FACTORS FOR CONSIDERATION IN PROTECTING WATER AND LAND RESOURCES

by

Kevin Andrew Johnson

A Plan B Paper

Submitted to:

Michigan State University
in partial fulfillment of the
requirements for the degree of:

MASTER IN URBAN PLANNING

College of Social Science
Urban Planning Program

August 20, 1993

TABLE OF CONTENTS

	Page
Introduction	1
The Hydrologic Cycle	4
The Impact of Land Uses on the Hydrologic Cycle	11
Public Sector Involvement in Protecting the Environment	16
Water and Land Resource Management Techniques	26
Effectiveness of Resource Protection Alternatives	41
Institutional Considerations	47
Conclusions	51

Introduction

There has been growing public awareness about the quality of the natural environment.[1] Over the past two decades, a host of environmental issues has emerged, ranging from air and water quality to energy conservation and the preservation of the ozone layer.[2] Concern with environmental degradation is manifested in the heightened public dialogue and legislative action pertaining to the quality of the environment that has transpired since the late 1960s.[3] Furthermore, national environmental policy has played a more significant role during recent presidential elections.[4] While environmental dialogue is desirable at the national level, it is essential that many of these environmental considerations be addressed at local and regional levels. Local land use decisions provide a basic building block, and can have far reaching implications with respect to environmental integrity. Moreover, decision makers at the local and regional levels should be better able to identify indigenous social and physical conditions. While individuals have made land use decisions for centuries, these

---

[1] Gale E. Newell, et al., "The Effect of Michigan's Environmental Regulations (including PA 307) on Accounting and Auditing," The Michigan CPA 44 (Fall 1992): 8-10.

[2] Forbes, "Meeting the Challenge of Sustainable Development," Forbes (May 25, 1992) 118-133.

[3] Roy M. Adams, Charles D. Fox, and Sheldon A. Zabel, "Liability for Environmental Hazards: The Saga Continues," Trusts & Estates (January 1993): 30-39.

[4] Steven V. Roberts, Dorian Friedman, and Susan Pastrick, "Election 1992: The Issues," U.S. News and World Report (August 31 - September 7, 1992) 43.

decisions have lacked a systematic means for evaluating potential environmental encumbrances that a particular land use may incur.[5] When evaluating land use proposals, planners and developers should evaluate the relationship between indigenous social and physical processes. The relationship of natural and cultural systems and elements across a landscape is referred to as an ecosystem. Tansley, who introduced the term the 1930s, described an ecosystem as a set of interrelated biotic and abiotic elements. Ecosystems are structured, open systems that exchange mass, energy and information.[6] If people are cognizant and respectful of this interrelationship, they can simultaneously protect natural processes and make nature work for them. Renowned landscape planner Ian McHarg suggested that a holistic environmental approach be taken when appraising the suitability of land for a given use. An ecological interconnectedness would be manifested when a proposed use was evaluated against a litany of eight factors: climate, geology, hydrology, physiography, soil, vegetation, wildlife, and existing land use. This examination would help to determine the land's critical and limiting factors, such as wetlands, floodplains, and faultlines. Societal values, which may be ascertained by citizen input, would also need to be factored into the equation in some manner, such as by degree of perceived

---

[5] Leonard Ortolano, Environmental Planning and Decision Making (New York: John Wiley & Sons, Inc., 1984), 3.

[6] A.P.A. Vink, Landscape Ecology and Land Use (New York: Longman, Inc., 1983), 16-23.

importance. The interconnectedness of all these data would lead to the ranking of land uses, suggesting an optimal use for a given zone.[7] While McHarg's analysis is preferable, not all communities have the time or economic resources to commit to preparing a detailed analysis for each parcel of land. Nevertheless, the community should attempt to understand the implications of decisions, and how certain decisions could lead to unintended results, due to the interconnectedness of the various aspects of the environment.

Throughout this paper, I will expand upon one key environmental issue - the preservation of water resources and the land and property affected by water - and will point out how these elements are interrelated. More specifically, I will address the reasons why a community should formulate a water resources plan, and I will illustrate how a community can effectively protect its water, land and property resources by means of various techniques, particularly growth management techniques. The primary focus of the analysis will be on urban and urbanizing areas.

When embarking upon a local water resources plan, it is important that planners and other decision makers understand the interconnectedness between land and water. Furthermore, there are many factors that influence local water resource planning: hydrologic issues, government intervention, land use decisions,

---

[7] Ian L. McHarg, Design with Nature (New York: John Wiley & Sons, Inc., 1992).

economic influences, structural and non-structural improvements, and institutional considerations. While this list may not be all encompassing, it should provide a point of departure for creating a local water resources plan.

The Hydrologic Cycle

The Occurrence of Water

In order to appreciate the dynamics of water supply, it is important to have an understanding of the hydrologic cycle. "The hydrologic cycle is the continuous, unsteady circulation of the water resource from the atmosphere to and under the land surface, and, by various processes, back to the atmosphere."[8] Furthermore, "of importance to water resources planning is the fact that as water is transferred among hydrologic cycle components, its quality is changed."[9] The components of the hydrologic cycle are: precipitation, infiltration, evaporation, transpiration, surface runoff, and groundwater flow. Precipitation takes place in the form of rain, snow, sleet and hail. Infiltration is the process whereby precipitation percolates into the ground. The rate at which precipitation infiltrates plays a key role in urban surface water management.[10] The evaporation and transpiration processes,

---

[8] Stuart G. Walesh, Urban Surface Water Management (New York: John Wiley & Sons, Inc., 1989), 53.

[9] Andrew A. Dzurik, Water Resources Planning (Savage, Maryland: Rowman & Littlefield, 1990), 14.

[10] Walesh, 55.

(referred to as evapotranspiration) is the osmotic movement of water from soil to vegetation that is subsequently released to the atmosphere. "Evapotranspiration has a major impact on the amount of precipitation that remains available for use as a water resource."[11] The surface runoff and groundwater flow components of the hydrologic process are of paramount interest to the quantity and quality of water resources.

Overland flow, or surface runoff, is the flow along the soil surface of excess precipitation that has not been absorbed into the ground by means of the process of infiltration, or lost to the atmosphere by means of the process of evapotranspiration.[12] Generally, water flows over the surface when the ground is saturated, such as the period during or immediately following rain storms. This water flows over the soil surface, and is eventually deposited in a channel, which then flows into progressively larger streams of water. Except for cases when overland flow is detained due to factors such as a rough surface, overland flow is the second fastest streamflow component, next to direct channel precipitation.[13]

Interflow, often classified as part of surface runoff, is water that infiltrates into the soil, but due to the presence of an impermeable layer, is forced to move laterally through the

---

[11] Dzurik, 15.

[12] Ibid., 15.

[13] Kenneth N. Brooks et al., Hydrology and the Management of Watersheds (Ames, Iowa: Iowa State University Press, 1991), 75.

upper levels of soil. The water continues to move laterally until it reaches a stream channel. The soil itself transports most of the water that is moved during this process.[14] When compared to surface runoff, water travelling as interflow is slower, due to the presence of less permeable material.[15]

Water that infiltrates downward until it reaches the water table is known as groundwater.[16] Groundwater accumulates and moves within parameters defined by the given geological setting. Eventually, groundwater may enter the stream bed, at the point where the channel intersects the water table. This type of water movement, also known as baseflow, moves slowly, but also provides a fairly constant supply of water to the stream, even during dry periods.[17]

Watershed Physical Factors

Comprehensive water planning involves analyzing water contributions on a watershed level. "A watershed is the land over which the water drains to a particular point in a stream."[18] Furthermore, watersheds "define the system within

---

[14] William M. Marsh, Landscape Planning: Environmental Applications (New York: John Wiley & Sons, Inc., 1991), 146.

[15] Ray K. Linsley, Jr., Max A. Kohler, and Joseph L. H. Paulhus, Hydrology for Engineers. (New York: McGraw Hill), 205.

[16] Ibid.

[17] Marsh, 146.

[18] Dzurik, 184.

which the hydrologic cycle functions."[19] Hence, it is paramount that planners and engineers are aware of physical factors that affect the watershed. These factors, which may be unique to a specific region, include: area, slope, soil characteristics, geology, vegetation, and meteorological considerations.

The total area of the catchment determines the total amount of precipitation that is caught within the confines of the catchment.[20] "The larger the watershed, the greater the volume and peak of streamflow for rainfall or snowmelt events. Watershed shape affects how quickly surface and subsurface flow reaches the outlet of a watershed."[21] Additionally, the height of the catchment can affect total runoff, by way of its orographic influence.[22]

The slope of the catchment area affects the degree of infiltration that occurs, and the speed that water moves over the surface.[23] Generally, flood peaks increase with a greater channel slope. Correspondingly, in channels with slight slopes, precipitation takes longer to reach the channel, and therefore takes a longer time to peak.[24] Slope direction also plays a

---

[19] Walesh, 460.

[20] R.C. Ward, Principles of Hydrology (London: McGraw Hill, 1967), 325.

[21] Brooks et al., 78.

[22] Ward, 325.

[23] Ibid, 331-332.

[24] H.C. Riggs, Streamflow Characteristics (Amsterdam: Elsevier Science Publishers, 1985), 22.

significant role, particularly with the presence of snow. Slopes facing the south tend to promote quicker snow melt, and therefore quicker dispersion of water. Meanwhile, on slopes facing to the north, snow may remain accumulated for a longer period of time. Upon a change in the season, snow melt may occur all at once, leading to peak runoff times.[25]

Soil, along with other surface matter, is the determining factor in the quantity and the rate at which precipitation infiltrates, and consequently in the proportion of precipitation that becomes overland flow.[26] Sandy soils typically have relatively high infiltration capacities, while compact clay soils tend to have lower infiltration capacities.[27] Additionally, soil type can influence the lateral movement of subsurface water that was previously described. This movement can affect the water table, and therefore, the groundwater contribution to streamflow.[28]

The geology of a catchment area is denoted by rock type as well as the area's structural features.[29] "The character of the rocks determines how the water moves underground and at what rates."[30] There is also a relationship between the subsurface

---

[25] Ward, 333.

[26] Riggs, 16.

[27] Ward, 336-337.

[28] Ibid.

[29] Ibid, 333.

[30] Riggs, 16.

rocks and soils.[31] This relationship helps to determine the form of streamflow contribution. And finally, "structure is largely important as a factor guiding the movement of groundwater towards the streams."[32]

Vegetative cover within a catchment area also can affect the level of runoff. Some types of vegetation can hold a greater amount of water than others. The process of evapotranspiration would play a greater role in these cases. Some types of vegetation are more effective than others at slowing down the rate of overland flow. Vegetation may even have an influence on the type of soils that are present below them. Moreover, vegetation levels can fluctuate as a result of seasonal changes.[33] All of these factors may have a considerable impact on the form of streamflow contribution.

Meteorological factors that can affect runoff include precipitation, temperature, humidity, wind, and sunshine, however the most significant of these is precipitation and temperature, in regions that have similar topography and geology.[34] Temperature, combined with other climatic factors, controls the process of evapotranspiration, and the form of precipitation.[35]

---

[31] Ward, 333-334.

[32] Ibid, 334.

[33] Ibid, 337-339.

[34] Riggs, 5.

[35] Ibid.

The type of precipitation that occurs can play a significant role in the contribution to streamflow. Precipitation may range from rain and hail to sleet and snow. While the surface runoff of rain may occur rather quickly, it may take a considerable amount of time before snow melt occurs. When the snow does melt, it may have a significant impact on the flow of water to a channel.[36]

The intensity and duration of rainfall are key elements in determining the type of contribution to streamflow. The intensity of rainfall plays a key role in determining whether the precipitation is infiltrated into the ground for possible interflow and groundwater flow, or whether the precipitation will be transported via surface runoff. Therefore, in periods of intense precipitation, there may be a high level of surface runoff, if precipitation is in excess of the soil infiltration capacity.[37] Similarly, precipitation of a long duration, though not necessarily high intensity, can impact the infiltration capacity, and therefore the type of contribution to streamflow.[38]

When performing a study of the local watershed, planners need to collect applicable hydrologic data in order to ascertain the local situation. This information will be useful when developing community objectives at a later stage. Furthermore,

---

[36] Ward, 326.

[37] Ibid, 327.

[38] Ibid, 328.

by recognizing the interconnectedness between land and water, planners will be able to identify the effects that proposed land uses will have on the hydrologic cycle.

The Impact of Land Uses on the Hydrologic Cycle

As previously illustrated, the hydrologic cycle depicts the interconnectedness between land and water. Decision makers must be cognizant of the consequences that certain land use decisions might bring. As a watershed becomes urbanized, many of its natural elements such as vegetation and porous soils are eradicated or altered. The implications of removing vegetative cover can affect the hydrologic cycle. In addition to the obvious effects upon the evapotranspiration process, Goodman points out that the removal of vegetation promotes:

> (1) the rate and quantity of runoff increases, while infiltration decreases because the soil loses its capacity to absorb water;
>
> (2) erosion of the bare soil increases, producing sediment which becomes a burden in waterways and may diminish water quality, or which becomes trapped in reservoirs and reduces their storage capacity (erosion not only strips away topsoil, but also deteriorates the beds and banks of watercourses); and
>
> (3) any function performed by the vegetation of filtering pollutants from runoff is lost.[39]

Often, the vegetative cover is replaced with impervious surfaces, which are impenetrable structures such as parking lots or roofs. Although the replacement of vegetative cover with

---

[39] Alvin S. Goodman, Principles of Water Resources Planning, (Englewood Cliffs, N.J.: Prentice Hall, 1984), 135.

impervious surfaces helps to reduce erosion, negative implications include further increases in surface runoff with accompanying decreases in infiltration.[40]

With an increased level of surface runoff, the risk of floods heightens during high level activities such as heavy rain storms and snow melt occurrences. Furthermore, since a larger portion of the rainfall leaves the area in the form of surface runoff during these peak periods, less water is available to infiltrate into the ground. Additionally, the evapotranspiration process in locally vegetated urban places can be increased by the presence of urban vegetation that is exposed to heat from surrounding surfaces. This concept, known as advectively-assisted evapotranspiration, may promote an increased rate of evapotranspiration, particularly during dry seasons. Water that had not been transferred via surface runoff, and would otherwise have been infiltrated to the groundwater supply, would instead be lost to the atmosphere.[41] All of these factors promote a decline of water flow during non-peak events and dry seasons, threatening the level of water supply.[42]

As a watershed makes its transition from its natural state

---

[40] Ibid.

[41] Bruce K. Ferguson and Philip W. Suckling, "Changing Rainfall-Runoff Relationships in the Urbanizing Peachtree Creek Watershed, Atlanta, Georgia," Water Resources Bulletin 26 (April 1990).

[42] Ferguson and Suckling.

to an urbanized one, there most likely will be an increased level of pollutants found in the water supply. Pollutants can be generated from a wide range of land uses, from commercial and industrial to residential and recreation, and likewise can be deposited in the water supply in a number of different ways. As described previously, with urbanization, there is an increased level of surface runoff. Offending pollutants "that have been deposited on the land surface are leached from the ground and may be washed downstream."[43] Additionally, contaminants, such as those found in landfills or storage tanks, could percolate to the groundwater, or enter surface water supplies as base flow.[44] Typically, pollutants are categorized as being either point source or nonpoint source. Point source pollutants are those that can easily be traced to a specific point, such as a municipal sewerage system's outlet to a river, or an industrial facility's direct discharge of effluent to a river. Meanwhile, point source pollution is contrasted with nonpoint pollution, which is pollution generated from a much broader area, making the task of identifying the source of pollutants more difficult. For example, chemical contaminants that enter the water supply via urban runoff may be considered as nonpoint pollution, if the point where they attached to the water is not readily apparent.[45]

---

[43] Goodman, 135.

[44] Ibid.

[45] Timothy R. Lazaro, Urban Hydrology: A Multidisciplinary Perspective rev. ed. (Lancaster, PA: Technomic Publishing Co., Inc., 1990), 44.

In sparsely populated areas, natural elements can easily absorb and assimilate various contaminants. However, as population densities become greater in urban and urbanizing areas, the earth can lose some of its natural ability to dispose of these pollutants. Areas that are particularly susceptible to the impacts of development are fragile or sensitive lands such as wetlands, floodplains, and shorelands. Wetlands, for instance, are located at the intersection between upland areas and aquatic systems.[46] Although there are many conflicting definitions, wetlands could be defined by the presence of certain types of water-loving vegetation, organic soils, and water, although water need not be present throughout the entire year.[47] Wetlands often serve as an important ecological habitat for wildlife and aquatic species. Furthermore, wetlands play a principal role in the hydrologic cycle, where they can serve as a buffer against hydrologic fluctuations, by reducing flood peaks during storm events, and releasing water during droughts. Wetlands may also provide a number of other benefits, from the decreasing of erosion and sedimentation for points downstream, to the recharge of groundwater.[48]

Finally, it is essential to reiterate that decision makers must be aware of the physical relationship between land and water. Land use patterns can significantly impact water supply

---

[46] Goodman, 135.

[47] Marsh, 280.

[48] Goodman, 135.

and quality. Likewise, the availability or lack of a quality water supply can impact an individual's decision to locate in a particular locality. For example, an industry may not locate in a particular area if a sufficient supply of water is not available; or, existing or new residential development may be negatively affected if an adequate amount of clean water is unavailable. Therefore, it is paramount that a community protect its water resources. Government has assumed the leadership role in the quest for protecting water supply and quality. Many programs have been implemented at the federal and state levels of government, and to some extent the local levels. Many of these traditional programs have dealt primarily with point source pollution, such as programs that regulate the discharge of contaminants from sewage treatment facilities.[49] However, there is also a need to address the growing problem of nonpoint pollutants. Most nonpoint pollution strategies must be addressed at the individual watershed level, due to the unique character of each watershed. Therefore, it is paramount that local communities assume a more significant role in the protection of their water and land resources. These strategies inevitably affect land use patterns.

---

[49] Ibid., 136.

Public Sector Involvement in Protecting the Environment

Bases for Public Sector Involvement

The public sector has assumed leadership in the quest to protect water resources and property. Many planning efforts have been performed at the national level, with varying degrees of success. The success of some of these larger-scale programs may have depended upon the acceptance by the local community and affected industries. The repercussions from the mixed outcomes of federal programs have resulted in a renewed interest in watershed level planning, due to each watershed's unique physical and social attributes. Before embarking upon possible watershed level strategies, it is important to first review the reasons for the public sector's involvement in the preservation of natural resources.

All levels of government have had input in establishing controls that address the protection of water resources. The difficulty arises in defining the level of government that should assume the dominant position. Interestingly, the United States Constitution does not explicitly delegate the authority to manage water resources to the federal government. As stated in the United States Constitution, any power not explicitly delegated to the federal government has been reserved for the states. However, the federal government has deemed water resource issues as being paramount to both national and public interests, and has assumed the dominant position in protecting the nation's water resources. "Actions of the federal

government have been confirmed by the courts through interpretations of the constitutional provisions relating to commerce, public lands, general welfare, and war."[50] Consequently, Congress has passed several major federal statutes pertaining to natural resources during the past couple of decades, some of which include: the Clean Water Act, the Resource Conservation and Recovery Act, and the Comprehensive Environmental Response, Compensation, and Liability Act.[51] These statutes have addressed a wide range of issues, including ground and surface water quality, remediation of contaminated property, and flood control. Meanwhile, the states have tried to facilitate compliance with federal regulations, as well as enact legislation in areas where federal regulation may have fallen short.

The states' basis for regulating the actions of private individuals and their property has been attributed to its responsibility to protect the interest of the public. Typically, the states have exercised actions pertaining to the environment under their inherent authority, termed police power. Police power, which requires that government protect the public's health, safety, and welfare, is a power reserved by the

---

[50] Ibid., 507.

[51] George R. Zuber and Charles G. Berry. "Assessing Environmental Risk," Journal of Accountancy 173 (March 1992): 43.

states.[52] Traditionally, the states have delegated this responsibility to local governments by means of state enabling legislation.[53]

Historically, local governments have used this delegated authority in addressing a broad range of issues concerning control of private property for the purpose of protecting the interests of the public. However, due to the enduring tradition in the United States of the sanctity of an individual's property rights, there has been a perennial struggle between public and private sectors in the pursuit of balance between the ideal of public interest and an individual's property rights, An individual's property rights are explicitly protected in the United States Constitution. The Fifth Amendment prohibits the taking of private property for a public purpose, unless just compensation is awarded to the property owner. Additionally, the Fourteenth Amendment requires that an individual not be deprived of property without the due process of the law. Furthermore, the Fourth Amendment guarantees individuals' security in their homes without unreasonable searches and seizures, protecting individuals against government's taking of property for trivial purposes.[54] Hence, if government takes

---

[52] Mike E. Miles, et al. Real Estate Development Principles and Process (Washington, D.C.: ULI - The Urban Land Institute, 1991), 208.

[53] Ibid.

[54] John M. Levy, Contemporary Urban Planning. 2d ed. (Englewood Cliffs, N.J.: Prentice Hall, 1991), 65.

individual property, the taking must be for a legitimate public purpose, with reasonable compensation, within the confines of the due process of the law. However, the courts' interpretations of these property rights provisions have evolved over time to allow for reasonable restrictions on the use of property in order to protect the public interest. At the beginning of the twentieth century, the Supreme Court ruled in two court cases, *Welch v. Swasey*, 214 U.S. 91 (1909) and *Hadachek v. Sebastian*, 239 U.S. 394 (1915), that local government had the right to regulate development under its police power provisions. In a later case, *Village of Euclid, Ohio v. Ambler Realty Co.*, 272 U.S. 365 (1926), the Court ruled that zoning was a legitimate form of police power regulation.[55] However, a governmental regulation must not be so restrictive in nature that all practical use of private property is lost. A regulation that is determined by the courts to be too restrictive can be considered as a taking, even though a physical taking has not occurred. With these issues in mind, a closer look at the underlying reasons for the public sector's intervention to guide land use decisions with respect to environmental quality is obligatory.

Local communities may have a multitude of goals related to the combination of water and land issues that benefit the general public. Most likely, these goals can be categorized as

---

[55] Miles, 208-209.

public health, safety, or general welfare issues, although in practice community objectives are probably a combination of all three of these extensive goals. In many cases, the government has had to assume the leadership role in setting guidelines for these public interest issues, primarily due to the combination of two reasons: the private sector had been unable or unwilling to do so, and the situation was such that if it remained unregulated, the public's interest would be compromised. Health and safety objectives would probably address such issues as water quality and flooding. These objectives may point to looking at alternatives such as wellhead protection, floodplain restrictions, and the prohibition of potentially dangerous land uses in sensitive areas (such as the locating of chemical companies near municipal drinking water supplies). Meanwhile, objectives pertaining to the general welfare of the public could be comprised of a wide range of issues, including aesthetics and externalities. These issues are often less apparent then the health and safety issues, and require further review.

As has been demonstrated throughout this paper, water and land resources are interconnected. An action by a landowner could be beneficial for his own holdings, but could prove detrimental for others. The wide-scale removal of vegetative cover and replacement with impervious surfaces in the upland part of a watershed could increase the risk of flooding in downstream areas, within or outside of the community where the offending action transpired. The release of dangerous

pollutants by an industry could contaminate the ground or surface water. In addition to the health and safety concerns with these issues, there are also economic concerns. These actions may, for example, impact other landowners by decreasing their holdings' property values, by degrading the aesthetic qualities of public space, or by threatening a community's water recreation industry. These types of situations give rise to the issue of externalities.

> An activity is said to generate a beneficial or detrimental externality if that activity causes incidental benefits or damages to others, and no corresponding compensation is provided to or paid by those who generate the externality.[56]

An externality, whether beneficial or detrimental, can be considered as a failure in the capitalistic market system on which the United States' economy is based. Many economists have approached the environmental degradation issue in terms of the concept of externalities. In this way, government interaction has been justified in order to protect the public's general welfare.

Approaches for Environmental Protection

Government's response in addressing water problems has involved both structural and nonstructural measures. Generally, these measures, can be divided into two categories: control techniques and market-driven techniques. Traditionally,

---

[56] William J. Baumol and Alan S. Blinder, Economics: Principles and Policy, 2nd ed. (New York: Harcourt Brace Jovanovich, Inc., 1982), 536.

government has incorporated various control measures in order to address water issues. For instance, many of the regulations enacted by the federal government, such as the Clean Water Act, have involved a control mechanism with specific industry-wide standards.[57] Proponents of continued federal control techniques have argued that these types of regulations should be performed in uniformity, across all regions. They have argued that unless uniform standards are set in place, offending parties would simply relocate their company to a less restrictive region, not only injuring the economy where they were previously located, but also damaging the environment at the new location. However, opponents of federal controls have argued that these standards have been developed at a macro-level, and have not been flexible enough to recognize individual circumstances. McConnell and Schwab, in their review of the motor vehicle industry's location decisions, concluded:

> Optimal environmental policy requires us to apply the same principle in every region: continue to reduce pollution up to the point that marginal abatement cost equals marginal social damage. Differences in meteorology, topography, industry mix, and land-use patterns strongly suggest, however, that we should not set the same standards everywhere. We have been reluctant, however, to incorporate regional differences in national policy in deference to what Pashigian has called 'the locational competition hypothesis'; that firms will shop among regions based on the differences in environmental regulations. Our evidence for this industry suggests that regional differences in environmental policy in the 1970s

---

[57] Richard B. Stewart, "Models for Environmental Regulation: Central Planning Versus Market-Based Approaches," Boston College Environmental Affairs Law Review 19 (Spring 1992): 551.

> discouraged firms from choosing only the handful of most polluted cities. In summary, it appears that environmental policymakers may have given too much weight to concerns over regional equity and that, as a consequence, efforts to 'level the playing field' have probably resulted in costly uniform national standards."[58]

Furthermore, these rigid controls could hinder the development of more efficient technological advancements.[59] Consequently, "while some of these regulatory controls have been initially effective in limiting environmental degradation, they have also proved to be costly and less effective over the longer term."[60]

Market-driven approaches to environmental protection have gained popularity as an alternative to traditional control techniques. As described previously, many pollution problems can be defined as negative externalities, or imperfections in the private market system. By focusing on the forces that influence market decisions, these externalities can be eliminated.

> Revising the market's system of pricing or consumer demand to include environmental considerations can turn the indefatigable creativity of diverse and flexible responses by market actors to environmental advantage. It reduces overall social costs because those who can prevent degradation most cheaply are encouraged to do so most. Finally, it advances environmental protection as the incentives spur innovation in environmentally benign technologies and

---

[58] Virginia D. McConnell and Robert M. Schwab, "The Impact of Environmental Regulation on Industry Location Decisions: The Motor Vehicle Industry," Land Economics 66 (February 1990): 79-80.

[59] Stewart, 551-552.

[60] Ibid., 551.

processes . . . [61]

One scenario would involve charging polluters with taxes or fees. Theoretically, organizations would be encouraged to reduce emissions to satisfactory levels, providing that the cost of doing so did not exceed the amount of tax or fine. In a second scenario, the concept of tradeable allowances, the government would establish a maximum amount of emissions that could be released. Each company would hold rights to discharge a specified level of emissions. Those companies that emitted an amount in excess of the rights that they held would be heavily fined or taxed. Those companies that were able to find more efficient ways to dispel of their emissions would be free to sell their rights on the open market, presumably for a profit. The total cost to take a product to market would be less expensive for these emission-efficient companies. Over time, those companies that did not devise efficiencies to reduce emissions would be eliminated by these market-driven forces.[62]

There are several other market-driven techniques that could be employed. While their scenarios may differ, they are similar in that they embrace flexibility in approach, financial incentive, and environmental protection in a more cost effective manner than traditional control techniques.[63] However, there are imperfections with this approach. The tax or fee scenario

---

[61] Ibid, 552.

[62] Ibid., 552-554.

[63] Ibid., 553.

would have to be based upon a rational, systematic approach for valuing the amount of damage. While a benefit-cost analysis could be performed, at the present time, it is extremely difficult to ascertain the exact value of damages caused by an offending land use. Additionally, the tradeable allowances scenario could encounter similar problems, with government placing the level of emissions too high or low. Furthermore, given the current level of technology, it may be not be feasible for government to obtain all of the information that would be required to gauge all involved companies.[64] Nevertheless, a market-driven approach promises new opportunities to move away from traditional control techniques.

Similar to the federal government, local governments have relied upon a control based system to address their water and land issues. Arguably, the use of a control mechanism at the local level may be more appropriate than at the federal level, particularly when the unique characteristics of each watershed are considered when designing the control. However, local governments' control mechanisms can also experience limitations over the long term, similar to federal control limitations, primarily due to inflexibility.[65] If cognizant of the market forces affecting land development, local governments can

---

[64] Ibid., 554-555.

[65] Jerold S. Kayden, "Market-Based Regulatory Approaches: A Comparative Discussion of Environmental and Land Use Techniques in the United States," Boston College Environmental Affairs Law Review 19 (Spring 1992): 567.

effectively address their water resource objectives. However, in order to provide further flexibility in land use decisions, local governments have employed alternatives to traditional land use controls, utilizing market-driven techniques. In fact, this market-driven approach promises new opportunities for communities in guiding their land use decisions. Initially, as local governments began to explore alternatives to traditional zoning, they allowed more permissive uses of land, utilizing techniques such as conditional zoning. Subsequent, market-based approaches to zoning have included techniques such as transferable development rights.[66] By working with market mechanisms, as opposed to using static controls, a local unit of government can better manage its growth. Accordingly, these growth management techniques can play an important role in a community's water resources plan.

Water and Land Resource Management Techniques

Community Review of Objectives and Alternatives

A community will need to determine its objectives before formulating its water resources plan. Inevitably, these objectives will focus on quality and safety issues, as well as resource sustainability for future generations. The issue of sustainability of water resources has far-reaching implications. Current water supplies could be lost to utilization exceeding replenishment, or to contamination. Communities must consider

---

[66] Ibid., 568.

alternatives for future water needs. One community in Colorado requires that new developments have a 300 year water supply.

> The regulations are an attempt to equate the availabilities of nonrenewable and renewable water supplies, and to balance the competing needs for economic development with the desire to avoid an expensive water bailout by future generations.[67]

Although they appear to be water rich, even the Great Lakes states need to devise plans for future water needs and threats. A community will need to review a number of scenarios, determining the extent to which plans are feasible, given current constraints.

As with other planning endeavors, when addressing water related objectives, several alternatives will have to evaluated in order to determine the most appropriate for the situation. These alternatives may involve structural or nonstructural measures, or a combination of the two. Structural measures tend to be large-scale public works projects involving specific engineering and construction standards, a multitude of governmental units, and a large financial commitment. Examples include dams, channel modifications, and floodwalls. Most of the structural measures require involvement from the federal government, due to the magnitude of the given project. Meanwhile, nonstructural alternatives usually involve little in terms of construction, and may include public awareness programs

---

[67] Alan, L. Mayo, "A 300-Year Water Supply Requirement," Journal of the American Planning Association 56 (Spring 1990): 197.

or land use controls.[68] Furthermore, nonstructural measures may not be considered as practical alternatives once a watershed becomes fully urbanized.

> In general, structural measures tend to be more applicable to already developed areas and nonstructural measures tend to be more applicable to undeveloped areas. Stated differently, structural measures tend to be more remedial, whereas nonstructural measures tend to be preventative.[69]

Whether a community needs to employ structural or nonstructural methods in order to protect the public's health, safety, and general welfare has been a subject of considerable debate. The employment of nonstructural measures prior to urbanization may reduce the need for structural measures once a watershed becomes urbanized.[70] Furthermore, the reliance on the natural environment to purify and replenish water supplies would most likely be preferable to constructed means, for various reasons, including quality, public attitude, and economic. In fact, when evaluating any alternative, there should be a complete economic analysis with respect to benefits and costs. This analysis should include not only financial elements, but also social welfare aspects.

---

[68] Walesh, 392.

[69] Ibid., 392.

[70] It is important to note that in many cases there are sound engineering reasons for utilizing built structures. In many of these cases, nonstructural measures alone cannot be substituted for the engineering necessity of a dam, levee, or other constructed unit. However, this paper is concerned with those cases where a community has an option to use nonstructural measures exclusively, or some combination of structural or nonstructural measures.

If communities can protect their watersheds by nonstructural means, a considerable amount of financial resources will most likely be saved over the long run. As suggested throughout this paper, local government can play a pivotal role in protecting its community's water resources. As contrasted with federal and state governmental units, a more local unit of government is better able to address a community's unique characteristics, due to its understanding of its natural resource base, its institutional framework, and local perceptions of water related problems. Land uses and their related pollution can vary extensively in their potential to pollute water. As discussed in the portion of this paper discussing the hydrologic cycle, susceptibility of a specific location to water contamination also depends upon its soil capacity and subsurface structure. A number of other hydrological elements that are unique to the community will also affect surface runoff, evapotranspiration, and infiltration. While federal and state regulations can provide general guidelines, it is preferable that the local government become involved with establishing a water resource protection program. In creating such a program, the local unit of government can employ a variety of regulatory and non-regulatory techniques that address the specific needs of the community.[71]

---

[71] Douglas A. Yanggen and Stephen M. Born, "Protecting Groundwater Quality by Managing Local Land Use," Journal of Soil and Water Conservation 45 (March-April 1990).

Growth Management Alternatives

Local units of government may have a wide range of growth management alternatives at their disposal, including land use controls, land acquisition techniques, tax and fee systems, and the provision of public facilities. Land use controls include zoning and subdivision regulations. There is an abundance of land acquisition techniques, ranging from fee simple acquisitions to transferable development rights. Innovative tax and fee systems may include provisions for use value taxes and impact fees.[72] Furthermore, some local units of government may have the authority to impose extraterritorial controls.[73] However, local units of government should be cognizant of federal and state mandates, and should design programs that complement the actions of these higher units of government.

Zoning techniques have traditionally served as a means to control land use in urban settings, by forbidding certain undesirable uses, in the interest of the health, safety, and general welfare of the public.

> Zoning divides the community into districts (zones) and imposes different land use controls on each district, specifying the allowed uses of land and buildings, the intensity and density of such uses, and the bulk of buildings on the land.[74]

---

[72] Mark A. Wyckoff, "Growth Management Techniques," Planning & Zoning News, August, 1989: 12-14.

[73] Yanggen and Born.

[74] Frank S. So and Judith Getzels, ed. The Practice of Local Government Planning, 2nd ed. (Washington D.C.: International City Management Association, 1988), 251.

Mills states:

> zoning assigns property rights concerning land use in a community. It circumscribes the private rights of landowners and establishes collective rights to community environment. A change in zoning simply reapportions property rights. Reapportionment occurs for many reasons but voluntary exchange on mutually advantageous terms is not often one of them.[75]

Furthermore, Pogodzinski and Sass suggest that

> zoning is welfare-improving if it reduces the level of negative externalities to which consumers and firms are exposed, by an amount greater than costs associated with implementing and enforcing zoning.[76]

Recently, zoning has been used as a technique to protect environmentally sensitive land. Zoning techniques have been used to protect shorelands, floodplains, wetlands, and groundwater.[77] A local unit of government could, for example, control a development's density, which would indirectly limit the amount of pollutants that could enter the groundwater supply.

Another zoning technique, overlay zoning, places additional requirements to existing underlying zoning. These overlay zones provide a means to protect sensitive areas that would not otherwise be covered by an area's existing zoning. These overlay zoning districts can be used to protect environmentally sensitive areas such as: vulnerable areas, aquifer recharge areas, areas of

---

[75] David E. Mills, "Zoning Rights and Land Development Timing," Land Economics 66 (August 1990): 283.

[76] J. Michael Pogodzinski and Tim R. Sass. "The Economic Theory of Zoning: A Critical Review," Land Economics 66 (August 1990): 295.

[77] Yanggen and Born.

suspected contamination, and well protection areas. Additionally, areas that are suspected of contamination (e.g. areas that are down stream from landfills) can be required to obtain its drinking supply from a lone deep well, rather than several shallow wells. Wellhead protection districts can be created to protect those locations where existing and future municipal or private wells are recharged.[78]

There is a number of other zoning methods that could be utilized for environmental protection purposes. Of particular interest are performance zoning, conditional zoning, and environmental and resource protection controls. Performance zoning is an approach that

> requires applicants to demonstrate that the current functions of the resource area or process will be maintained or improved. . . . For example, in the case of the aquifer recharge, the ordinance might require applicants to demonstrate that the recharge area, following development, will continue to transmit water at y quality and x quantity per unit of time.[79]

Conditional zoning, which can be issued on a case-by-case basis, permits a petitioner to implement a non-zoned use, providing that the petitioner promises to "limit the future use of land, dedicate property, or meet any other conditions."[80] Environmental and resource protection controls are special types of land use controls that designate critical or environmentally sensitive areas. Critical environmental areas may include

---

[78] Yanggen and Born.

[79] So and Getzels, 133.

[80] Wyckoff, 7.

"floodplains, rivers, stream valleys, wetlands, inland lakes, shorelands, scenic uplands, steep slopes, woodlands, groundwater acquifers, unique plant and animal habitats, unique natural features, etc."[81] These controls may also include techniques to prevent pollution to surface and groundwater, and can limit waterfront access.[82]

Subdivision regulations are used to direct the platting and development of individual lots of land. Local governments can review subdivided plats for a number of physical elements, including the sufficiency of water supply, adequate stormwater management, and erosion and sedimentation control. Interestingly, subdivision regulations may require that a subdivider perform structural improvements, such as a centralized water and sewer system or monitoring wells.[83]

Land acquisition techniques can range from the purchase of title and all the rights attached to the land, to the purchase of a portion of the rights to land. In making a full fee acquisition, the land could be reserved for permanent public open space. This technique could be used to help set the course for an area's desired land use patterns. However, there are also negative connotations with full fee acquisition, in that costs can be exorbitant, particularly if the plan promoted land

---

[81] Ibid., 9.

[82] Ibid., 9.

[83] Yanggen and Born.

speculation.[84] Furthermore, in contested cases, local units of government would have to exercise their right of eminent domain (assuming, of course, that the purchase met the public purpose requirements for a taking). These proceedings would further increase program costs.

Local units of government may also be able to purchase certain rights pertaining to development, without actually taking title to the land. These purchased development rights could range from to temporary holding to permanent purchases. This practice could help to slow growth, or eliminate particular land uses that may be environmentally harmful. Mills asserts:

> if the community owns development rights to the offending land use, then landowners (developers) may not impose external costs on the community without first acquiring development rights. The community's rights may be protected by either a liability rule or a property rule If the rights are protected by a liability rule then landowners may buy them for a price equal to the damage caused by development. If they are protected by a property rule then the city may agree or refuse to sell them at any price. In either case, if the community sells development rights for a price equal to the external damage caused by development, then efficient land use is achieved.[85]

Transferable development rights is another technique that uses market-driven forces to help divert development from sensitive or undesirable areas to more preferable locations. This technique "permits owners of property restricted from

---

[84] Seymour I. Schwartz, Robert A. Johnston, James R. Blackmarr, David E. Hansen, Controlling Land Use for Water Management and Urban Growth Management: A Policy Analysis, (Davis, CA: California Water Resources Center, 1979), 8.

[85] Mills, 283-284.

development to recoup some lost value by selling development rights to developers for transfer to another location where increased densities are allowed."[86]

Tax and fee systems also provide a market-driven approach to guiding land use decisions. While traditional property taxation often leads to premature conversion of land to urban use, primarily due to speculation, other forms of taxation on property may help to deter this conversion. However, many of these techniques could invite legal challenges, if appropriate state enabling legislation has not been enacted. Land value taxation is "the taxation of land only, or the taxation of land at a higher rate than any improvements on it."[87] Land value taxation is popular among economists, however, there are uncertainties with respect to the effectiveness of the land value tax as a tool to protect water resources.

> This measure is likely to produce a smaller rate of conversion of agricultural and other open space lands to urban use. However, the measure is not selective with respect to preservation of resource lands that are desirable for water management objectives."[88]

Preferential, or deferred, taxation can be a particularly effective means of discouraging urban growth. These programs, which may be administered at the state level, involve

> the assessment of property based on 'current use' rather than 'highest and best use,' with all or some portion of any taxes that are avoided deferred and

---

[86] Miles, 219.

[87] Wyckoff, 13.

[88] Schwartz et al., 48.

levied upon a change of use with or without interest and a penalty.[89]

In addition to these tax techniques, local communities may want to explore the use of development impact fees as part of their growth management plan. However, the use of impact fees is controversial, and involves many legal implications. "The argument about impact fees is based, in part, on the economic theory of externalities."[90] Essentially, impact fees are assessed to developers to finance public facilities, whether on-site or off-site that are necessitated by new development. The use of impact fees could serve a dual purpose, in that development could be discouraged due to the added cost of developing a site, or new facilities would be added to offset the negative externalities from the development. In the case of water resources protection, structural facilities could be erected to protect resources from the effects of urbanization. However, developers have argued that improvements benefit not only their development, but also the entire community. Consequently, as the following discussion will indicate, it is paramount that a community incorporate a systematic, rational means when determining impact fees.[91]

---

[89] Wyckoff, 13.

[90] Donald G. Hagman, and Julian C. Juergensmeyer, Urban Planning and Land Development Control Law, 2nd ed. (St. Paul, MN: West, 1986), 284.

[91] Richard Peiser, "Calculating Equity-Neutral Water and Sewer Impact Fees," Journal of The American Planning Association 54 (Winter, 1988): 38.

There are a number of court cases that have helped to shape the criteria for the use of impact fees. These standards may also be applicable for an assortment of non-traditional taxes and fees that may be considered by local units of government. There are several tests that the courts have imposed in order to determine the validity of impact fees. Generally, the validity of the fee is based upon the authority of the community to exact an impact fee. Impact fees have generally been created as regulations, but occasionally have been created as taxes. If the impact fee is challenged, the courts should determine under which form the impact fee has been developed, and whether the community is authorized to enact this measure under state law.[92] If the court determines that the impact fee is indeed a tax, the court will then look for express statutory authorization to levy such a tax. Most states will generally not authorize municipalities to enact taxes other than property taxes (with the possible exception of income taxes). If this is the case, the impact fee ordinance will be disallowed as ultra vires. "Even if statutory authorization is present, constitutional limitations on taxation may still invalidate the statute."[93]

Due to the state courts' narrow interpretation of taxing authority, in most states impact fees are usually created as

---

[92] Kristine Williams, "Impact Fees & Exactions: An Overview and Look at Their Applicability in Michigan," Planning & Zoning News, August, 1987: 5-6.

[93] Hagman and Juergensmeyer, 279.

regulatory measures.[94] In the absence of specific state enabling legislation, local units of government have imposed impact fees as a function of their police power.[95] If the courts determine that the fee is within the local unit of government's implied authority, the courts have applied an additional test, the rational nexus test, which requires that there be "a close nexus between the fee and the purpose it serves."[96] The Supreme Court appears to have reaffirmed the application of the rational nexus test in Nollan v. California Coastal Commission, 107 S.Ct. 3141 (1987).[97]

A community can also influence future growth patterns by means of public provision of public facilities, which includes governmental development of infrastructure, such as roads and public utilities.

---

[94] Williams, 5-6.

[95] Ibid.

[96] Nancy Stroud, "Legal Considerations of Development Impact Fees," Journal of The American Planning Association 54 (Winter, 1988): 33.

[97] There has been some disagreement regarding the actual Supreme Court position regarding the use of impact fees, since the Nollan case involved a physical taking. Many scholars such as Stroud (see Stroud) maintain that the decision reaffirms the rational nexus test used by most state courts. Meanwhile, other legal commentators such as Morgan state that various legal tests apply, depending upon the constitutional provision in which the fee has been challenged (see Terry D. Morgan, "The Effect of State Legislation on the Law of Impact Fees, With Special Emphasis on Texas Legislation," Institute on Planning, Zoning, and Eminent Domain (1988): pp. 7.11 - 7.14). Until the Supreme Court rules specifically on impact fees, the state courts will have to make this determination, and as stated previously, most are already using the rational nexus test.

> By deciding where to put water lines, sewers, roads, and other public facilities, and by deciding when to put them there, a community is not only making public investment decisions, but, more, important, is setting a pattern and establishing a framework for the much larger amount of private development that will be influenced by these public decisions.[98]

The timing of funding for public facilities is generally included in a community's capital improvement program.

In some states, a local unit of government may have the power to incorporate land use regulations for locations outside of its municipal boundaries. In these places, a municipality could devise a plan to protect its groundwater resource by imposing zoning or subdivision regulations on those areas outside of its boundaries, and thus prevent the development of undesirable land uses, in an area in which a municipality would not normally have authority.[99]

Additional Considerations

Best management practices are procedures that landowners can use to help address a number of concerns, such as reducing the level of pollutants that flow from their properties to the water, or promoting the sustainability of resources.[100] These methods, which may be structural or nonstructural, or a combination thereof, could be incorporated into local zoning

---

[98] Hagman and Juergensmeyer, 268.

[99] Yanggen and Born.

[100] John D. Warbach, Mark A. Wyckoff, and Kristine Williams. Protecting Inland Lakes: A Watershed Management Guidebook, (Lansing, MI: Planning & Zoning Center, Inc., May 1991), 5-1.

ordinances or used on a voluntary basis. Best management practices have traditionally been associated with agricultural lands, so as to preserve important resources, protecting against things such as soil erosion and decline in water quality and quantity. Some of these principles can be applied to urban land uses. Stormwater practices could include "limiting the production of sediments, maintaining wetlands to store runoff, and directing runoff to vegetation strips, wetlands, or detention basins that will filter out sediments."[101] Retention and detention ponds may be built to reduce flows of sediment to lakes and streams.[102] The amount of impervious surfaces could be limited by building "narrower roads serving multiple parcels, and smaller parking lots."[103] Best management practices could also reduce the risk of groundwater contamination by incorporating a number of different measures. For example, the threat of contamination from industrial uses could be reduced by placing containers such as drums or tanks into secondary containment devices; or, interior floor drains could be connected directly to public sanitary sewer systems or closed holding tanks.[104]

---

[101] Ibid.

[102] Ibid., 5-6.

[103] Ibid.

[104] Lillian F. Dean and Mark A. Wyckoff. Community Planning & Zoning for Groundwater Protection in Michigan: A Guidebook for Local Officials (Lansing, MI: Office of Water Resources, Michigan Department of Natural Resources, May 1991), 2-10 - 2-11.

A community may also want to examine nonregulatory techniques, including public education and notification programs. These programs provide additional opportunities for citizens to become involved with the protection of water resources. However, it is important that educational and public relations efforts also be extended to include elected officials, business organizations, the press, and any other organization that could affect or be affected by the plan. The local community's involvement and commitment at an early stage is paramount to successful implementation of the plan.

In summary, in order to successfully develop a water resources plan, a community must identify its water and land resource objectives, review available alternatives, and determine the feasibility for each alternative. The feasibility of each alternative should be evaluated in light of any number of applicable variables, including benefits versus costs, political viability, public acceptance, practicality, and any other factors deemed as being important to the community. In the next section, there will be a closer look at some important considerations when selecting growth management techniques.

Effectiveness of Resource Protection Alternatives

The federal, state, and local levels of government have had varying degrees of success with their wide range of water protection programs. These programs have had a diverse set of objectives, ranging from floodplain management to groundwater

protection. While there may be distinct objectives for each of these water management programs, there are many similarities between the underlying land use techniques that have been used to guide these various programs The following discussion examines the effectiveness of various resource protection techniques, and whether their results can match a community's intended objectives.

The National Flood Insurance Program is a federal program that was created for two primary purposes. The first intention was to level out federal emergency funding by initiating flood insurance premiums. The second intention was longer-term in nature, requiring participating communities throughout the nation to develop floodplain regulations.[105]

> The intrusion of the federal government into local land-use regulation has been justified by the nature of flooding -- a low-probability, high-impact event -- and the inadequate response by local governments to risks of that nature. Flooding risks are often ignored by local governments and floodplain residents until the flooding occurs. By then, though, it is too late to prevent unwise development in these critical areas.[106]

Holway and Burby concluded that the National Flood Insurance Program has "had an effect on land use in localities across the U.S., but that its effect can be amplified or subverted by local land use policy decisions."[107]

---

[105] Walesh, 42.

[106] James M. Holway and Raymond J. Burby, "The Effects of Floodplain Development Controls on Residential Land Values," Land Economics 66 (August 1990): 259.

[107] Ibid.

In general, floodplain land use management programs have focused upon altering private sector decisions. These growth management programs have already been described at length. Burby points out that "land use management programs often are targeted at several different decision points in the land conversion process."[108] As the land conversion process progresses from vacant land to developed sites, some prevention techniques may be more effective then others, depending upon a site's position in this process. The likelihood for development increases the further along a site is in its conversion process. Furthermore, Holway and Burby state that "land value is expected to increase with proximity to urban services and neighborhood status and to decrease with increasing parcel size. The effect of flood hazards can be examined similarly."[109] The thought is that the risk of flood hazards would be capitalized into the cost of the property, lowering property values. If the developer took measures to account for this hazard, in response to purchaser concern, his cost of development would increase, reducing the likelihood of development.

In their conclusion, Holway and Burby declared that floodplain land use regulations, particularly low density zoning, would deter floodplain development. Their studies

---

[108] Raymond J. Burby, et al. Cities Under Water (Colorado: University of Colorado Institute of Behavioral Science, 1988), 85.

[109] Holway and Burby, "Floodplain Development Controls," 259.

indicated that as parcel size increased, the value per square foot decreased. The authors' findings also indicated that the location of thoroughfares and distance to an interchange can also affect the value of land. By carefully developing a capital improvement program, a community can divert public facilities that promote development from identified critical or sensitive areas. A local unit of government that keeps abreast of the market-driven forces of supply and demand that affect the land conversion process, can effectively influence the development decisions. "By decreasing the potential profit from development, floodplain land use management programs should discourage intensive uses of flood hazard areas."[110]

However, communities must also realize that some programs may have little effect, or may actually help promote the opposite of desired effects. For example, a community may want to discourage development in a floodplain, for a variety of reasons, including flood damage, water quality, and the presence of environmentally sensitive elements. This community may explore a number of issues, both structural and nonstructural. Holway & Burby assert that structural remedies to the flood hazard, such as dams or floodwalls, would reduce flood risk, and would not deter development in the floodplain.[111] In fact, public projects such as these would most likely increase

---

[110] Burby et al., 118.

[111] Holway and Burby, "Floodplain Development Controls," 263.

property values, stimulating development.[112] Additionally, certain regulatory approaches such as building requirements, and loss protection measures, such as the NFIP, will reduce the risk of flood damage costs to property owners. As a result, these measures would not serve their objective as deterrents to building in the floodplain. Therefore, it is important that communities are aware of the implications for each scenario before enactment, as desired outcomes may not occur.

A growth management technique that has grown in popularity is transferable development rights (TDR). The concept of TDR recognizes that development rights is one of the many bundle of rights that a landowner possesses. Although a landowner may possess land that is located in a sensitive, government restricted area, he can recoup possible losses by selling this particular right to another landowner who possessed land in an acceptable area for higher density development. This technique "helps equalize the windfalls and wipeouts that are so common with many zoning decisions."[113] The TDR technique, however, relies upon the market demand for these rights. In order to generate an acceptable level of demand for TDRs, the community would have to have a well constructed plan that limited the total amount of development within the community. This demand could be promoted by downzoning buildable areas from their previous level of allowable units, but allowing landowners in

---

[112] Burby et al., 156.

[113] Wyckoff, 12.

these areas to increase their densities by purchasing TDRs.[114] However, the pricing of these rights could be an issue that would involve a great deal of negotiation.[115] Government may need to intercede to help streamline the pricing process.

There has been successful implementation of the TDR technique, such as in the New Jersey Pinelands Development, where each landowner received

> different amounts of TDRs depending on the value to society of preserving that owner's property. In areas in which development is permitted, landowners must hold TDRs to develop their property. Thus, the total amount of development in the Pinelands is capped, and the regional distribution is partly restricted, but the precise allocation of development on permissible properties is left to the market for TDRs.[116]

In addition to the approaches described above, there have been a number of important nonregulatory approaches. One important nonregulatory approach appears to be the providing of information regarding water hazards to the public. Researchers have demonstrated that in addition to likely concern with loss of human life, ecological damages, and loss in intrinsic value, there also appears to be concern with other costs needed to avoid exposure to water contaminants, or averting expenditures.[117] The issue of averting expenditures appear to

---

[114] Schwartz et al., 33.

[115] Kayden, 578.

[116] Stewart, 556.

[117] Charles W. Abdalla, Brian A. Roach, and Donald J. Epp, "Valuing Environmental Quality Changes Using Averting Expenditures: An Application to Groundwater Contamination," Land Economics 68 (May 1992): 163.

be correlated to effective public notification.

> Since awareness of contamination influences averting behavior, the policies and procedures for public notification are also important factors affecting public realization of the costs. . . . Notification efforts could be intensified towards those groups which appear to be more concerned with water quality." (e.g. family with children; notify child care centers, pediatricians' offices)[118]

When considering an appropriate techniques, a community must select the technique that is appropriate for its situation. Selected techniques should also be evaluated for potential pitfalls and opposing results. Both regulatory and nonregulatory approaches should be considered. In fact, a community may want to concentrate its initial endeavors on practices that educate the public and elected officials, so that these individuals become involved with the process at an early stage. Finally, a community must be cognizant of the institutional framework in which the plan will be implemented.

Institutional Considerations

As has been emphasized throughout this paper, it is paramount that water issues be addressed at the watershed level. At the watershed level, unique characteristics can be considered when implementing plans. Furthermore, at this level constituents can become more involved with solving their own problems. However, once a community has gained an awareness of its water resources issues, it would then need to identify the

---

[118] Ibid., 168-169.

appropriate institutional framework under which to formulate and implement water resources plans. As discussed previously, the most appropriate form of institution would be at a more local level of government than federal or state government, preferably a regional form of government that operates at the watershed level.

This approach is shared by Harrison, who contends that the problem with federal control lies in problems with institutional perspectives.[119] Harrison attributes disputes to the federal agencies that serve in a managerial capacity. These agencies define the public interest along their narrow mission-oriented perspective, rather than on a comprehensive basis. Harrison maintains that local governments should be given the opportunity to develop the mechanism that best serves the needs of the public, since local governments are much closer to their constituencies. However, a reform process is needed to encourage the federal government, and to some extent state governments, to relinquish some of its authority over water matters, so that local units of government can come together to develop their own institutions. Furthermore, with local governments taking control of policy guidance, the federal and state agencies' assignment would be redesignated, from their current capacity, where they serve by default as narrow perspective policy makers, to a supporting or implementation

---

[119] David C. Harrison, "The Local Role in Water Policy," Unified River Basin Management - Stage II (American Water Resources Association), (October, 1981).

role to local government. In order to develop a constituency-based water policy process with a coherent institutional structure, the federal government would have to provide support. This support should include financial, technical, procedural, and legal backing.[120]

While Harrison's approach may be considered by many as either visionary or fantasy, depending upon their convictions, he does touch upon several interesting points. His viewpoint regarding the removal of federal agencies from a managerial capacity is thought provoking. Other authors have shared his view, including Brimelow and Spencer, who preferred that the Environmental Protection Agency (EPA) be abolished. If the EPA were not abolished, they believed that its mission should be redirected to serve in a more advisory-oriented capacity. Brimelow and Spencer also favored a return to traditional property rights and the common law of torts.[121] The abolition of the EPA is probably not feasible, given the current political atmosphere. However, more authority should be given to units of government that perform watershed-level planning.

Local or regional level institutions may take several forms, including lake associations, watershed councils, or citizen-based groups. In the case of market-driven techniques such as TDRs, a special institution may have to be initiated to

---

[120] Ibid.

[121] Peter Brimelow and Leslie Spencer, "Should We Abolish the EPA?" Forbes 150 (September 19, 1992): 432-444.

accommodate the market place. However, given many states' current statutory practice of home rule, any effort to plan at the regional level would require a great deal of intergovernmental cooperation between local levels of government. It would be necessary for each affected unit of government to provide its approval in order for most plans to be implemented. While the states could reassert their authority over such matters by directly overseeing this watershed approach, the state creation of regional governments that possess broad powers could prove more beneficial. These regional governments could institute a process that local governments would need to consider in order to gain approval for development or development related regulation. Furthermore, regional levels of government are close enough to the local situation to ascertain constituency-based considerations. The successful New Jersey Pinelands case that was previously described was instituted at the regional level. Similarly, a successful Chesapeake Bay area growth management plan that was instituted to protect an environmentally fragile area, was also initiated at the regional level.[122] In fact, growth management plans executed at the regional level would most likely be more successful than those instituted at the local level, due to the greater amount of area involved, most likely encompassing whole watersheds.

---

[122] Patrick W. Beaton and Marcus Pollack, "Economic Impact of Growth Management Policies Surrounding the Chesapeake Bay," Land Economics 68 (November 1992): 434-453.

The feasibility of implementing powerful regional units of government in most states is questionable, in light of the political environment favoring strong home rule. However, while the states continue to explore the possibility of strong regional governments, local units of government will need to guide their water resources efforts. Nevertheless, this practice can prove worthwhile if the affected local units of government consider the effects of their actions on the entire watershed, not just the portion of the watershed within their own boundaries. Furthermore, "by directly involving all affected units of government in the watershed planning process, it will be easier to garner support for regulations, implementation programs, and ordinance changes in the future."[123] While this effort would require a great deal of effort and intergovernmental cooperation, the long term benefit to affected parties could prove beneficial.

Conclusions

Due to their broad ramifications, environmental related concerns will remain at the public forefront. A primary concern is the protection and sustainability of water resources, and the land and property affected by water. Obviously, water is essential to human sustenance and ecological stability, but it also affects most activities, ranging from recreation to industry. While water resources affect national interests, it

---

[123] Warbach et al., 4-6.

is important to realize that the characteristics of the occurrence of water differs across each watershed. Therefore, it is vital that water resources planning be performed at a more local level of government than federal or state government, preferably a regional form of government that operates at the watershed level.

When embarking upon a water resource plan, a community needs to review all alternatives, including feasibility. Growth management techniques have been useful tools in protecting resources. Resource protection controls appear to be particularly useful in the protection of environmentally sensitive or critical areas. Techniques that are particularly intriguing are market-driven approaches, such as TDRs. Further research regarding the effectiveness of these techniques needs to be performed, considering such elements as success at meeting objectives, public perception, political feasibility, and economic feasibility.

Finally, further research should be undertaken regarding a regional approach to water resources planning. State decision makers may welcome a regional approach to planning, even in the absence of specific enabling legislation, Of particular interest would be a study that examines the effectiveness of inter-governmental cooperation in fostering a regional approach in "home rule" states. The analysis could also address the extent to which these states' existing body of laws facilitate a regional approach.

BIBLIOGRAPHY

Abdalla, Charles W., Brian A. Roach, and Donald J. Epp. "Valuing Environmental Quality Changes Using Averting Expenditures: An Application to Groundwater Contamination." Land Economics 68 (May 1992): 163-169.

Adams, Roy M., Charles D. Fox, and Sheldon A. Zabel, "Liability for Environmental Hazards: The Saga Continues." Trusts & Estates (January 1993): 30-39.

Baumol, William J. and Alan S. Blinder, Economics: Principles and Policy. 2nd ed. New York: Harcourt Brace Jovanovich, Inc., 1982.

Beaton, W. Patrick. "The Impact of Regional Land-Use Controls on Property Values: The Case of the New Jersey Pinelands." Land Economics 67 (May 1991): 172-194.

Beaton, W. Patrick and Marcus Pollack. "Economic Impact of Growth Management Policies Surrounding the Chesapeake Bay." Land Economics 68 (November 1992): 434-453.

Black, Peter E. Conservation of Water and Related Land Resources. Rowman & Littlefield, 1987.

Brimelow, Peter and Leslie Spencer. "Should We Abolish the EPA?" Forbes 150 (September 19, 1992): 432-442.

Brooks, Kenneth N., et al. Hydrology and the Management of Watersheds. Ames, Iowa: Iowa State University Press, 1991.

Burby, Raymond J., et al. Cities Under Water. Colorado: University of Colorado Institute of Behavioral Science, 1988.

DiNova, Frank and Martin Jaffe. Local Groundwater Protection:Midwest Region. Chicago: American Planning Association, 1984.

Dean, Lillian F. and Mark A. Wyckoff. Community Planning & Zoning for Groundwater Protection in Michigan: A Guidebook for Local Officials. Lansing, MI: Office of Water Resources, Michigan Department of Natural Resources, May 1991.

Dzurik, Andrew A. Water Resources Planning. Savage, Maryland: Rowman & Littlefield, 1990.

The Economist. "Cleaning up: A Survey of Industry and the Environment." The Economist (September 8, 1990): 3-20.

Forbes, "Meeting the Challenge of Sustainable Development." Forbes (May 25, 1992) 118-133.

Ferguson, Bruce K. and Philip W. Suckling. "Changing Rainfall-Runoff Relationships in the Urbanizing Peachtree Creek Watershed, Atlanta, Georgia." Water Resources Bulletin 26 (April 1990): 313-322.

Goodman, Alvin S. Principles of Water Resources Planning. Englewood Cliffs, N.J.: Prentice Hall, 1984.

Grigg, Neil S. Water Resources Planning. New York: McGraw Hill, 1985.

Hagman, Donald G. and Juergensmeyer, Julian C. Urban Planning and Land Development Control Law. 2nd ed. St. Paul, MN: West, 1986.

Harrison, David C. "The Local Role in Water Policy." Unified River Basin Management - Stage II (American Water Resources Association) (October, 1981): 483-493.

Holway, James M. and Raymond J. Burby. "The Effects of Floodplain Development Controls on Residential Land Values." Land Economics 66 (August 1990): 259-271.

Holway, James M. and Raymond J. Burby. "Reducing Flood Loss: Local Planning and Land Use Controls." Journal of the American Planning Association 59 (Spring 1993): 205-216.

Isberg, Gunnar. "Strategic Planning for a Comprehensive Water Plan." Journal of Soil and Water Conservation 46 (May-June 1991): 178-183.

Jones, Philip. Hydrology. Oxford: Basil Blackwell Publisher, 1984.

Kayden, Jerold S. "Market-Based Regulatory Approaches: A Comparative Discussion of Environmental and Land Use Techniques in the United States." Boston College Environmental Affairs Law Review 19 (Spring 1992): 565-580.

Lazaro, Timothy R. Urban Hydrology: A Multidisciplinary Perspective. rev. ed. Lancaster, PA: Technomic Publishing Co., Inc., 1990.

Levy, John M. Contemporary Urgan Planning. 2d ed. Englewood Cliffs, N.J.: Prentice Hall, 1991.

Linsley, Ray K. Jr., Max A. Kohler, and Joseph L. H. Paulhus. Hydrology for Engineers. New York: McGraw Hill.

Marsh, William M. Landscape Planning: Environmental Applications. New York: John Wiley & Sons, Inc., 1991.

Mayo, Alan L. "A 300-Year Water Supply Requirement." Journal of the American Planning Association 56 (Spring 1990): 197-207.

McConnell, Virginia D. and Robert M. Schwab "The Impact of Environmental Regulation on Industry Location Decisions: The Motor Vehicle Industry." Land Economics 66 (February 1990): 67-81.

McHarg, Ian L. Design with Nature. New York: John Wiley & Sons, Inc., 1992.

Miles, Mike E., et al. Real Estate Development Principles and Process. Washington, D.C.: ULI - the Urban Land Institute, 1991.

Mills, David E. "Zoning Rights and Land Development Timing." Land Economics 66 (August 1990): 283-293.

Morgan, Terry D. "The Effect of State Legislation on the Law of Impact Fees, With Special Emphasis on Texas Legislation." Institute on Planning, Zoning, and Eminent Domain (1988): Chapter 7.

Newell, Gale E., et al., "The Effect of Michigan's Environmental Regulations (including PA 307) on Accounting and Auditing." The Michigan CPA 44 (Fall 1992): 8-14.

Nothdurft, William E. Renewing America: Natural Resource Assets and State Economic Development. Washington D.C.: The Council of State Planning Agencies.

Ortolano, Leonard. Environmental Planning and Decision Making. New York: John Wiley & Sons, Inc., 1984.

Page, G. William, ed. Planning for Groundwater Protection. Orlando: Harcourt Brace Jovanovich, 1987.

Peiser, Richard. "Calculating Equity-Neutral Water and Sewer Impact Fees." Journal of The American Planning Association 54 (Winter, 1988): 38-48.

Pogodzinski, J. Michael and Tim R. Sass. "The Economic Theory of Zoning: A Critical Review." Land Economics 66 (August 1990): 294-313.

Riggs, H.C. Streamflow Characteristics. Amsterdam: Elsevier Science Publishers, 1985.

Roberts, Steven V., Dorian Friedman, and Susan Pastrick, "Election 1992: The Issues." U.S. News and World Report (August 31 -September 7, 1992) 42-44.

Schwartz, Seymour I., Robert A. Johnston, James R. Blackmarr, David E. Hansen. Controlling Land Use for Water Management and Urban Growth Management: A Policy Analysis. Davis, CA: California Water Resources Center, 1979.

So, Frank S. and Judith Getzels, ed. The Practice of Local Government Planning. 2nd ed. Washington D.C.: International City Management Association, 1988.

Steiner, Frederick. The Living Landscape. New York: McGraw-Hill, Inc., 1991.

Stewart, Richard B. "Models for Environmental Regulation: Central Planning Versus Market-Based Approaches." Boston College Environmental Affairs Law Review 19 (Spring 1992): 547-559.

Stroud, Nancy. "Legal Considerations of Development Impact Fees." Journal of The American Planning Association 54 (Winter, 1988): 29-37.

Vink, A.P.A. Landscape Ecology and Land Use. New York: Longman, Inc., 1983.

Walesh, Stuart G. Urban Surface Water Management. New York: John Wiley & Sons, Inc., 1989.

Warbach, John D., Mark A. Wyckoff, and Kristine Williams. Protecting Inland Lakes: A Watershed Management Guidebook. Lansing, MI: Planning & Zoning Center, Inc., May 1991.

Ward, R.C. Principles of Hydrology. London: McGraw Hill, 1967.

Williams, Kristine. "Impact Fees & Exactions: An Overview and Look at Their Applicability in Michigan." Planning & Zoning News, August, 1987, pp. 4-11.

Wyckoff, Mark A. "Growth Management Techniques." Planning & Zoning News, August, 1989, pp. 4-15.

Yanggen, Douglas A. and Stephen M. Born. "Protecting Groundwater Quality by Managing Local Land Use." Journal of Soil and Water Conservation 45 (March-April 1990): 207-211.

Zuber, George R. and Charles G. Berry. "Assessing Environmental Risk." Journal of Accountancy 173 (March 1992): 43-48.