the ecological balance exceptional to this river basin."[193] It specifically calls for the "maintenance of flows ... [o]f not less than the acceptable minimum monthly natural flow" of water in the Mekong River Basin, as well as flows "[t]o enable the acceptable natural reverse flow of the Tonle Sap to take place during the wet season."[194]

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190 1815 General Treaty of the Final Act of the Congress of Vienna, at Art. 113.
191 1964 (Finland-U.S.S.R.) Agreement Concerning Frontier Watercourses.
192 *Ibid.*
193 1995 Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin, *supra*, n. 95, at Preamble.
194 *Ibid.*, at Art. 6.

Another example is the Instream Flow Requirement Policy of the Lesotho Highlands Water Project—the product of negotiations between Lesotho Highlands Development Authority, the World Bank, and the Governments of Lesotho and South Africa. The Policy, which comports with the environmental and social commitments under the Lesotho-South Africa treaty for the Project,[195] establishes the principle, among others, that "releases of water from the dams shall be optimised to meet environmental criteria and community user requirements."[196] Significantly, the Policy also emphasizes monitoring downstream impacts related to instream flows and providing for "mitigation and compensation by payment for resource losses and increased risks, and flow release adjustments, in accordance with clearly articulated procedures."[197]

7. The unique situation of transboundary aquifers

Although surface and groundwater resources share numerous similarities, it is now well understood that groundwater resources have a number of unique characteristics that must be carefully considered when contemplating appropriate regulatory tools for managing such resources. For example, groundwater is typically more vulnerable than surface water to pollution and other forms of contamination because water in aquifers generally flows at much slower rates than in rivers and lakes, typically measured in distances of centimeters or meters per day.[198] As a result, contamination and other problems affecting aquifers may manifest at much slower rates than they do in surface waters. Moreover, the slower flow rates greatly diminish the natural filtering capacities of aquifers and, thereby, their ability to reclaim and clean themselves. In addition, because of the geographic extent of most aquifers and the difficulties associated with monitoring and working with underground formations, the artificial reclamation of a polluted aquifer can be prohibitively complex and expensive. The result is that once contaminated, an affected aquifer may be rendered unusable for years, decades or longer.

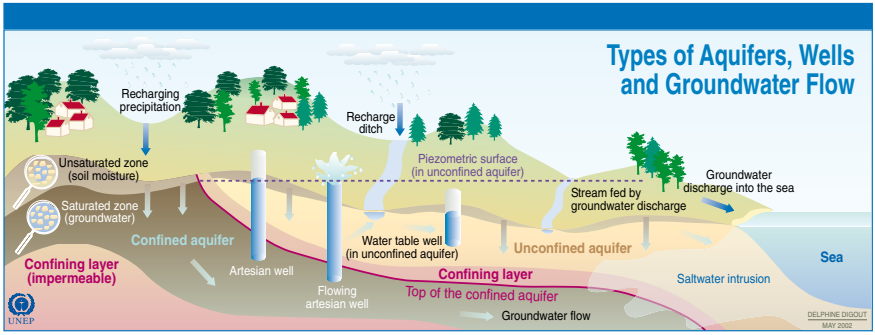
Groundwater is typically more vulnerable than surface water to pollution and other forms of contamination.

195 1986 Treaty on the Lesotho Highlands Water Project between the Government of the Kingdom of Lesotho and the Government of the Republic of South Africa, at Arts. 7(18) and 15.

196 Policy for Instream Flow Requirements, Lesotho Highlands Water Project, Phase 1, at Principle 2.2.

197 *Ibid.*, at Principle 2.11.

198 W.K. Hamblin and E.H. Christiansen, Earth's Dynamic Systems (2001), at p. 325.



Source: Environment Canada, 2001 (Adapted from: http://www.ec.ca/water/index.htm).

Consider, for example, a toxic chemical spill occurring near both a river and an underlying aquifer. On the surface, the flow direction and velocity of such a spill is typically visible with the naked eye and can be tracked using both simple and sophisticated technologies. Moreover, natural conditions, such as circumstances that might hasten or slow down the potential harm resulting from the spill, are more easily discernable. In contrast, when that same spill begins infiltrating underground, it becomes tremendously more difficult to assess and monitor. The very fact that it is underground requires considerably greater effort, technology, knowledge, and financial resources in order to evaluate the flow direction and velocity, the existence of natural flow patterns and channels, possible obstacles, and, generally, the extent of the threat to area groundwater resources.[199] To complicate the matter, placing those groundwater resources in a transboundary context creates even more difficulties because of the nascent state of international water law for transboundary aquifers, and because sovereign interests of nations often involve political impediments that are unrelated to the waters of a shared resources.

Notwithstanding, given groundwater's greater vulnerability to contamination, as well as the complexities associated with monitoring and reclaiming aquifers, protections afforded to aquifers that traverse political boundaries must be considered in direct relation to their unique characteristics. For example, in seeking to implement a no significant harm standard to activities related to the utilization of a transboundary aquifer, a lower threshold—e.g., less evidence of possible harm or of causation—may be appropriate than that applied to surface waters. Likewise, a tailored standard may be especially fitting in relation

199 G. Eckstein, *supra*, n. 107, at p. 570.

to the imminency of harm from a spill given the slower flow rates of water and contaminants in underground geologic formations and the resulting persistence of such contaminants.[200]

Another characteristic of aquifers that is relevant to this discussion pertains to the expansive geographic scope of the recharge area of many aquifers. While not dissimilar in concept from a watershed from which a river may derive its volume of water, an aquifer's recharge zone can have far greater implications for the viability of an aquifer than most watersheds may have for the sustainability of a watercourse. This, again, is directly related to the distinctly slower flow rates of most aquifers and the complications associated with cleaning—whether naturally or artificially—polluted aquifers. Accordingly, activities operating in the recharge zone of a transboundary aquifer, such as industrial and agricultural activities, can have profound consequences for the aquifer on both sides of the border. This is the precise concern raised for the alluvial aquifer system in the Praded region along the border between the Czech Republic and Poland where deforestation and intensive agriculture and industry on the Czech side is believed to have contaminated wells on the Polish side.[201]

Accordingly, the protection of the recharge zone of an aquifer is a critical component of any effort to ensure the sustainability and viability of an aquifer for human use as well as for the environment. As described above, the ILC Draft Articles recognize this distinction and tailor the no significant harm rule to the unique characteristics of transboundary aquifers by extending the applicability of the principle to activities that, although they may be unrelated to the utilization or management of the aquifer itself, "have, or are likely to have, an impact on that transboundary aquifer or aquifer system."[202]

The protection of the recharge zone of an aquifer is a critical component of any effort to ensure the sustainability and viability of an aquifer for human use as well as for the environment.

200 *Ibid*., at p. 571.

201 S. Puri, et.al. (eds.), Internationally Shared (Transboundary) Aquifer Resources Management: Their Significance and Sustainable Management—A Framework Document, IHP-VI Series on Groundwater, No. 1 (2001), at p. 39.

202 United Nation General Assembly Resolution on the Law of Transboundary Aquifers, *supra*, n. 94, Annex, at Art. 6.

Moreover, the Articles place even greater emphasis on the importance of protecting aquifer recharge zones by including a separate provision requiring aquifer States to protect recharge zones. Article 11 obliges aquifer States to both identify the recharge zones of aquifers within their territory and to "take appropriate measures to prevent and minimize detrimental impacts on the recharge … processes." In so doing, the provision enhances the safeguards afforded to the recharge zones of aquifers and particularly, to the normal recharge process—the volume, flow, and quality of water that flow into the aquifer.

It is noteworthy that the formulation of international standards applicable to transboundary aquifers is still in a nascent stage of development.[203] Accordingly, the number of instruments directly addressing the use, allocation, and protection of transboundary aquifers is relatively minute as compared to those focusing on surface waters. Nevertheless, the lack of such arrangements creates substantial opportunities for implementing green laws and agreements related to the management of such transboundary resources.

8. Case Studies

Although green notions and procedures can be employed on an *ad hoc* basis, the greening of water law and policy is a dynamic and cumulative process in which greater benefits are realized where multiple, interrelated mechanisms are implemented. Consequently, the process is more effective when approached through a comprehensive regime that involves multiple principles and concepts, and that encompasses all interrelated freshwater resources and water stakeholders.

The following case studies offer insight into three wide-ranging approaches. The first—the Revised Protocol on Shared Watercourses in the Southern African Development Community—is a regional watercourses treaty that is at the forefront of the greening process in international law. The second—the ILC Draft Articles on the Law of Transboundary Aquifers—offer a series of principles that, if formally adopted by the United Nations, may form a global framework arrangement under which more detailed aquifer-specific treaties could be developed. They too are in the vanguard of

203 G. Eckstein, Managing Hidden Treasures Across Frontiers: The International Law of Transboundary Aquifers, proceedings of the UNESCO *Conference: Transboundary Aquifers – Challenges and New Directions*, 6-8 December 2010, Paris, France (*forthcoming 2011*).

legal development, both for articulating the law applicable to transboundary aquifers and for their green approach to international law. The third is the UNECE Watercourses Convention, broadly considered a pioneering *green* regional water convention.

(i) The Revised Protocol on Shared Watercourses in the Southern African Development Community

On 7 August 2000, all but one of the fourteen members of the Southern African Development Community[204] signed the Revised Protocol on Shared Watercourses in the Southern African Development Community (2000 SADC Revised Protocol).[205] The revision was undertaken to account for developments in international water law as reflected in the 1997 Watercourses Convention, as well as to address certain limitations of the original Protocol. Given southern Africa's limited freshwater resources, temporal and spatial rainfall variability, and numerous transboundary river basins, the revision marked a significant achievement for the region.

The 2000 SADC Revised Protocol is a regional arrangement whose overall objective is to "foster closer cooperation for judicious, sustainable and co-ordinated management, protection and utilisation of shared watercourses …."[206] To achieve this objective, the Protocol seeks, among other actions, to "promote a co-ordinated and integrated environmentally sound development and management of shared watercourses."[207]

To a large extent, the 2000 SADC Revised Protocol is based on the 1997 Watercourses Convention. It tracks closely the language of the Convention as it relates to the principles of equitable and reasonable utilization (Article 3(7)) and no significant harm (Article 3(10)). Moreover, with regard to determining what constitutes an equitable and reasonable utilization of a watercourse, it enumerates factors identical to those found in Article 6 of the Convention (Article 3(8)). In addition, the Protocol incorporates nearly identical provisions to those found in the Convention related to: the protection and preservation of ecosystems; prevention,

204 SADC is composed of Angola, Botswana, the Democratic Republic of Congo, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia, and Zimbabwe.

205 2000 Revised Protocol on Shared Watercourses in the Southern African Development Community, *supra,* n. 95.

206 *Ibid*., at Art. 2.

207 *Ibid., at Art. 2.*

reduction and control of pollution; introduction of alien species; and protection and preservation of the aquatic environment (Article 4(2)).[208]

The 2000 SADC Revised Protocol, however, diverges from the 1997 Watercourses Convention in a number of important ways that evidence the more "green" nature of the agreement relative to that of the Convention. In its Preamble, the Protocol explicitly recognizes the "impact on the environment" of "existing and emerging socio-economic development programmes in the SADC Region."[209] Moreover, Parties to the Protocol are "CONVINCED of the need for co-ordinated and environmentally sound development of the resources of shared watercourses in the SADC Region in order to support sustainable socio-economic development."[210]

Furthermore, in articulating the general principles by which State Parties to the 2000 SADC Revised Protocol would be bound, Article 3(2) provides that "[t]he utilisation of the resources of the watercourses shall include agricultural, domestic, industrial, navigational *and environmental uses*."[211] It also asserts that "State Parties shall maintain a proper balance between resource development for a higher standard of living for their people and conservation and enhancement of the environment to promote sustainable development" (Article 3(4)).[212] Finally, the Protocol includes a direct obligation for the protection and preservation of the aquatic environment in Article 4(2)(d), which binds State Parties to "take all measures with respect to a shared watercourse that are necessary to protect and preserve the aquatic environment, including estuaries."[213]

The 2000 SADC Revised Protocol is a regional arrangement whose overall objective is to "foster closer cooperation for judicious, sustainable and co-ordinated management, protection and utilisation of shared watercourses".

208 *Ibid*., at Art. 4(2).
209 *Ibid*., at Preamble.
210 *Ibid*., at Preamble (*emphasis in original*).
211 *Ibid*., at Art. 3(2) (*emphasis inserted*).
212 *Ibid*., at Art. 3(4).
213 *Ibid*., at Art. 4(2)(d).

Select Articles of the 2000 SADC Revised Protocol:

Article 2—Objective

b) advance the sustainable, equitable and reasonable utilisation of the shared watercourses;

c) promote a co-ordinated and integrated environmentally sound development and management of shared watercourses;

d) promote the harmonization and monitoring of legislation and policies for planning, development, conservation, protection of shared watercourses, and allocation of the resource thereof;

Article 3—General Principles

2. The utilisation of the resources of the watercourses shall include agriculture, domestic, industrial, navigational and environmental uses.

4. State Parties shall maintain a proper balance between resource development for a higher standard of living for their people and conservation and enhancement of the environment to promote sustainable development.

7. a) Watercourse States shall in their respective territories utilise a shared watercourse in an equitable and reasonable manner. In particular, a shared watercourse shall be used and developed by Watercourse State with a view to attain optimal and sustainable utilisation thereof and benefits therefrom, taking into account the interests of the Watercourse States concerned with adequate protection of the watercourse for the benefit of current and future generations.

b) Watercourse States shall participate in the use, development and protection of a shared watercourse in an equitable and reasonable manner. Such participation includes both the right to use the watercourse and the duty to co-operate in the protection and development thereof, as provided in this Protocol.

Article 4—Specific Provisions

2. Environmental Protection and Preservation

a) Protection and preservation of ecosystems
State Parties shall, individually and, where appropriate, jointly, protect and preserve the ecosystems of a shared watercourse.

b) Prevention, reduction and control of pollution

i) State Parties shall, individually and, where appropriate, jointly, prevent, reduce and control the pollution and environmental

degradation of a shared watercourse that may cause significant harm to other Watercourse States or to their environment, including harm to human health or safety, to the use of the waters for any beneficial purpose or to the living resources of the watercourse.

ii) Watercourse States shall take steps to harmonise their policies and legislation in this connection.

iii) State Parties shall, at the request of any one or more of them, consult with a view to arriving at mutually agreeable measures and methods to prevent, reduce and control pollution of a shared watercourse, such as:

a) setting joint water quality objectives and criteria;

b) establishing techniques and practices to address pollution from point and non-point sources;

c) establishing lists of substances the introduction of which, into the waters of a shared watercourse, is to be prohibited, limited, investigated or monitored.

c) Introduction of alien or new species

State Parties shall take all measures necessary to prevent the introduction of species, alien or new, into a shared watercourse which may have effects detrimental to the ecosystems of the watercourse resulting in significant harm to other Watercourse States.

d) Protection and preservation of the aquatic environment

State Parties shall individually and, where appropriate, in co-operation with other States, take all measures with respect to a shared watercourse that are necessary to protect and preserve the aquatic environment, including estuaries, taking into account generally accepted international rules and standards.

(ii) The Law of Transboundary Aquifers

In recent years, transboundary groundwater resources have received increasing attention in various policy and law-making efforts at all levels of civil society, in a number of significant negotiations, and even in academic exercises.[214] Among others, rudimentary consultative and data-sharing agreements have been implemented on the Nubian Sandstone and Northwestern Sahara aquifers in North

214 G. Eckstein, *supra*, n. 203.

Africa,[215] while more complex management mechanisms were developed for the Genevese Aquifer along the French-Swiss border,[216] and for the Iullemeden Aquifer in West Africa.[217] Additionally, cooperative, sub-regional arrangements have been crafted on the Hueco Bolson between the City of El Paso and Ciudad Juarez on the border between Mexico and the USA,[218] and on the Abbotsford-Sumas Aquifer between the US State of Washington and Canadian Provence of British Columbia,[219] while transboundary groundwater resources are featured prominently in the 1992 UNECE Watercourses Convention, the 1997 Watercourses Convention,[220] the 2000 SADC Revised Protocol,[221] and the International Law Association's 2004 Berlin Rules.[222] One of the more significant developments, however, in the ongoing evolution of international groundwater law is the work of the UN International Law Commission (ILC).

The work of the ILC to elucidate and articulate the international law applicable to transboundary groundwater resources formally began in 2002.[223] Its effort built on and complemented the Commission's prior work, which had resulted in the 1997 Watercourses Convention.[224] The outcome of this latter work was a document containing nineteen Draft Articles representing, in the Commission's best estimation, the state of international law applicable to transboundary aquifers. In December 2008, the UN General Assembly adopted a Resolution on the Law of Transboundary Aquifers and transmitted the ILC Draft Articles on the Law of Transboundary Aquifers to the Member States of the UN. In the Resolution, the General Assembly recommended that Members States take note of the Draft Articles and consider entering into bilateral or regional arrangements for the proper management of their transboundary

215 2000 Programme for the Development of a Regional Strategy for the Utilisation of the Nubian Sandstone Aquifer System (NSAS) - Terms of Reference for the Monitoring and Exchange of Groundwater Information of the Nubian Sandstone Aquifer System; 2002 Establishment of a Consultation Mechanism for the Northwestern Sahara Aquifer System.

216 2008 Convention relative à la protection, à l'utilisation, à la realimentation et au suivi de la Nappe Souterraine Franco-Suisse du Génevois, done in Geneva, on 18 December 2007.

217 2009 Memorandum of Understanding relating to the setting up of a Consultative Mechanism for the management of the Iullemeden Aquifer System.

218 1999 Memorandum of Understanding between City of Juárez, Mexico Utilities and the El Paso Water Utilities Public Services Board (PSP) of the City of El Paso, Texas.

219 1996 Memorandum of Agreement Related to Referral of Water Right Applications Between the State of Washington as represented by the Department of Ecology and the Province of British Columbia as represented by the Minister of Environment, Lands and Parks.

220 UN Convention on the Law of Non-navigational Uses of International Watercourses, *supra*, n. 93.

221 2000 Revised Protocol on Shared Watercourses in the Southern African Development Community, *supra,* n. 95.

222 International Law Association, Berlin Conference on Water Resources Law (2004).

223 C. Yamada, UNILC Special Rapporteur, *Shared Natural Resources: First Report on Outlines*, UN Doc. A/CN.4/533/ (2003), at pp. 1–2.

224 UN Convention on the Law of Non-navigational Uses of International Watercourses, *supra*, n. 93.

aquifers, taking into account the provisions contained in the Draft Articles.[225] The Resolution was presented with the caveat that it be considered "without prejudice to the question of their future adoption or other appropriate action". However, a further consideration by the General Assembly as to the possible form that might be given to the Draft Articles is scheduled for the General Assembly's 66th session in 2011.

The nineteen ILC Draft Articles, which were annexed to the Resolution, are arranged in four parts and track very closely the structure of the 1997 Watercourses Convention.Like the Convention, the Draft Articles have four main sections: Introduction; General Principles; Protection, Preservation and Management; and Miscellaneous Provisions. Moreover, like the Convention, the Draft Articles articulate general State obligations under international law, thereby forming a framework arrangement under which States should be able to develop more specific agreements tailored to local circumstances.

Additionally, like the 1997 Watercourses Convention, the chief substantive State obligations are equitable and reasonable utilization and no significant harm. Both rules, however, are somewhat tailored to the unique qualities that differentiate surface waters from groundwater resources. For example, for determining what constitutes an equitable and reasonable utilization of a transboundary aquifer, Article 5 provides a non-exhaustive list of factors that include such unique criteria as "the natural characteristics of the aquifer or aquifer system" (Article 5 (1)(c)), "the contribution to the formation and recharge of the aquifer or aquifer system" (Article 5 (1)(d)), and "the role of the aquifer or aquifer system in the related ecosystem" (Article 5 (1)(i)).

The ILC Draft Articles, however, diverge from the structure of the 1997 Watercourse Convention in a number of significant ways that are particularly relevant to the discussion on the greening of water law. The provision pertaining to the no significant harm rule, for example, includes a paragraph obligating aquifer States not to cause significant harm through "activities other than utilization of a transboundary aquifer ... that have, or are likely to have, an impact upon that transboundary aquifer." This provision specifically relates to the distinct likelihood that an aquifer could be detrimentally affected from non-aquifer utilization activities undertaken above or around aquifers, such as: industrial and agricultural operations in the recharge zone that might pollute

225 United Nation General Assembly Resolution A/RES/63/124 on the Law of Transboundary Aquifers, *supra*, n. 94, Annex.

the aquifer; mining activities that could destroy the aquifer matrix and, thereby, its functioning; construction, forestry, and other activities that might deplete the aquifer by preventing the normal recharge process.[226] Hence, the provision is intended to prevent the unduly narrow construction of the obligation to prevent the causing of significant harm to transboundary aquifers given their unique susceptibility to activities unrelated to the use of the aquifer. Taking this a step further, Article 11 requires aquifer States to identify both recharge and discharge zones of a transboundary aquifer as well as to "take special measures to minimize detrimental impacts on the recharge and discharge processes." Significantly, it further recognizes the possibility that a recharge and/or discharge zone of an aquifer may be located in a State other than those directly overlaying the aquifer. Accordingly, the provision would require non-aquifer States to cooperate with aquifer States as a way of protecting the aquifer and its dependent ecosystems. In focusing on the integrity and functioning of aquifers over the values of sovereignty, it clearly evidences a green approach to aquifer management and regulation.

Yet another important characteristic of the ILC Draft Articles evidencing their relative *green* nature can be seen in Article 4 on equitable and reasonable utilization in the paragraph obligating aquifer States to "not utilize a recharging transboundary aquifer or aquifer system at a level that would prevent continuance of its effective functioning." Although the "functioning" of an aquifer is not defined in the Articles, hydrogeologists understand this notion as referring to the way a particular aquifer works or operates as an aquifer.[227] For example, aquifers typically store and transport water, dilute wastes and other contaminants, provide a habitat for aquatic biota, and serve as a source of freshwater and nutrients to aquifer-dependent ecosystems. Some aquifers even provide geothermal heat. Each of these qualities comprises a specific aquifer function that is dependent on the particular aquifer's unique characteristics, such as its hydrostatic pressure, hydraulic conductiveness, and mineralogical, biological, and chemical attributes.[228] Accordingly, the provision supporting the functioning of aquifers recognizes the unique characteristic of aquifers as dynamic but fragile mechanisms for transporting, storing, and processing water. Moreover, it acknowledges that the modification or removal of any segment of that mechanism—such as a reduction in recharge or overexploitation of the aquifer, both of which could reduce water flow and possibly drain the aquifer, as well as

226 G. Eckstein, *supra*, n. 107, at p. 545.

227 R.C. Heath, Basic Ground-Water Hydrology, Water Supply Paper 2220 (U.S. Geological Survey 1983), at pp. 14–15, available at http://pubs.er.usgs.gov/djvu/WSP/wsp_2220.pdf.

228 *Ibid.*

pollution of the aquifer or removal of the aquifer matrix (e.g., for its mineral content)—could have considerable detrimental consequences on the operation of the aquifer as an aquifer. Regardless of whether this provision is applied to achieve eco-centric or anthropocentric objectives—e.g., whether protecting aquifer functions for the sake of the aquifer itself or its dependent ecosystems, or whether safeguarding those functions because of the tremendous benefits aquifers provide people and the environment—it achieves outcomes that are positive both to people and the environment.

Other important green characteristic of the Draft Articles include the duty to protect ecosystems in Article 10, and the obligation to prevent pollution in Article 12. However, the overall approach of the provisions contained in the Articles comprises an overall green approach to the management and regulation of transboundary freshwater resources to the extent that the Articles accurately reflect the science of groundwater resources. By ensuring that the legal principles and obligations follow sound scientific reasoning and the latest knowledge, the Articles recognize the intricacies of transboundary aquifers and their relation to both the human and natural environments.

Select Articles of the ILC Draft Articles on the Law of Transboundary Aquifers:

Article 4—Equitable and reasonable utilization

1. *Aquifer States shall utilize transboundary aquifers or aquifer systems according to the principle of equitable and reasonable utilization, as follows:*
   (a) They shall utilize transboundary aquifers or aquifer systems in a manner that is consistent with the equitable and reasonable accrual of benefits therefrom to the aquifer States concerned;
   (b) They shall aim at maximizing the long-term benefits derived from the use of water contained therein;
   (c) They shall establish individually or jointly a comprehensive utilization plan, taking into account present and future needs of, and alternative water sources for, the aquifer States; and
   (d) They shall not utilize a recharging transboundary aquifer or aquifer system at a level that would prevent continuance of its effective functioning.

Article 5 Factors relevant to equitable and reasonable utilization

1. *Utilization of a transboundary aquifer or aquifer system in an equitable and reasonable manner within the meaning of article 4 requires taking into account all relevant factors, including:*
   (a) The population dependent on the aquifer or aquifer system in each aquifer State;
   (b) The social, economic and other needs, present and future, of the aquifer States concerned;
   (c) The natural characteristics of the aquifer or aquifer system;
   (d) The contribution to the formation and recharge of the aquifer or aquifer system;
   (e) The existing and potential utilization of the aquifer or aquifer system;
   (f) The actual and potential effects of the utilization of the aquifer or aquifer system in one aquifer State on other aquifer States concerned;
   (g) The availability of alternatives to a particular existing and planned utilization of the aquifer or aquifer system;
   (h) The development, protection and conservation of the aquifer or aquifer system and the costs of measures to be taken to that effect;
   (i) The role of the aquifer or aquifer system in the related ecosystem.
2. *The weight to be given to each factor is to be determined by its importance with regard to a specific transboundary aquifer or aquifer system in comparison with that of other relevant factors. In determining what is equitable and reasonable utilization, all relevant factors are to be considered together and a conclusion reached on the basis of all the factors. However, in weighing different kinds of utilization of a transboundary aquifer or aquifer system, special regard shall be given to vital human needs.*

Article 6—Obligation not to cause significant harm

1. *Aquifer States shall, in utilizing transboundary aquifers or aquifer systems in their territories, take all appropriate measures to prevent the causing of significant harm to other aquifer States or other States in whose territory a discharge zone is located.*
2. *Aquifer States shall, in undertaking activities other than utilization of a transboundary aquifer or aquifer system that have, or are likely to have, an impact upon that transboundary aquifer or aquifer system, take all appropriate measures to prevent the causing of*

significant harm through that aquifer or aquifer system to other aquifer States or other States in whose territory a discharge zone is located.

3. *Where significant harm nevertheless is caused to another aquifer State or a State in whose territory a discharge zone is located, the aquifer State whose activities cause such harm shall take, in consultation with the affected State, all appropriate response measures to eliminate or mitigate such harm, having due regard for the provisions of articles 4 and 5.*

Article 10—Protection and preservation of ecosystems

Aquifer States shall take all appropriate measures to protect and preserve ecosystems within, or dependent upon, their transboundary aquifers or aquifer systems, including measures to ensure that the quality and quantity of water retained in an aquifer or aquifer system, as well as that released through its discharge zones, are sufficient to protect and preserve such ecosystems.

Article 11—Recharge and discharge zones

1. *Aquifer States shall identify the recharge and discharge zones of transboundary aquifers or aquifer systems that exist within their territory. They shall take appropriate measures to prevent and minimize detrimental impacts on the recharge and discharge processes.*
2. *All States in whose territory a recharge or discharge zone is located, in whole or in part, and which are not aquifer States with regard to that aquifer or aquifer system, shall cooperate with the aquifer States to protect the aquifer or aquifer system and related ecosystems.*

Article 12—Prevention, reduction and control of pollution

Aquifer States shall, individually and, where appropriate, jointly, prevent, reduce and control pollution of their transboundary aquifers or aquifer systems, including through the recharge process, that may cause significant harm to other aquifer States. Aquifer States shall take a precautionary approach in view of uncertainty about the nature and extent of a transboundary aquifer or aquifer system and of its vulnerability to pollution.

(iii) The UNECE Convention on the Protection and Use of Transboundary Watercourses and Lakes – A Pioneering Green Regional Water Convention

In 1992, the UN Economic Commission for Europe (UNECE) adopted the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (1992 UNECE Watercourses Convention).[229] The UNECE Watercourses Convention entered into force in 1996, and it applies to the thirty seven States which have ratified it.

The Convention applies to all transboundary waters, which are defined as "any surface or ground waters which mark, cross or are located on boundaries between two or more States" (Article 1(1)). Its central aim is to protect and ensure the quantity, quality and sustainable use of transboundary water resources.

In view of reaching these objectives, the Convention requires Parties to fulfill certain obligations. These include:

- To prevent, control and reduce adverse transboundary impacts on the environment, human health and socio-economic conditions;
- To manage shared waters in a reasonable and equitable manner (Article 2(c)) using the ecosystem approach (Article 3(d)) and guided by the precautionary principle (Article 2 (5)(a)) and the polluter-pays principle (Article 2 (5)(b));
- To preserve and restore ecosystems (Article 2 (2)(d)) ;
- To carry out environmental impact assessments, to draw up contingency plans, set water-quality objectives and minimize the risk of accidental water pollution (Article 3 (1)).

While requesting cooperation over transboundary waters, the Convention is based on strict environmental considerations and objectives. It calls for the implementation of the key principles of environmental law such as the carrying out of environmental impact assessments, the precautionary principle, and the polluter-pays principle. It also refers to one of the core principles of international water law "the equitable and reasonable utilization", which, as mentioned above, has strong "green" connotations.

229 1992 UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes, *supra*, n. 95.

The Convention affords considerable importance to ecosystems and their protection. It even mentions the possibility of imposing "stricter requirements, even leading to prohibition in individual cases,… when the quality of the receiving water or the ecosystem so requires" (Article 3(d)). It also gives due regard to the needs of future generations and the necessity to manage water resources without compromising their ability to meet their own needs (Article 2 (5)(c)). And, finally, the Convention acknowledges the great impact of pollution on groundwater resources and the difficulties of restoring contaminated groundwaters, by mentioning that "[a]dditional specific measures are taken to prevent the pollution of groundwaters"(Article 3 (1)(k)); albeit without providing additional details or specifications.

On the practical side, the Convention requires from the Parties to monitor their transboundary waters jointly by agreeing on pollution parameters (Articles 4 and 11). Parties are also requested to cooperate in research and development to prevent, control and reduce transboundary impacts (Article 5), and to exchange data and information on, *inter alia,* the environmental conditions and the measures taken and planned to prevent, control and reduce transboundary impacts (Article 13). Riparian States are also requested to enter into agreements in order to define their relations regarding the objectives of the Convention and to establish a joint body (Article 9).

While requesting cooperation over transboundary waters, the Convention is based on strict environmental considerations and objectives.

The 1992 UNECE Watercourses Convention has been widely accepted on the European continent and has been recognized and referred to in many other treaties. Among others, references to the Convention can be found in the 1994 Convention on Cooperation for the Protection and Sustainable Use of the Danube River, the 1999 Convention on the Protection of the Rhine, and the 2008 Convention on the Protection, Utilization, Recharge and Monitoring of the Genevese Aquifer between France and Switzerland.

Chapter 4:
The Integration of Environmental Considerations into National Water Law

Until recently, water laws around the world focused on the use and allocation of freshwater resources from a nearly exclusively anthropocentric approach. Water was lawfully usable primarily for human consumption, health, and related domestic needs as well as for productive economic progress. Hence, doctrines such as prior appropriation and riparian rights, as well as the various permitting systems of many nations worldwide, limited water allocations to activities that either ensured human existence or that created economic benefits. As U.S. President Herbert Hoover famously said in 1926, while he served as U.S. Commerce Secretary, "True conservation of water is not the prevention of its use. Every drop of water that runs to the sea without yielding its full commercial returns to the nation is an economic waste."[230]

As a result of the emphasis on utilizing water to its maximum economic potential, communities around the world applied freshwater resources for a myriad of ambitious projects intended to expand cultivation, boost industrial production, and meet growing demands from burgeoning populations. Worldwide, by the end of the 20th century, over 45,000 large dams had been built in more than 140 countries.[231] In Central Asia, the waters of the sister rivers, Amu Darya and Syr Darya, were diverted by the region's former Soviet masters to develop a cotton industry in a desert climate with limited precipitation.[232] In Libya, the country's president, Muammar Abu Minyar al-Gaddafi, implemented The Great Man Made River Project, which diverts groundwater from a non-recharging fossil aquifer underlying the Sahara Desert in the southern region of the country through pipes and aqueducts running thousands of kilometers to the coastal cities of

230 H. Hoover, The Memoirs of Herbert Hoover, Vol. Two: The Cabinet and the Presidency 1920-1933 (The Macmillan Company, 1951), at p. 112.

231 Dams and Development: A New Framework for Decision-Making, The Report of the World Commission on Dams (2000), at p. 8.

232 M. Spoor, *The Aral Sea Basin Crisis: Transition and Environment in Former Soviet Central Asia*, Development and Change, Vol. 29 (2002), at p. 409.

Tripoli, Benghazi, and elsewhere.[233] The project is routing some 6.5 million cubic meters of water daily through more than 5,000 kilometers of pipelines and has been recognized by Guinness World Records as the largest irrigation project ever constructed.[234] While not intentionally seeking to top that feat, China is currently undertaking an equally colossal endeavor—to divert water from the more plentiful southern territory, including from the Yangtze River, to the increasingly parched northern region of the country. By mid-century, once fully operational, the project is expected to divert around 45 million cubic meters of water annually.[235]

These examples are but a few of the thousands of projects worldwide that have harnessed freshwater resources in the name of human and economic progress. While some measure of progress has been achieved by many communities and nations developing their water resources, as well as by private corporations, it has come at considerable environmental costs. One of the worst environmental outcomes was the devastation wrought on the Aral Sea from the diversion of the Amu Darya and Syr Darya. Today, the Aral Sea is but a shadow of its former self, reduced in size to one-half of its previous surface area and 25% of its former volume.[236] Moreover, as the Sea dried out, salts in the lakebed, which were laced with herbicides, pesticides, and other chemicals from modern agricultural practices, were exposed to the elements and blown throughout Central Asia poisoning the surrounding lands.[237] In another water-related tragedy, the Colorado River delta, once one of the world's great desert river deltas spanning nearly 1.5 million acres, now barely occupies 150,000 acres. The tremendous decrease in size of this once very productive wetland is directly due to the extensive over-allocation and massive system of dams and diversion infrastructure constructed throughout its course.[238] The result has been a significant reduction in the delta's biological productivity, estimated currently at one-fifteenth of its former capacity, including a host of species now threatened with extinction.[239] Globally, approximately one-half of all wetlands existing in 1900 have been lost to agriculture, urban development, and water system regulation.[240]

233 J. Watkins, *Libya's thirst for 'fossil water'*, BBC (18 March 2006).
234 Guinness World Records 2008 (2007), at p. 367.
235 J. Yardley, *Beneath Booming Cities, China's Future Is Drying Up*, The New York Times, (28 September 2007).
236 I. Greenberg, *A Vanished Sea Reclaims its Form in Central Asia; Aral Dam Project Surpasses Expectations*, International Herald Tribune, (6 April 2006), at 2.
237 T. Bissell, *Eternal Winter: Lessons of the Aral Sea Disaster*, Harper's Magazine (1 April 2002), at p. 41.
238 R.W. Adler, Restoring Colorado River Ecosystems: A Troubled Sense of Immensity (2007).
239 M. Kowaleski, et.al., *Dead Delta's Former Productivity: Two Trillion Shells at the Mouth of the Colorado River*, Geology, Vol. 28 (2000), at pp. 1059-1062.
240 C. Shine & C. de Klemm, Wetlands, Water and the Law: Using Law to Advance Wetland Conservation and Wise Use, IUCN Environmental Policy and Law Paper No. 38 (1999), at p. 13.

In addition, water stress has had a deleterious effect on people and communities as their surrounding environments became more inhospitable for human habitation. In Yemen, a country heavily reliant on groundwater, municipal water management practices may cause Sana'a to become the first capital city to run out of water, possibly within the coming decade, and the rest of the country within 50–100 years.[241] In northern China, nitrate contamination of the region's groundwater, generated from agricultural activities, exceeds the World Health Organization's drinking water guideline by as much as six times.[242] In his First Report on Outlines, UN International Law Commission Special Rapporteur, Chusei Yamada, ominously reported that "[f]ifty per cent of the population in developing countries is currently exposed to unsafe water resources; 6,000 infants in the developing world die every day as a result of dirty, contaminated water … We are headed for a world water crisis."[243]

In light of growing concern for the environment as well as distress in the state of global and local freshwater supplies, people and the global community have become increasingly aware of the plight of the world's freshwater resources and the need to manage both surface and groundwater in a more environmentally sustainable manner. In particular, the negative impacts of productive economic water use on various species and ecosystems have created a growing movement toward a greening of water management, use, and law. There is now a mounting interest in raising the status and importance of water for the environment to a level that is, at least, on par with other societal needs (as well as wants) for freshwater resources. This movement is not merely an altruistic movement (albeit many do pursue it for altruistic reasons), but rather also involves a recognition that people and communities stand to benefit from ensuring water for the natural environment.

Fundamentally, the objective is to find a balance between water for human and economics-based demands and water for maintaining ecosystem integrity and environment sustainability.

Fundamentally, the objective is to find a balance between water for human and economics-based demands and water for maintaining ecosystem integrity and

241 K. Hudges, Groundwater Management in Yemen: Legal and Regulatory Issues, in Groundwater: Legal and Policy Perspectives, Proceedings of a World Bank Seminar (Salman M.A., Salman ed., 1999), at p. 133.

242 P. Sampat, Deep Trouble: The Hidden Threat of Groundwater Pollution, Worldwatch Paper No. 154 (2000), at p. 19.

243 C. Yamada, *supra*, n. 223, at p. 21.

environmental sustainability. In the context of water management and allocation laws and policies, this balance entails reconciling the seemingly disparate goals of socio-economic development with those of environmental protection and conservation. Given the historically heavy emphasis on economic and human progress, this process necessitates a reassessment of priorities and laws to recognize environmental concerns while maintaining equilibrium with human and economic objectives.

The following section offers specific examples of mechanisms for greening of water law. It discusses the "greening" concept in the context of specific provisions or processes that States might incorporate into their domestic laws and regulations, and considers the expected benefits and possible drawbacks of the various approaches. The process of greening water law at the national level, however, is already underway. As indicated in the following pages, many nations have begun seeking out mechanisms for integrating environmental protection values into water management and allocation laws and policies. Among others, those mechanisms include environmental criteria for water permits and licenses, pollution prevention and abatement standards, environmental impact assessments requirements, prioritization of water allocations for environmental purposes, minimum instream and environmental flow criteria for rivers, reserved water requirements for specific purposes, groundwater exploitation controls for ensuring the viability of dependant ecosystem, environmentally-sensitive trading systems for water rights, ecosystem services payment schemes, protected areas for water-related purposes, and general environmental perspectives in the overall water legal scheme. Certainly, this list is not an exhaustive compilation of mechanisms for accommodating environmental objectives in water laws. Yet, the breadth of requirements and processes already employed in the domestic laws of many nations indicates that water laws can become, and are becoming, more environmentally sensitive. Accordingly, this section also elaborates on the elements and mechanisms currently employed in national water laws and, where possible, offers examples of domestic laws in which such incorporation has been attempted.

1. Environmental criteria in water permits and licenses

Historically, water laws were conceived to meet the basic needs of people and of economic development. Among the earliest regulatory systems, 3,700 years ago the Code of Hammurabi of ancient Mesopotamia provided rules for individual responsibility for managing and maintaining irrigation systems,

while 2,200 years ago the Chinese *Li-Chi* (treatise on ceremonial rules) authorized a centralized administrative system to manage water resources, including hydraulic works, bridges, navigation, and fishing.[244] Other and more recent communities added to such regulatory foundations and formulated rules for flood control, navigation and transport, and municipal supplies, albeit always with the needs of people and development as the core criterion.[245] Where these systems employed permits, licenses, or other formal grants of authority, they generally limited water use only to those activities that the system deemed productive. In the American West, for example, where the prior appropriation system continues to predominate, water has long been subject to the requirement that it only be used for "beneficial use." Although the definition of that phrase has been expanded over the years and varies among the States in which the law is employed, the phrase historically limited water use solely to agricultural, mining, and industrial purposes, and for domestic consumption. Water for the environment was not, and in some U.S. States is still not, regarded by the regulatory system as a permissible beneficial use.

With the state of the environment markedly more important today, environmental criteria are becoming more prevalent in the processes for obtaining water permits and licenses. In many cases, such criteria are forcing water users to consider the environmental implications of their proposed water uses, to use their water more prudently, and even to undertake mitigation measures to minimize the negative consequences that their water use might cause. In some cases, permit and license applications have been denied by the State's water regulatory authority because of the extent of the potential environmental impact of proposed uses. Hence, to the extent that environmental criteria in water permits and licenses create opportunities to balance human needs for freshwater resources in relation to those of the environment, they constitute a greening of water law. Moreover, they offer opportunities to ensure environmental sustainability goals, such as those found in the United Nations' MDGs, as well as enhance the

With the state of the environment markedly more important today, environmental criteria are becoming more prevalent in the processes for obtaining water permits and licenses.

244 D.E. Caponera, Principles of Water Law and Administration: National and International (2nd edition, revised by Marcella Nanni 2007), at pp. 12-21.

245 D.E. Caponera, *Ibid.*, at pp. 12-24; G. Eckstein, *Development of International Water Law and the UN Watercourse Convention*, *supra*, n. 87, at pp. 81-82.

human condition, including alleviating poverty and improving peoples' health and access to freshwater resources, by protecting the environment. The 2007 Water Act of Australia for example references the Conventions on Biological Diversity, Migratory Species, the Ramsar Convention, as well as the Climate Change Convention and the Desertification Convention along with regional agreements, like the JAMBA Agreement.[246]

Environmental criteria in water permits and licenses can include pre-application or concurrent obligations for data and information, such as justification for the proposed water use, explanation of the expected benefits, data on the availability and quality of water in the source water body, and a discussion of possible alternative sources for the desired water. For example, under Chapter 6115 of the Department of Natural Resources of the U.S. State of Minnesota, an application for a permit must include information on:

> *(1) hydrology and hydraulics of the water sources involved, including for surface waters the applicant's analysis of the effect of proposed withdrawals on levels and flows and anticipated impacts, if any, on instream flow or lake level conditions to the extent that such facts are not already available to the commissioner;* [and]
> "*(5) alternative sources of water or methods which were considered, to attain the appropriation objective and why the particular alternative proposed in the application was selected.*[247]

Moreover, that State's regulation authorizes the Minnesota Commissioner of Natural Resources:

> *in cooperation with the owners of water supply systems, [to] analyze the water use practices and procedures and [to] require a more efficient use of water to be employed by the permittee or applicant, subject to notice and opportunity for hearing.*[248]

The 2008 Water Resources Management Act of Samoa[249] applies environmental standards to the granting of licenses and permits for the taking of water and to any

246 JAMBA refers to the 1981 Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment. Water Act 2007, Reprint I, Commonwealth of Australia, 2009.
247 Minnesota Administrative Rules. 6115.0660, Application for Permit.
248 *Ibid*., Water Conservation.
249 Samoa Water Resources Management Act, 5 November 2008, No.31.

activity that may affect water quality or the integrity of any water source, including waste management operations and any commercial enterprise (Article 12.1). Any person to whom an approved standard applies and who fails or refuses to comply with the standard commits an offence and shall be liable to a fine (Article 12.4). In addition to any fine, the failure to observe or comply with an approved standard shall be grounds for suspending or revoking any registration, licence or permit applying to the person in breach; and may form the basis for refusing any subsequent registration, licence or permit sought by the person in breach.

Environmental criteria in water permits and licenses can also include pre-authorization obligations to assess the potential impact of the proposed water use on the environment, as well as to provide options for mitigating any adverse consequences that may result. Such obligations may be imposed on the applicant or the regulating entity, or both. Thus, under the Water Management Act of the U.S. State of Massachusetts, before issuing a water use permit, the State's Department of Environmental Protection is required to consider various factors including the impact that the proposed withdrawal may have on other hydrologically linked water resources, the safe yield of the water source from which the water would be withdrawn, "reasonable conservation practices and measures, consistent with efficient utilization of the water," and "reasonable protection of public drinking water supplies, water quality, wastewater treatment capacity, waste assimilation capacity, groundwater recharge areas, navigation, hydropower resources, water-based recreation, wetland habitat, fish and wildlife, agriculture, and flood plains."[250]

In Namibia, under that country's Water Resources Management Act, consideration of the environmental effects is one of the specified criteria employed during the application process for obtaining water abstraction and effluent discharge permits. Under the Act, "[a]n environmental impact analysis of the proposed abstraction of water upon the environment and existing water users and water resources" must accompany the permit application[251] and must be considered by the minister responsible for water before granting or denying

In Namibia consideration of the environmental effects is one of the specified criteria employed during the application process for obtaining water abstraction and effluent discharge permits.

250 Massachusetts General Laws, Chapter 21g, at § 7 – Issuance of permits; criteria and standards.
251 Namibia, Water Resources Management Act No. 24 of 2004, at para. 33(3).

an application.[252] Moreover, environmental criteria comprise a critical part of the terms and conditions of such concessions as "a licence to abstract and use water is issued subject to … the protection of the environment and water resource from which the abstraction will be made, the stream flow regime, and other existing and potential use of the water resource."[253]

Yet another environmental criterion that can be incorporated into the permitting and licensing process is a rule that subordinates the authorized use to an ongoing minimum environmental requirement. In other words, the authorized user may withdraw or use the water approved under her permit so long as there is adequate freshwater for the sustainability of species and their habitats. The moment that drought or other low-flow conditions threaten that sustainability, that user would have to halt operations to ensure adequate flows for the natural environment.

2. Pollution prevention and abatement

As noted previously, the pollution of freshwater resources is a tragedy of global proportions affecting human communities in every corner of the world. It is directly responsible for the death and illness of millions of children and adults, as well as the destruction of aquatic and related ecosystems, and has become one of the most critical challenges for nations struggling to balance economic development with the health of their populace and natural environment.

As a response to this profound threat, one the most direct mechanisms designed to protect and enhance the environmental quality of freshwater resources, both surface and underground, has been water pollution controls. While regulations for the prevention and abatement of water pollution have been around for decades, prior to the 1970s such regulations focused primarily on achieving public health, social, and even economic objectives. Following the environmental movement of the 1970s, as nations began to acknowledge the growing threat posed by pollution to their

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252 *Ibid*., paras. 34(3) and 35(1).
253 *Ibid*., paras. 33, 34, 35 and 37.

freshwater resources, governments around the world began implementing more environmentally-focused constraints on pollution discharges as a way to prevent and minimize harm to species, habitats, and ecosystems.

In most jurisdictions, water pollution has typically been grouped into two distinct types of pollutants based on the origin of the effluent: point source and non-point source. Point source pollution comprises water pollution originating through a discrete and traceable origin, such as effluent outflows from industries, municipal sewers, waste dumps, and other sources whose entry point into specific water bodies can be established with sufficient certainty.[254] Under the U.S. Clean Water Act, a point source is defined as:

> *any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture.*[255]

In contrast, non-point source pollution originates from diffuse or indistinct sources whose origins and entry point into water bodies are difficult or impossible to determine with accuracy.[256] Non-point source pollution typically results from rainfall or snowmelt moving over and through the ground, picking up and carrying away natural and human pollutants and eventually depositing them in lakes, rivers, wetlands, coastal waters and ground waters.

The most pervasive source of non-point source pollution is irrigated agriculture, although, a significant amount flows off of development projects, parking lots, roads, and highways.

The distinction between point and non-point sources of pollution is especially relevant from a management perspective because of the greater difficulty involved with tracing the origin, monitoring, and measuring the impact of pollution originating from a diffuse source. As a result, most regulations

254 S. Burchi and A. D'Andrea, Preparing national regulations for water resources management Principles and practice, UN Food and Agricultural organization Legislative Study 80 (2003), at p. 91.

255 United States Federal Water Pollution Control Act (Clean Water Act), 33 U.S.C. 1251, et. seq., at para. 502(14).

256 S. Burchi and A. D'Andrea, *supra*, n. 254, at p. 91.

designed to prevent or abate pollution of freshwater resources have focused on point source pollution. In the context of environmental protection, national and local environment agencies have pursued this single-target approach, in part, through absolute prohibitions on the release of certain effluents into the environment that are considered too toxic or otherwise too hazardous for animal and plant life, as well as for human health. They have also implemented permitting requirements for the discharge of other pollutants that, while they could be harmful to people and the environment, may be tolerated in limited amounts.

The Uganda Water (Waste Discharge) Regulations prohibit the "discharge [of] effluent or waste on land or into the aquatic environment … unless he or she has a permit".

An example of an absolute prohibition on water pollution for environmental purposes is evident in Malaysia's Environmental Quality (Sewage and Industrial Effluents) Regulations of 1979, which provides that:

> *no person shall discharge or cause or permit the discharge of any of the following substances into any inland waters: (1) any inflammable solvent; (2) any tar or other liquids immiscible with water; (3) refuse, garbage, sawdust, timber, human or animal waste or solid matters.*[257]

Similarly, Nigeria's National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations of 1991 provides that "no industry or facility shall release hazardous or toxic substances into the air, water or land of Nigeria's ecosystems beyond limits approved by the Agency."[258] In Algeria, according to Article 43 of its Water Law, all water resources and aquatic ecosystems have to be protected against all forms of pollution affecting the quality of waters and their different uses.

An example of controlling environmental water pollution through discharge permits is found in Uganda's 1998 Water (Waste Discharge) Regulations, which prohibit the "discharge [of] effluent or waste on land or into the aquatic environment … unless he or she has a permit in the format specified in the First Schedule issued by the Director."[259] The regulations further

257 Malaysia, Environmental Quality (Sewage and Industrial Effluents) Regulations 1979, at Art. 6.
258 Nigeria National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations of 1991, at p. 1.
259 Uganda, The Water (Waste Discharge) Regulations, 1988., at Art. 4(1).

provide that in considering a waste discharge permit application, the Director must consider "any adverse effect which the discharge of waste is likely to have on … the environment, including the riverine and riparian environment."[260] In a similar vein, under Malaysia's regulations, a license application for the discharge of effluent into a water body may be denied where the evidence suggests that the granting of the license will likely "cause a worsening of condition in the inland waters or cause pollution in any other segment or element of the environment."[261] In Mauritania, Article 72 of the Water Code prohibits any discharge of pollutants into water resources without licensing.

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The greater ease in regulating point-source pollution, however, should not been to the exclusion of regulating diffuse pollution sources. While it may be considerably difficult to trace the source of discharge of such pollutants, it may be advantageous to shift the effort from regulating water resources to the regulation of land uses giving rise to a diffuse discharge. Thus, cultivation practices have been increasingly attracting regulatory restrictions aimed at preventing, abating or minimizing pollution from substances such as the nitrates employed in agriculture. For example, the European Union's Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources directs member States to designate nitrate-sensitive (or nitrate-vulnerable) areas and to draw up a code or codes of good agricultural practice. Within the designated areas, the provisions of such code or codes become mandatory for farmers.[262]

The Water Rights Act of Austria extends its provisions for limiting effluent emissions to both, point and non-point sources of pollution.

Taking a more comprehensive approach, the Water Rights Act of Austria extends its provisions for limiting effluent emissions to both, point and non-point sources of pollution. The provisions are anchored in the prescription of best available technologies for both sources in order to attain the objectives

260 *Ibid*., at Art. 9(1)(b).
261 Malaysia, Environmental Quality (Sewage and Industrial Effluents) Regulations 1979, at Art. 11(3).
262 Law and Sustainable Development since Rio - Legal Trends in Agriculture and Natural Resource Management, UN Food and Agricultural organization Legislative Study 73 (2002), at p. 157.

of the Act, which include not only a mandate to prevent the degradation of surface and groundwater but also obligations to reach an improvement in the overall aquatic environment in line with the Water Framework Directive of the European Union.[263]

Regardless of whether a nation pursues pollution prevention and abatement regulations by targeting point-sources or non-point sources of pollution (or both), both the natural environment and human communities stand to benefit. The expected benefits that would arise from the implementation of such a principle include enhanced environmental and human health as well as human access to freshwater resources. This, in turn, could lessen poverty and disease conditions and help fortify the effort to achieve both national and international goals.

3. Environmental impact assessment

One of the more considered responses to the threat of environmental harm is the process known as Environmental Impact Assessment (EIA). An EIA is a systematic methodology for evaluating possible environmental consequences of a proposed activity and then including that assessment in the decision-making process for the proposed activity.[264] While simple in its outline, the implementation of such a process can be time consuming, politically controversial, and expensive. Nevertheless, in relation to the health care and environmental costs associated with polluted waters, as well as costs associated with the remediation of environmental catastrophes, the foresight generated through an EIA will often be far more prudential and cost effective. In particular, by implementing such assessments, nations create opportunities for the development of information that otherwise might not have been generated, and for expanding the ambit of mitigatory and alternative actions in response to potential negative impacts to people and the environment, including freshwater resources. This, in turn, can produce conditions that are more favourable to sustaining and enhancing human and environmental health and even societal and economic development. To the degree that an EIA incorporates environmental concerns and information into the decision-making process, it enhances the management of freshwater resources and clearly constitutes the greening of water law.

263 *See* for e.g. paras. 30 and 30 (g) of the Water Rights Act of the Republic of Austria, Wasserrechtsgesetz, BGBl. Nr. 215/1959 last revised by BGBl. I Nr. 123/2006

264 J. Glasson, et al., Introduction to Environmental Impact Assessment 3rd (2005), at pp. 3-4.

In the context of water law, EIAs are most commonly found as part of the statutory scheme that authorizes governmental agencies to grant water use concessions for surface and groundwater abstractions. Many national water laws include EIAs as prerequisites for licenses and permits. In Cameroon, for example, water abstraction regulations prescribe that applications for water abstraction authorizations must be accompanied by an environmental impact study of the proposed use, together with the conclusions from the agency responsible for the environment.[265] Under Mexico's Law on National Waters, permits for the discharge of wastewater, as well as development and abstraction concessions, must be applied for together with an environmental impact statement, which is also prepared under the relevant environment protection legislation.[266] Similarly, the Kenyan statutory framework outlining the procedure for obtaining permits stipulates that environmental impact assessments shall be carried out in line with relevant provisions detailed in the Environmental Management and Co-ordination Act of 1999,[267] while the Paraguayan Water Resources Act of 2007 imposes EIA requirements for all water abstraction projects.[268]

Under Mexico's Law on National Waters, permits for the discharge of wastewater, as well as development and abstraction concessions, must be applied for together with an environmental impact statement.

The Paraguayan Water Resources Act of 2007 imposes EIA requirements for all water abstraction projects.

EIA requirements, however, may also be imposed in other water-related activities, separate from use and abstraction concessions, as for example in the case of waste disposal and construction of waterworks. Under the Chinese Water Law of 2002, review and approval of an impact assessment report must be completed before the construction of sewerage outfall projects.[269] In South Africa, public consultation and an environmental impact assessment must be undertaken by the Minister of Water Affairs prior to the construction of waterworks, the report summary of which must be published in the Government Gazette. Moreover,

265 Cameroon Décret No. 2001/164/PM, at Art. 5(4)(a).
266 Mexico, National Water Law, 1 December 1992, at Art. 21bis (III).
267 Kenya, Water Act No.8 of 2002, at Art. 29(4).
268 Paraguay Water Resources Law 3.239/2007 of 14 June 2007, at Arts. 28 and 36.
269 China Water Law of 2002, at Art. 34.

two years following the completion of such waterworks, the Minister must again consider the results of another environmental impact assessment.[270]

4. Prioritization of water allocations for environmental purposes

Given the emerging emphasis on ensuring freshwater for species, habitats, and ecosystems, it comes as no surprise that many countries have begun to legislate systems for prioritizing the allocation of water resources among competing uses and needs, including the natural environment. This process of prioritizing water uses in national water resources legislation creates mechanisms for directing an increasingly scarce resource to where public policy goals dictate it should go. The most profound implication of such ranking systems is the official recognition by the state of the "water environment" as a legitimate resource "user." Moreover, the more important the nation and its populace regard the viability of the natural environment, the higher it ranks as a user on the priority list. As a result, prioritization under law has the potential for protecting environmental sustainability and, consequently, the human condition where communities are reliant on a vibrant and stable water environment.

Mechanisms for prioritizing water allocations, however, can vary depending on where in the management process of freshwater resources the State decides to impose the prioritization of uses and the extent to which it wants to balance freshwater resources among the various users, including the natural environment. In its most concise form, as is found in the water law of Mozambique, the environment is simply afforded "paramount" priority in the order of resource allocations.[271] As such, the needs of species and habitats always trump those of other water users when water supplies are limited, such as during a drought.

In its most concise form, as is found in the water law of Mozambique, the environment is simply afforded "paramount" priority in the order of resource allocations.

In a more structured system, a priority system for allocating water might be employed at the initial permitting or licensing stage where competing uses

270 South Africa, National Water Act, Act No. 36 of 1998, at para. 110.
271 Mozambique Decree of the Council of Ministers No.43/2007 of 30 October 2007, at Art. 20.

vie for the right to use available freshwater resources. Hence, under Paraguay's Water Resources Law, Article 18 ranks the water needs of aquatic ecosystems second only to water allocations for human consumption and ahead of agricultural, power generation, and industrial uses, while Article 33 directs that this priority order be observed when issuing new water abstraction grants.[272] In a similar fashion, under the Nicaraguan General Law on National Waters, the granting of concession, authorizations, and licenses of freshwater resources for ecological conservation ranks fourth after water for human consumption, potable water services, and agriculture and forestry, and ahead of water for public energy generation, industrial uses, recreational purposes, and other purposes.[273] This approach, which has already been instituted in a number of countries' national water laws, necessitates identifying all water uses eligible to receive water allocations, including the environment, and then ranking them in order of priority. If water resources are plentiful, and where all other criteria are met, all applicants may receive their requested allocation. However, where the demand for freshwater resources exceeds the available supply, as is the case in dozens of countries and regions around the world, allocations and licenses would be awarded according to the prioritization scheme.

A prioritization system for allocating limited water resources can also be implemented after water permits or licenses have been issued in the context of maintaining users' water allocation during times of scarcity. This can be an especially effective way to condition water allocation permits and licences on the possibility that their rightful allocation could be reduced or, at least temporarily, cancelled in the face of a water shortage due to drought or other circumstances. In the case of New South Wales (Australia), the State's Water Management Act of 2000 provides that in the event that a severe water shortage is declared by the government, freshwater will be allocated first to meet basic domestic needs and essential town purposes authorized by an access license, then in response to the needs of the environment, and thereafter for all other priorities.[274]

While none of the above-noted laws articulate an explicit process for implementing these alternative hierarchy systems, there seems to be a presumption that allocations for higher priority uses must be entirely fulfilled before lower priority uses receive any water. Such a presumption, however,

272 *Supra*, n. 268, at Arts. 18 and 33.
273 Nicaragua General Law on National Waters, Law No.620 of 29 August 2007, at Art. 46.
274 Australia New South Wales Water Management Act No. 92 of December 2000, at para. 60.

is not critical for managing limited freshwater resources so long as States, especially those experiencing scarcity, establish clear rules or procedures for determining how and in what quantities water will be apportioned in the event of shortage. In addition to the absolute fulfillment option, the process of distribution could be based on pro rata sharing of reductions, predetermined percentage decreases, or some other appropriate mechanism.

Under the prior appropriation system, which predominates in the western, more arid region the United States, water allocations in times of shortage are awarded by each State based on the applicant's permit date; the older the right, the more senior the right. Thus, under the water code of the U.S. State of Texas, "[a]s between appropriators, the first in time is the first in right."[275] Furthermore, under this system, rightful allocations are awarded absolutely; uses with a higher priority receive their full allocation before uses with a lower priority can obtain any of their allotment. This is true even in the case of emergency or drought and regardless of environmental needs. While some U.S. prior appropriation States now recognize the natural environment as a valid water rights holder, these rights have relatively low priorities since they are based on the dates on which the environmental rights were legally recognized, which in most cases occurred in the past few decades. In contrast, under the riparian rights system that predominates in the eastern half of the United States, water allocations in times of shortage are allotted on a pro rata basis or by applying a reasonableness standard.[276] While not a true prioritization regime, the riparian rights system does afford the possibility of ensuring some measure of freshwater for the environment, especially in those riparian rights States that formally recognize environmental water uses.

5. Minimum instream or environmental flows

In many watercourses, water allocations for human and economic purposes have depleted the resources to the extent of jeopardizing the existence of dependent species and ecosystem varieties. Worldwide, approximately 250 of the world's 500 major watercourses have been seriously depleted and polluted, degrading and poisoning the watercourse and surrounding ecosystems and thereby endangering

275 Texas Water Code, at para. 11.027.

276 Jones v. Oz-Ark-Val Poultry Co., 306 S.W.2d 111, 115 (Ark. 1957); White v. East Lake Land Co., 23 S.E. 393, 394 (Ga. 1895); Bouris v. Largent, 236 N.E.2d 15, 17 (Ill. App. Ct. 1968).

the health and livelihood of people who depend upon them for irrigation, drinking and industrial water.[277]

As a result, minimum flow requirements—some using the phrase "instream flows" while others employing "environmental flows"—have become more prevalent where jurisdictions have sought to ensure the viability of watercourse ecosystems and to prevent the destruction of habitats and extinction of wildlife. Just like in the international context discussed above, such flow requirements are designed to maintain a base water level in rivers as a means of protecting the ecological, chemical, and physical integrity of riverine and related ecosystems. Moreover, they are employed as a green mechanism for balancing the water needs of human and economics-based demands with those required to maintain ecosystem integrity and environmental sustainability.[278] Nonetheless, given that maintaining minimum flows in watercourses in itself is advantageous to people and communities—through enhancements to water-borne commerce and transportation activities, commercial fishing ventures, tourism and recreational endeavors, and sewage and effluent treatment operations—such balancing efforts often produce favourable outcomes for both people and the environment.

Minimum flow refers to some measure of water necessary for a watercourse to maintain water quality and the survival of dependant species and ecosystem varieties. Hence, statutory requirements securing such minimum flows are frequently used with an explicit reference to the purpose of the minimum flow, such as for maintaining fish populations and the health of riverine ecosystems. In the U.S. State of California, for example, the Public Resources Code obligates the California Director of Fish and Game to prepare streamflow requirements "in order to assure the continued viability of stream-related fish and wildlife resources."[279] In the U.S. State of Washington, the Department of Ecology is authorized to establish minimum flows or levels for all public water bodies

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277 UNESCO, International Year of Freshwater 2003, *available at* http://www.unesco.org/water/iyfw2/ecosystems.shtml.

278 A.E., Utton and J. Utton., *International Law of Minimum Stream Flows*, Colorado Journal of International Environmental Law and Policy, Vol. 10(1) (1999), at pp. 7-37.

279 California Public Resources Code, Division 10 (2007).

"for the purposes of protecting fish, game, birds or other wildlife resources, or recreational or aesthetic values of said public waters whenever it appears to be in the public interest to establish the same."[280]

Laws pertaining to minimum flows can be precise and stipulate the actual percentage of flow required. For example, the Chilean legislation prescribes that minimum flows should be no greater than twenty percent of the average annual flow or, in exceptional cases as set by the President, not more than forty percent of the average annual flow.[281] Under this law, minimum requirements only affect permits granted *after* the establishment of standard minimum flow percentages. A similar approach has been adopted in Nicaragua where an interim statutory requirement of ten percent of the average inter-annual flow of watercourses has been inaugurated on a country-wide basis. On a par with Chile, the Nicaragua statutory requirement only affects subsequent resource users.[282]

Whereas stream flows can vary naturally along a watercourse and as a result of climatic conditions at different times of the year, the law may vary on the minimum flow for each individual stream type and stream segment. The Swiss Water Protection Act of 1991 prescribes water protection targets and minimum flow figures for different average flow rates, which take into account the geographic and ecological function of the water bodies.[283] While regulations at the federal level establish minimum flow requirements, individual Swiss cantons may flesh out these provisions depending on local geographic, economic, and ecological considerations.[284]

Most recently, the government of Mexico announced its commitment to publish a national standard for environmental flow determination in 2010.[285] While still under consideration, the standard is expected to prescribe a hierarchy of methods for determining environmental flows as well as include a framework to

280 Washington Revised Code Annotated, at p. 90.22.010.
281 Chile Law No. 20.017 of 11 May 2005 (amending the Water Code), at Art. 129bis 1.
282 Nicaragua Resolutions of the National Environmental Authority No.0127-2006 of 3 March 2006 and 0522-2006 of 21 September 2006.
283 M. Dyson, et.al., (eds.), Flow: The Essentials of Environmental Flows, International Union for the Conservation of Nature (2003), at pp. 80-81.
284 S.M.M. Kuks, *The Evolution of National Water Regimes in Europe: Transitions in Water Rights and Water Policies*, Paper for the Conference on "Sustainable Water Management: Comparing Perspectives from Australia, Europe and the United States," 15-16 September 2005 at The National Museum of Australia, Canberra, Australia. Hosted by the National Europe Centre at The Australian National University.
285 eFlow News, Mexican Govenment Announcing Publication of National Standard, Vol. 6(4) (December 2009), *available at* www.eflownet.org/newsletter.

integrate ecological ramifications of human-induced streamflow alterations known as Ecological Limits of Hydrological Alterations.[286] A draft of the national standard, which was formulated by Mexico's National Water Commission (CONAGUA) in collaboration with experts and environmental organizations, proposes a four-level approach to estimating environmental flows depending on water availability, ecological importance, and conservation conditions. These levels would be applied to both regional water planning and to specific ecosystems, like wetlands, employing specific and holistic methodologies.[287]

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As environmentally significant as provisions authorizing minimum instream and environmental flows may be, their development can be ineffective on and inconsequential for watercourses that are already fully or over appropriated. This is the case in some of the arid regions of the world, including much of the western United States where tightly held water rights have left little, if any, water available for sustaining aquatic and related ecosystems. Of course, many of the obstacles preventing people from relinquishing their water rights in favor of providing water for the environment relate to the economic value associated with water rights. Water for agriculture, industry, and other economically productive uses can be worth a considerable sum and it may be unreasonable to expect holders of water rights to willingly surrender those rights without some measure of compensation. Certainly, a number of governments around the world might be financially capable or even willing to expend the resources necessary to buy out those water rights. What is needed, however, is a mechanism for converting existing water rights from economically productive uses to environmental applications. The pioneering Instream Water Rights Act in the U.S. State of Oregon may be an instructive mechanism.

Creating a complementary legal procedure to the State's in-stream flow provision, the Oregon Act authorizes any person or organization to "purchase or lease all or a portion of an existing [out-of-stream] water right or accept a

286 For a discussion of the scientific basis for Ecological Limits of Hydrological Alterations, see A.H. Arthington, et al., *The Challenge of Providing Environmental Flow Rules to Sustain River Ecosystems*, Ecological Applications, Vol. 16(4) (2006), at pp. 1311-1318.

287 *Supra*, n. 285.

gift of all or a portion of an existing water right for conversion to an in-stream water right."[288] While the original water right comprises resource-intensive water uses, such as for irrigation or industrial purposes, the converted right connotes non-consumptive, environmental uses. The complete conversion of one to the other is intended to rehabilitate streamflows permanently, which, as a result of various factors including over-abstraction, were often diminished below the natural minimum flow needs of the watercourse.[289] Yet, even partial conversion through time-limited leases can help restore riverine ecosystems during periods when the water rights are not otherwise being used. Under the Oregon Act, though, only the State can hold instream flow rights.[290] Accordingly, once an out-of-stream water right is converted into an in-stream water right, it must then be transferred to and held in trust by the State's Water Resources Department for the benefit of the people of Oregon. Variations on this mechanism have been implemented in other United States jurisdictions, including the States of Colorado, Idaho, Montana, Texas, Utah, and Washington.[291] Laws in the U.S. States of Alaska and Arizona also permit the conversion of water rights for in-stream flow purposes but allow in-stream rights to be held privately.[292]

One of the innovative developments that have further complemented the instream flows process in Oregon is the creation by private citizens of The Freshwater Trust (successor to both Oregon Trout and the Oregon Water Trust). The non-for-profit organization raises funds and applies market-based approaches for converting existing consumptive water rights into instream water rights and then works with the Oregon Water Resources Department to monitor and enforce these converted rights.[293] The Trust's relative success in restoring many stream segments in the State through this conversion process suggests that "environmental water transactions have gained a prominent role as an important tool in protecting and restoring water-dependent ecosystems in a way that minimizes disruption and controversy."[294] In particular, the recourse

288 Oregon Instream Water Rights Act, Oregon Revised Statutes 537.348(1).
289 A. Purkey & C. Landry, *A New Tool for New Partnerships: Water Acquisitions and the Oregon Trust Fund*, Water Law, Vol. 12(5) (2001), at p. 5.
290 Oregon Instream Water Rights Act, Oregon Revised Statutes 537.332(3).
291 M.A. King, *Getting Our Feet Wet; An Introduction to Water Trusts*, Harvard Environmental Law Review, Vol. 28 (2004), at fn 5.
292 Alaska Statutes. 46.15.145, 46.15.260 (1998); Arizona Revised Statutes Annotated 45-141A (West 1998).
293 The Freshwater Trust website, *available at* http://www.thefreshwatertrust.org/.
294 S. Malloch, *Liquid Assets: Protecting and Restoring the West's Rivers and Wetlands through Environmental Water Transactions*, Trout Unlimited (March 2005), at p. 35.

given to citizens to use the market to pursue water-related environmental protection goals aptly illustrates the juxtaposition of development and conservation, where in essence the environment has become a market player and transfers are based on environmental considerations.

6. Reserved waters

While minimum instream and environmental flows appear to be a growing trend within the domestic water laws of nations around the world, a number of countries have taken another approach to ensure the basic water needs of people and the environment. The notion of reserved waters essentially creates a set-aside of water for specific purposes, such as basic human or environmental needs, and imposes safeguards to ensure that the base amount of the reserve is never allocated or applied to other uses. Hence, in jurisdictions adopting such measures, absent subsequent legislative change, reserved waters for ecological purposes can never be used for industrial, agricultural, or other uses.

For example, both the South African National Water Act and the Kenyan Water Act recognize reserved water for both human and environmental purpose. Under South Africa's law, "reserve" is defined in terms of "satisfy[ing] basic human needs" and "protect[ing] aquatic ecosystems,"[295] while under Kenya's law, it is described with regard to "the quantity and quality of water required to, (a) satisfy basic human needs for all people who are or may be supplied from the water source; and (b) protect aquatic ecosystems in order to secure ecologically sustainable development and use of the water resource."[296] Both laws require the government to characterize and quantify each reserve,[297] as well as authorize the water licensing authority to condition the issuance of new and amended water licenses on first meeting the needs of reserve waters.[298] Additional provisions in both nations' water laws further instruct relevant governmental authorities to give effect to and take into account the requirements of the reserve in all water-resource related decisions

Both the South African National Water Act and the Kenyan Water Act recognize reserved water for both human and environmental purpose.

295 *Supra*, n. 270, at Art. 1(1)(xviii).
296 *Supra*, n. 267, at Art. 2(1).
297 *Supra*, n. 270, at Arts. 12 and 16; *supra*, n. 267, at Art. 13.
298 *Supra*, n. 270, at Arts. 27(1) and 49; *supra*, n. 267, at Art. 32(1).

and also in the formulation of national and catchment-level strategies.[299] Significantly, the notion of "reserve" in South Africa has effectively served as a prototype for other nations' legislations establishing related categories of reserves, most of which incorporate an environmental protection dimension.

The Armenian Water Code, which may provide even stronger protections for waters reserved for restricted purposes, defines "National Reserve" as "[t]he quality and quantity of water that is required to satisfy present and future basic human needs, as well as to protect aquatic ecosystems and to secure sustainable development and use of that water resource."[300] The Code safeguards water in the National Reserve from other potential uses by defining "Useable Water Resources" as "[t]he portion of water resources that may be allocated for consumptive use without reducing the National Water Reserve."[301] The Armenian Water Code also mandates the quantification of the National Reserve, as well as "measures to enhance its preservation,"[302] and conditions all water use permits on ensuring that they cause no harm to the National Reserve.[303]

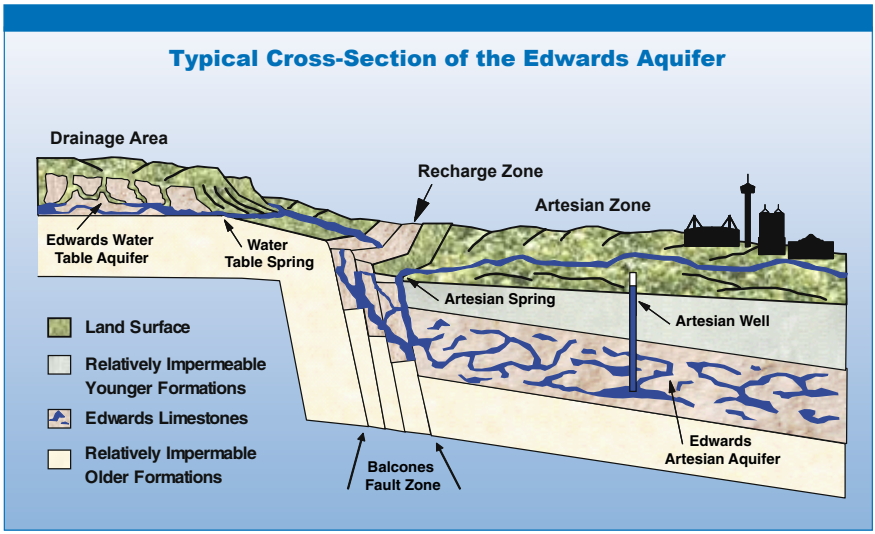
The Spanish Law on the National Water Master Plan empowers the government to set aside not only a specific volume of water, but also entire rivers and river segments, aquifers, and other water bodies as part of an environmental reserve.

In yet another variation on this theme, the Spanish Law on the National Water Master Plan empowers the government to set aside not only a specific volume of water, but also entire rivers and river segments, aquifers, and other water bodies as part of an environmental reserve. Furthermore, the law authorizes the proscription of new water abstraction rights and licenses where such grants would interfere with the set-aside and its intended purposes.[304]

299 *Supra*, n. 270, at Arts. 9(a), 18, 36, 45(2), and Schedule 3(6)(3); *supra*, n. 267, at Arts. 13(2) and 36(1).
300 Armenia Water Code 2002, at Art. 1.
301 *Ibid*., at Art. 1.
302 *Ibid*., at Arts. 16 and 18.
303 *Ibid*., at Arts. 28-29 and 31.
304 Spain, Law Concerning the National Water Master Plan, Law No.10 of 2001, at Art. 25.

7. Controlling groundwater exploitation to ensure its ecosystem support function

As noted in the international discussion on transboundary aquifers, groundwater resources have unique characteristics that can differ significantly from those of surface waters. One of the traits that is actually quite comparable between the two water sources is the ability of both resources to sustain an assortment of habitats and a variety of animal and plant species. While river and lake-dependant ecosystems can be relatively conspicuous, as in the case of fisheries and river-fed wetlands, those reliant on aquifers are often less perceptible. For example, oases ecosystems, such as the Awjila and Kufra oases of the Sahara Desert and the Ein Gedi Oasis near the Dead Sea in Israel, are sustained exclusively by groundwater flowing underneath the oases. Likewise, wetlands ecosystems, such as those of La Mancha Húmeda in the semi-arid territory of central Spain, are often highly dependent on the region's groundwater resources.



Typical cross-section of the Edwards Aquifer Region. Graphic courtesy of Gregg Eckhardt, The Edwards Aquifer Website, http://www.edwardsaquifer.net/

More unique, though, are groundwater-dependent ecosystems found within the matrix of certain aquifer types. Predominantly of karst formations, a number of aquifers are now known to sustain a variety of distinct habitats and species, typically not found anywhere else in the world, within the geologic formations that form these aquifers. Some of the best studied aquifer-

dependent habitats are those of the Edwards Aquifer in the south-central region of the U.S. State of Texas. Considered one of the most diverse aquifer ecosystem in the world, the Edwards Aquifer contains more than 40 species of highly adapted, aquatic, subterranean species, including amphipod crustaceans, gastropod snails, and vertebrates such as blind catfish.[305]

Groundwater resources have unique characteristics that can differ significantly from those of surface waters.

Like their surface water-related counterparts, aquifer-dependent ecosystems are highly susceptible to stress, pollution, and destruction. The overexploitation of aquifers is an especially critical threat to such ecosystems because even a slight drop in an aquifer's water table can dry up springs and seeps that feed hydraulically related wetlands and other ecosystems, as well as desiccate inter-aquifer habitats.

As a result, many nations and international institutions have begun implementing discrete and self-standing protections tailored specifically for aquifers to ensure their ecosystem support function. To a large extent, these provisions have been formulated in response to the importance of these resources as a source in their own right, to their connection to surface water bodies, and to their support function to neighbouring wetlands and forests. For example, under the New South Wales (Australia) Water Management Act of 2000, aquifer-related activities must, *inter alia*, avoid or minimize land degradation such as the decline of native vegetation, increased acidity, and soil erosion.[306] Moreover, any aquifer-related activity that impacts the aquifer must obtain governmental approval in advance.[307] Furthermore, the management plan for the relevant area where such controlled activity occurs must identify the nature of the aquifer interference having any effect, including "cumulative impacts, on water sources or their dependent ecosystems, and the extent of those impacts."[308]

Under the New South Wales (Australia) Water Management Act of 2000, aquifer-related activities must, inter alia, avoid or minimize land degradation such as the decline of native vegetation, increased acidity, and soil erosion.

305 Endangered Species and the Edwards Aquifer, The Edwards Aquifer Website, http://www.edwardsaquifer.net/species.html.
306 *Supra*, n. 274, at para. 5(8).
307 *Ibid*., at para. 32.
308 *Ibid*., n. 274, at para. 32.

Plans for such controlled activity also deal with undertaking work with a view to rehabilitating the water source or its dependent ecosystems and habitats.[309]

The 2006 EU Groundwater Directive, a daughter directive of the Water Framework Directive (WFD) designated to implement Article 17 of the WFD, establishes a standard regime for groundwater protection, a criteria for assessing and restoring groundwater status, and introduces measures to prevent and limit the discharge of pollutants into groundwater resources with the goal of achieving the WFD's environmental objectives.[310] The quantitative status of groundwater is given particular importance not only for general purposes of environmental protection, but also in view of the protection of the ecological quality of surface waters and terrestrial ecosystems associated with a groundwater body. The WFD considers that a certain amount of the annual groundwater recharge is needed to support interrelated and dependent ecosystems (whether they be surface water bodies or terrestrial systems such as wetlands).

In another example, the 2004 Namibia Water Resources Management Act empowers the Namibian Water Minister to establish the "safe yield" of aquifers when making determinations regarding its use, where "safe yield" refers to the amount and rate of abstraction that would not cause damage to the aquifer, quality of the water, or the environment.[311] The rationale behind this provision is that, through a prior safe yield determination, the government will be in a position to make more considered decisions regarding the extractions of groundwater from a given aquifer that takes into account, among other things, the water requirements of groundwater-dependent habitats, most notably, wetlands.

Although minimum in-stream or environmental flows do not apply directly to groundwater resources, the notion of maintaining a minimum flow regime for an aquifer and its dependent ecosystems is a justifiable objective. Like minimum flow requirements for surface bodies of water, ensuring the water flow through an aquifer will safeguard habitats and species that rely on the aquifer for their survival and would otherwise disappear. For example, under the Edwards Aquifer Authority Act, which manages the Edwards Aquifer in central Texas, the Authority

309 *Ibid*., n. 274, at para. 33.

310 Protection of Groundwater Against Pollution and Deterioration, Council Directive 2006/118, 2006 O.J. (L 372) 19 (EC).

311 *Supra*, n. 251, at para. 51.

may not authorize withdrawals from the entire aquifer exceeding 572,000 acre-feet (approximately 705,550 cubic meters) of water annually.[312] The stated objective of this cap is, *inter alia,* to ensure that the continuous minimum springflows of specified springs discharging from the aquifer are maintained and, thereby, to protect endangered and threatened species and ensure water quality of the aquifer and the discharging springs. Significantly, the law also states that the purpose of the withdrawal limitation is intended to "recognize the extent of the hydro-geologic connection and interaction between surface water and groundwater."[313]

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8. Water rights trading

As suggested in the discussion on minimum instream and environmental flows, under certain circumstances, the market can have positive implications for the management of freshwater resources. This is particularly true in the redistribution and reallocation of water rights from lower value priorities to higher value ones, which can help alleviate the pressure on scarce freshwater sources by enhancing efficiency in the allocation and reallocation of water for abstraction and use permits and concessions.

The trading of water entitlements involves the use of market forces to buy and sell, trade, or barter entitlements to freshwater resources that have previously been issued by the government. Although such trades typically involve transfers of water rights in exchange for direct monetary compensation, there is nothing to indicate that other payment mechanisms may be any less effective. In the case of Oregon's Freshwater Trust, the non-for-profit organization occasionally has paid farmers for their water rights by funding or otherwise supporting farmers' water conservation efforts, such as replacing antiquated and low-tech diversion structures with modern systems or replacing leaky open ditches and

312 Edwards Aquifer Authority Act of May 30, 1993, 73rd Legislature, Regular Session, Chapter 626, 1993 Tex. Gen. Laws 2350, as amended.

313 *Ibid*., at para. 1.14.

stockponds with pipes and water troughs, and even offering exchanges using alternative water sources.[314]

To implement a framework allowing water trading, governments must provide legal recognition to the notion that water can be valued in economic terms and, more specifically, that water rights have monetary values that can be traded on a market. Moreover, prerequisites to an effective water rights trading scheme necessitate legislation that recognizes the limits on the availability of the resource, clearly defines the property rights aspects of freshwater resources, authorizes the transferability of water rights, and establishes the parameters of the trading scheme—notably, conditions on transfers and uses aimed at preventing adverse third party effects, particularly on the environment.[315]

Australia, long known for its ongoing and devastating drought in much of the country, is also known for its well-developed system for water rights trading. In the State of New South Wales, for example, under its Water Management Act of 2000, water access licenses may be held by individuals, corporations or by several parties at once and are held as a property right separate from title in land. With some exceptions, these water access licenses are fully transferable, permanently and temporarily, through a State regulated water market.[316] Before a water access license holder may use the water "for a particular purpose at a particular location," the holder must obtain a water use approval.[317] Such approvals are attached to the land and are not independently transferable. Water use approvals both streamline the transferability of water access licenses on a private market and ensure that the public interest is protected by the State.[318]

In a similar vein, Mexico's National Water Law authorizes the transfer of water permits, wholly and in part, permanently and temporarily, on a seasonal basis.[319] Temporary transfers are subject to prior notification to the

314 J. Neuman and C. Chapman, *Wading Into the Water Market: The First Five Years of the Oregon Water Trust*, Journal of Environmental Law and Litigation, Vol. 14 (1999), at p. 145; J. Neuman, *The Good, The Bad, and The Ugly: The First Ten Years of the Oregon Water Trust*, Nebraska Law Review, Vol. 83 (2004), at p. 444.

315 M. Dyson & J. Scanlon, *Trading in Water Entitlements in the Murray Darling Basin in Australia—Realizing the Potential for Environmental Benefits*, IUCN ELP Newsletter, No. 1 (2002).

316 *Supra,* n. 274, at paras. 71M and N.

317 *Ibid*., at para. 89.

318 K.M. Sibbernsen, *Looking for Water Down Under: Revitalizing Wyoming's Water Laws in Light of New South Wale's Water Management Act of 2000*, Georgetown International Environmental Law Review, Vol. 21 (2009), at pp. 786-787.

319 Mexico, National Water Law, *supra,* n. 266, at Art. 22.

government,[320] whereas permanent transfers require governmental review prior to the exchange if the transfer entails modifications to the terms of the grant or if it may have third-party, environmental, or hydrological effects.[321]

Another jurisdiction known for its system for water rights trading is the U.S. State of California. The California Water Code, which distinguishes between long-term and short-term water entitlement transfers, places no restrictions on private transfers of water rights unless they are accompanied by a change in the way the water right is utilized. Provisions governing petitions for short term transfers that include changes to the water right can only be authorized where it is shown that the change will not, *inter alia*, "unreasonably affect[] fish, wildlife, or other instream beneficial uses."[322] While a similar proviso is missing from the provisions governing long-term transfers accompanied with water rights changes,[323] the California State Water Resources Control Board relies on its responsibility under the public trust doctrine to judge whether the approval of such a long-term change is in the public interest.[324]

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While the overall advantages and disadvantages of water rights trading systems are still being debated, it is evident that where societal priorities emphasize the needs of people and ecosystems, such systems can influence the market value of water for such priorities as human and environmental health, food production, and the needs of future generations. To the extent that governments and individuals have the resources to secure water for these purposes, the market can certainly support the pursuit of such ideals as the MDGs.

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320 *Ibid.*, at Art. 23bis.
321 *Ibid.*, at Art. 33.
322 California Water Code, at para. 1725.
323 *Ibid.*, at paras. 1702 and 1735.
324 A Guide to Water Transfers, Division of Water Rights, State Water Resources Control Board, California Environmental Protection Agency, Draft July 1999, at pp. 6-13, *available at* http://www.waterboards.ca.gov/waterrights/water_issues/programs/water_transfers/docs/watertransferguide.pdf.

9. Ecosystem or environmental services payments

People and communities around the world obtain considerable benefits from a multitude of resources and processes that are provided by the natural functioning of ecosystems. Collectively, these benefits are known as ecosystem or environmental services and include outputs such as clean drinking water and processes like the decomposition of wastes. Bogs, swamps, marshlands and other types of wetlands worldwide, for example, have collectively been estimated to provide the equivalent of US$15 trillion in ecosystem services in the form of clean freshwater.[325] But for these natural processes, humankind would have had to pay colossal sums to achieve the same amount of clean water through artificial purification and detoxification processes. The seminal 1997 Nature Magazine article, *The Value of the World's Ecosystem Services and Natural Capital*, estimated the annual average value of global ecological benefits at $33 trillion, nearly double the global gross national product at that time.[326]

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Ecosystem and environmental services constitute the processes by which the natural environment produces resources and services that benefit human society.[327] In addition to the water purification qualities of wetlands, other ecosystem and environmental services include: water purification via aquifers; bulk water storage in aquifers, lakes, permafrost, snowpack, icebergs, and glaciers; detoxification and decomposition of waste though functioning wetlands and aquifers; protection against floods, storm surges, and land erosion from maintained wetlands that absorb runoff and flood waters; and moderation of weather extremes as a result of balanced ecosystems.[328] These services, in

325 V. Carter, *Technical Aspects of Wetlands: Wetland Hydrology, Water Quality, and Associated Functions*, *in* National Water Summary on Wetlands Resources, United States Geological Survey Water Supply Paper 2425 (J.D. Fretwell, et.al., Compilers 1996).

326 R. Costanza, et.al. *The value of the world's ecosystem services and natural capital*, Nature, Vol. 387 (15 May 1997), at pp. 253-260.

327 J. Salzman, *Creating Markets for Ecosystem Services: Notes from the Field*, New York University Law Review, Vol. 80 (2005), at p. 870.

328 Living Beyond Our Means: Natural Assets and Human Well-Being—Statement from the Board, Millennium Ecosystem Assessment (2005), *available at* http://www.millenniumassessment.org/documents/document.429.aspx.pdf.

turn, provide tremendous benefits to people and communities in the form of enhanced opportunities for aquaculture and other food production efforts, sustained availability of freshwater for human consumption, and improvements in human health through reduction in water-related diseases and water for sanitation services.

Ecosystem and environmental services operate freely in the sense that individuals and communities do not pay for them directly and, for the most part, ignore them. Yet, natural resources and the environment are neither invulnerable nor infinitely available. As human populations and economic developments continue to expand, the demands imposed on ecosystems are also growing. Today, many ecosystems have been taxed beyond their capacities to provide the benefits to which humanity has become accustomed. Air and water quality have been compromised, fish stocks and the availability of other animals and plants have been depleted, pests and diseases have extended their historical ranges, and deforestation has exacerbated flooding and erosion.

As a result of diminishing ecosystem and environmental services, people and communities around the world are becoming increasingly aware of the value that such natural processes provide society. More specifically, they are beginning to recognize that these services are not only limited, but also that they are threatened by human activity. Hence, there is an overriding need to ensure the viability and sustainability of ecosystem and environmental services not only to protect the health of the environment, but also to secure the long-term advantages derived from these services and that enable human societies and economic development to progress.

Until recently, the market, water rights holders, and most economic models neglected the economic value of ecosystem and environmental services when assessing the value of the environment for human endeavour as well as when estimating the worth of water rights. Today, many governments have begun to explore mechanisms that recognize the monetary values of such services and that incentivize the protection and continued delivery of these services through financial and other payment schemes. These payments are directed primarily to private owners and managers

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of land and water rights as an inducement to carry out, or refrain from, certain activities that ultimately reverberate on the quality and dependability of freshwater systems. In particular, they are being aimed at ecological and conservation purposes through the payment for services that confer water-related environmental benefits.

Although most countries that have implemented such programs have done so on a voluntary basis, a number of governments have experimented with binding requirements. Moreover, while regulations requiring payment for such services are more often within the purview of environmental statutes, they are now finding their way into some modern water laws as well. An example of a mandatory payment for ecosystem services structured within a nation's water laws can be found in Costa Rica, which, in 2005, instituted a water tariff structure that highlights the economic, social and environmental importance of water.[329] Under the law, the value of water, and thereby water tariffs, comprises both a "use" element and an "environmental" element.[330] Half of the proceeds from water charges are allocated by the government for national water management and for specific projects, while the remainder is allocated to conserve, maintain, and restore the basin unit ecosystem, including surrounding forests.[331] Part of the National Forestry Fund that finances the Environmental Services Payment Programme is used to remunerate private property holders within forests for the services rendered therein, which result in water resource conservation and protection.[332] Part of these funds can also go to municipalities to fund the purchase of private land for the protection of groundwater recharge areas and for the protection of water sources of local significance.[333]

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329 Costa Rica Decree of the President of the Republic No. 32868 of 24 August 2005 Inaugurating and Regulating a Water Charging Scheme.
330 *Ibid*., at Art. 3.
331 *Ibid*., at Arts. 13 and 14.
332 *Ibid*., at Art. 14.
333 *Ibid*., at Art. 14.

10. Protected water areas and zones

According to the International Union for the Conservation of Nature (IUCN), a protected area is defined as "[a] clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values."[334] Protected areas can vary by habitats and geography, such as wildlife sanctuaries and marine protected areas, as well as by the extent of protection created. In 2009, over 120,000 protected areas, zones and reserves had been established worldwide, covering approximately 13.4% of the Earth's land area.[335]

Protected areas can also apply to freshwater resources. The Spanish Law on the National Water Master Plan, for example, empowers the government to set aside entire rivers (or sections thereof), aquifers, and other water bodies as part of an environmental reserve. The creation of such reserves under the law creates the possibility that new water abstraction rights and licenses in that area may be prohibited to safeguard the reserve's water.[336] Conceptually analogous to the notion of reserves, protected water areas and zones in Namibia are designed to protect "any water resource, riverine habitat, watershed, wetland, environment or ecosystem at risk of depletion, contamination, extinction or disturbance from any source, including aquatic and terrestrial weeds."[337]

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The purposes of designating a body of water a protected area or zone—and restricting or banning activities therein—are often included in the main statute, with the specific geographic boundaries in which they apply indicated

334 N. Dudley, ed. Guidelines for Applying Protected Area Management Categories, International Union for the Conservation of Nature (2008), at p. 19.

335 L. Coad, et.al., Progress Towards the Convention on Biological Diversity's 2010 and 2012 Targets for Protected Area Coverage: A technical report for the IUCN international workshop "Looking to the Future of the CBD Programme of Work on Protected Areas", Jeju Island, Republic of Korea, 14-17 September 2009, United nations Environmental Programme and World Conservation Monitoring Centre (2009), at pp. 5-7.

336 *Supra*, n. 304, at Art. 25.

337 *Supra*, n. 251, at para. 72.

in subsidiary legislation. The types of activities proscribed in the water body or its vicinity include the application or storage of pesticides or fertiliser chemicals, road construction, tree felling, mining, abstractions and effluent discharge. Under the Armenian Water Code, the government is directed to establish procedures for, among other things, controlling impact to water resources in watersheds and wetlands, designating and protecting water resources that are considered natural monuments, and establishing zones for water ecosystem protection. It also requires that the government develop measures for allocating land and forest use, construction of pipelines or other communication devices, and extraction of biological resources and materials at water ecosystem protection zones.[338]

Under the Armenian Water Code, the government is directed to establish procedures for, among other things, controlling impact to water resources in watersheds and wetlands, designating and protecting water resources that are considered natural monuments, and establishing zones for water ecosystem protection.

11. General environmental perspective

The degree to which a nation's water law is interpreted to be environmentally sensitive is often a function of the perspective from which the water law itself is presented. A water law, for example, may be described in its preamble or introductory articles solely as a mechanism for allocating or managing property rights in water resources. In such a case, it is unlikely that a court, water resources manager, or water rights holder would view the law as having any environment-related qualities. In contrast, a water law that explicitly provides that it is designed, at least in part, to benefit the environment would likely be perceived by a court or water rights holder as an environmental type of law.

The degree to which a nation's water law is interpreted to be environmentally sensitive is often a function of the perspective from which the water law itself is presented.

While this distinction may appear overly simplistic, the perspective from which a water law is presented can have considerable impact on how it is perceived and implemented by courts, water resource managers, and

338 *Supra*, n. 300, at Art. 121(5).

water rights holders. Absent specific rules of construction instructing the reader to interpret the law in a certain light, or other guidance or intention evidenced in the legislative history of the law, courts tend to read laws rigidly in accordance with the letter of the written law. Thus, in order to ensure that environmental principles are to be borne in mind in the reading, construction, and implementation of a water law, it is critical that environmental protection and conservation priorities are underscored in the fundamental or guiding tenets at the start of the law.

An example of a clear environmental perspective is evidenced in Paragraph 3 of the New South Wales (Australia) Water Management Act of 2000, which defines the purpose of the law, in part, as:

> *to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations and, in particular:*
>
> *(a) to apply the principles of ecologically sustainable development, and*
> *(b) to protect, enhance and restore water sources, their associated ecosystems, ecological processes and biological diversity and their water quality, and*
> *(c) to recognise and foster the significant social and economic benefits to the State that result from the sustainable and efficient use of water, including:*
> *(i) benefits to the environment, and*
> *(ii) benefits to urban communities, agriculture, fisheries, industry and recreation, and*
> *(iii) benefits to culture and heritage, and*
> *(iv) benefits to the Aboriginal people in relation to their spiritual, social, customary and economic use of land and water*[339]

Significantly, the New South Wales Water Management Act also provides a strong environmental perspective in Paragraph 5 where it explicitly articulates the water management principles to be utilized in construing the Act, including:

> *(a) water sources floodplains and dependent ecosystems (including groundwater and wetlands) should be protected and restored ...*

339 *Supra*, n. 274, at p.3.

(b) *habitats, animals and plants that benefit from water, or are potentially affected by managed activities should be protected and (in the case of habitats) restored; and*
(d) *The cumulative impacts of water management licences and approvals and other activities on water sources and their dependent ecosystems, should be considered and minimised.*[340]

In Mali the objective of the Water Code (Law No. 02-006 31 January 2002) as mentioned in Article 1, is to establish rules for the use, conservation, protection and management of water resources. The management of water resources is to be conducted in an equitable and sustainable manner (Article 8). It is the same for Burkina Faso where the Water Law (2001) promotes the sustainable management of water resources as a national priority, and fixes the preservation and restoration of water quality and the protection of ecosystems as one of its goals.

Similar expressions can be found for example in the Water Act of Austria and in other countries' legislation. In a far more detailed fashion, the South African National Water Act of 1998, in its introductory paragraph to Chapter 1 on Interpretation and Fundamental Principles, explains that:

[t]his Chapter sets out the fundamental principles of the Act. Sustainability and equity are identified as central guiding principles in the protection, use, development, conservation, management and control of water resources.[341]

It then articulates the purpose of the Act as:

to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in ways which take into account amongst other factors … (d) promoting the efficient, sustainable and beneficial use of water in the public interest … (g) protecting aquatic and associated ecosystems and their biological diversity … (h) reducing and preventing pollution and degradation of water resources.[342]

340 *Ibid*., at p.5.
341 *Supra*, n. 263, at Chapter 1.
342 *Ibid*., at Chapter 1(2).

Thereafter, in Article 3, the South African National Water Act elucidates the necessary balance that must be struck between development and environmental protection goals:

> *(1) As the public trustee of the nation's water resources the National Government, acting through the Minister, must ensure that water is protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner, for the benefit of all persons and in accordance with its constitutional mandate.*
> *(2) Without limiting subsection (1), the Minister is ultimately responsible to ensure that water is allocated equitably and used beneficially in the public interest, while promoting environmental values.*[343]

In 2000 the European Union adopted a Directive "establishing a framework for Community action in the field of water policy", called the Water Framework Directive (WFD).[344] The text of the WFD has strong environmental objectives and is intended "to establish a framework for the protection"[345] of all waters (surface, coastal, transitional and groundwaters). The goals of the WFD are to:

- Prevent further deterioration, and protect and enhance the status of aquatic and terrestrial ecosystems and wetlands;
- Promote the sustainable use of freshwater based on long-term protection of available water uses;
- Enhance the protection of and improve the aquatic environment;
- Ensure the progressive reduction of pollution of groundwater and prevent its further degradation.

The WFD obligates Member States to achieve good water status for both surface and groundwater by 2015 (Article 4). For surface waters, the obligation concerns the ecological and chemical status, while for groundwaters it is related to the quantitative and chemical status (Annex V).

Although water laws are typically intended as mechanisms for managing and allocating nations' freshwater resources, by including general environmental

343 *Ibid*., at Chapter 1(3).
344 European Union Water Framework Directive, Council Directive 2000/60/EC, P9, 2000 O.J. (1327) (EC).
345 *Ibid*., at Art. 1.

perspectives into the foundational sections of the laws, legislatures can help emphasize the importance of environmental protection and conservation priorities in relation to other national objectives, especially economic development and the protection of private property rights. Moreover, they can aid in raising environmental concerns to the level of other national interests and allow a more judicious balancing effort among competing claims for freshwater resources.

Conclusions

During the late 1980s, the concept of sustainable development introduced the idea that human societies could reconcile environmental conservation aspirations with human survival and economic development objectives, and thereby ensure the sustainability and advancement of both humanity and the natural environment into the future. While the notion was quickly integrated into numerous aspects of societal and human development processes, the incorporation of environmental priorities into the management and regulation of freshwater resources took a more circumspect and individualized approach.

Regardless of the slow progress in integrating the environmental dimension into the management and regulation of fresh water resources, nearly three decades later the greening of national and international water laws can no longer be described as isolated or discrete occurrences. Today, there is an emerging appreciation for the interrelationship between human activity and the integrity of the natural environment, as well as for the complex association between the water needs of both people and of nature. Moreover, nations and communities around the world are becoming increasingly aware and respectful of the notion that great benefits can ensue, to both human communities and the natural environment, from the sustainable management of fresh water resources. Hence, people and communities globally are now implementing programs, procedures, and laws that, at the very least, ensure that the water needs of the natural environment are considered in societal water management decisions. Some nations have even secured a protected amount of fresh water to ensure the sustainability of their fauna and flora.

Moreover, nations and communities around the world are becoming increasingly aware and respectful of the notion that great benefits can ensue, to both human communities and the natural environment, from the sustainable management of fresh water resources.

The greening trends related to water law, at both the national and international levels, may be fairly described as movements based on a rational

long-term response to a growing global concern. Countries around the world are experiencing considerable pressure to address environmental problems, especially those related to fresh water resources. It is now widely acknowledged that a clean and healthy aquatic environment is essential for ensuring, not only the integrity of species, habitats, and other aspects of the natural environmental, but also for the sustainability and continued progress of people and human communities. Accordingly, the greening of water laws that is now underway can be characterized simply as a matter of common sense—action worth taking because it is likely to benefit both humanity and the natural environment.

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Interestingly, the foregoing analysis evidences no direct linkages between the changes occurring in the national and the international arenas. Certainly, some nations have involved themselves with greening efforts at both levels of governance. South Africa, for example, in its National Water Act mandates that fresh water resources must be "allocated equitably and used beneficially in the public interest, while promoting environmental values."[346] Similarly, the 2000 Revised SADC Protocol, to which South Africa is a party and which was adopted two years after South Africa enacted its National Water Act, obligates State Parties to "maintain a proper balance" in managing fresh water resources for people and the environment "to promote sustainable development."[347] Although such similarities in the greening mechanisms and objectives introduced at both the national and international levels may exist, few if any correlations can be derived from these occurrences. Rather, it remains to be seen whether changes at the national level are having any bearing on developments at the international level, changes at the international level are influencing domestic legislation, or some combination of both.

While the examples provided in the preceding chapters suggest that the trend in the integration of environmental considerations into water laws and policies is well on its way, it is far from universal or comprehensive. Many

346 *Supra*, n. 270.

347 2000 Revised Protocol on Shared Watercourses in the Southern African Development Community, *supra*, n. 95, at Art. 3(4).

nations, in both the developed and developing world, have yet to embrace the greening movement within their water regulatory regime and many more have yet to recognize the considerable advantages that may emanate from a more integrated and balanced approach to water management. Moreover, because the green approach to water regulation does not always result in immediate societal benefits, governments also face political and economic obstacles in seeking to realign medium and long-term water management strategies rather than on providing for the immediate needs of their citizens.

The core water challenge facing most governments today, from the local to the international levels, is how to realign the availability of water with human and economics-based demand at levels that maintain ecosystem integrity and environment sustainability.

The core water challenge facing most governments today, from the local to the international levels, is how to realign the availability of water with human and economics-based demand at levels that maintain ecosystem integrity and environment sustainability. In large part, this realignment requires the integration of environmental considerations, alongside needs for personal consumption, sanitation, agriculture, and industry, into the drafting and implementation of water resource-related national and international policies and legislation. Given that environmental considerations have historically been deemed secondary or even non-priorities in decision-making related to the allocation and management of freshwater resources, the realignment will have to focus, at least initially, on expanding the attention accorded to environmental concerns in the existing people-centered processes.

Nevertheless, governments and institutions at all level of civil society must be encouraged to seek such realignment and a more balanced approach to their water uses with regard to both human and environmental water needs. They must make sustainability in water use and allocation a hallmark of their water management practices and seek mechanisms for ensuring the continuity of benefits of the natural environment for people as well as for species and habitats. Moreover, people and communities must ensure that environmental and aquatic ecosystem needs are considered equally alongside human and economic priorities, and that decision-makers afford equity when allocating costs and benefits among all of these concerns.

While the mechanisms and approaches explored in this publication do not constitute an exhaustive series of recommendations on how to further integrate environmental concerns into water laws and policies, they do suggest that there is considerable space for implementing additional greening efforts. Governments and other entities, however, should not pursue such objectives haphazardly and merely for altruistic reasons. Rather, they should be engaged in a methodical and purposeful process that clearly identifies the goals, procedure, stakeholders, priorities, and methods of implementation. Moreover, the expected costs and benefits associated with the proposed efforts must be calculated and assessed against the objectives of the proposal. Likewise, legislatures and legislators must make a concerted effort to harmonize environmentally-friendly water laws with other laws to the extent that the implementation of one does not frustrate the objective of another.

Ultimately, the greening of water law represents both an historic opportunity and a considerable challenge for people and nations around the world in the effort to ensure both human progress and environmental sustainability.

Ultimately, the greening of water law represents both an historic opportunity and a considerable challenge for people and nations around the world in the effort to ensure both human progress and environmental sustainability. The opportunity lies in building thriving societies that exist in harmony with nature, where communities prosper with economies that develop and expand, and where such progress does not tax or infringe on the surrounding environment and its sustainability. The challenge, though, is for governments and institutions to find the appropriate mechanisms and tools that will effectively implement such a balance. The challenge also lies in nations' ability to overcome the historic disparities that they have imposed through their legal systems on the management of fresh water resources for people and development, and for species, habitats, and ecosystems. The benefits, however, should be well worth the effort.

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