Water Supply as a Factor in Local Growth Management Planning in the U.S.: A Review of Current Practice, and Implications for Maryland

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Preface

In February of 2002, as aquifers, streams and reservoirs in many parts of Maryland reached record lows, 72 members of the state's General Assembly signed a letter to the then-Governor Parris Glendening requesting the creation of a special commission to investigate ways of stemming the decline of water supplies. A year later, Governor Robert Ehrlich signed an executive order creating a Water Resource Management Advisory Committee. Among other activities, that committee is directed to review ongoing scientific research on climate change and its regional impacts on water sources; assess the adequacy of current governmental laws, policies, regulations, resources, regulatory enforcement and monitoring programs directed to water resource management, development, conservation and protection in the State; and make recommendations for the actions needed (and the associated costs and funding alternatives) to ensure that the State's water resources are used "in a manner consistent with their long-term sustainable use and protection".

What was particularly striking about the General Assembly's letter and the creation of the Advisory Committee is that, even in the state that has earned a national reputation for its pioneering environmental programs and Smart Growth Initiatives, Maryland local officials appeared to have insufficient information on the adequacy of water supplies to support future development. Water limitations to growth will become more compelling if droughts occur with more frequency. This led the author to ponder two main questions. 1) What is the state of the science in determining how much water is available to support additional growth in a given area? 2) What is the state of the planning practice in using the results of such water supply analyses, in making local growth management decisions? The author was particularly interested in the nature and degree of coordination between water supply planning and local land use planning, in states that have earned reputations for growth management. This working paper is intended to provide examples and perspectives to assist Maryland's current effort to improve water supply planning.

Four states were selected for case study: Oregon, Florida, New Jersey and Maryland. Over the past decade, these have arguably been the most frequently mentioned in review articles and other literature on state growth management efforts. To varying degrees, each of the studied states has faced water supply stresses in particular locations in the past few years. Key statutes, regulations, state and regional plans and reports, selected local plans and ordinances, and other official documents on growth management and on water supply planning in each of the four states were examined. Interviews were conducted with relevant state officials and with other knowledgeable stakeholders and analysts (such as hydrologists and land use attorneys) to gain perspectives pertinent to the two research questions. Additional information was derived from relevant books, journals, newspapers and websites.

This paper contains considerable discussion of water supply planning and growth management methods and issues in each of the four states. The following executive summary outlines the case study highlights, the major findings, and the implication of those findings for Maryland's effort to improve water supply planning.

Executive Summary

Highlights of the Case Studies

Oregon

- Oregon allocates water rights under a "prior appropriation" doctrine rather than the "riparian" doctrine used in most states east of the Mississippi River (including Florida, New Jersey and Maryland). The Oregon Water Resources Department issues permits for water use in a state challenged by conflicts over water for cities, agriculture, fish and wildlife ("instream flow"), and Native American claims.

- Oregon does not have a statewide water plan. Instead, the Water Resources Department uses hydrological models to makes water rights allocation decisions on a permit-by-permit basis, in an attempt to ensure that surface and groundwater resources are used in a sustainable manner.

- In November 2002 the water resources department strengthened requirements for major suppliers (those serving > 1000 people) to prepare water management and conservation plans. Suppliers must prepare long-term water supply plans and a "reasonable and appropriate schedule with five-year benchmarks of conservation activities". The Water Resources Department is supposed to use suppliers' reported outcomes in meeting their benchmarks, as the basis for state decisions on water permit extensions or issuance of new water rights. Some key informants question whether the department will demand more than minimal compliance with the requirements.

- Oregon's growth management system requires local governments to prepare comprehensive plans that address a set of 19 statewide goals, including the creation of urban growth boundaries and the creation of a public facilities plan that encompasses water supply considerations. Some persons interviews for this report express concerns that the connection between water supply planning and land use planning is more theoretical than real.

- Two local case studies were conducted to examine the actual extent of coordination between water supply planning and land use planning. The cases show that while Oregon is the state with the nation's most comprehensive state-wide growth management system, there are unanswered questions about the actual, effective link between water supply and growth management planning.

- In the Portland metropolitan area, a consortium of 23 water providers (including the city of Portland - which supplies water to half of the region's residents) prepared a regional water supply plan in 1996. The Portland case study suggests a mixed picture of the linkage between water supply and growth management planning. On one hand, it is obvious that regional water suppliers do long-range water supply

analysis using population and employment forecasts provided by the Metro, the metropolitan land use planning agency. On the other hand, it is not clear that Metro is basing long-range growth management decisions with an in-depth analysis of water supply – although the latter question is not pressing at the moment since the region benefits from sufficient precipitation and has a number of alternative supply sources. Nevertheless, under a high growth, peak-water-demand scenario, the consortium plan forecasts that water demand in the region will exceed supply by the year 2017.

- The City of Bend / Deschutes County case study profiles water conflicts in a jurisdiction that is the fastest growing area of the state due to its scenic beauty, pleasant climate and easy access from the population centers of western Oregon. Located east of the Cascades in a dry part of the state, the County features the Deschutes River, popular for fishing and rafting, a source of irrigation water for farming, and an important wildlife and ecological resource. The case illustrates that two of the major strategies proposed to obtain water for additional growth have consequences that undermine other growth management goals and produce politically controversial results. First, buying groundwater rights from agricultural landowners could result in the loss of productive farmland. Second, lining irrigation canals and using other mitigation accounting practices could result in depletion of surface water flows in some critical, downstream portions of the river – due to the connection between groundwater and surface water – leading to declines in water levels and damage to native fish populations and scenic recreational uses.

- In summary, several key informants for this study, including the Water Resources Department official in charge of reviewing Water Management and Conservation Plans, question whether the state has the political will to deny new water rights and permits requested by municipal suppliers. It remains to be seen whether: the required water management plans will contain realistic alternatives to current surface and groundwater withdrawal practices; whether the plans will contain forecasts and ensuing strategy alternatives under a scenario in which "peak-day" episodes become more frequent than in the past; whether the department will apply pressure to municipal providers that do not provide adequate reasons for failing to meet their 5-year progress benchmarks; and whether local jurisdictions will base growth management decisions on the water management and conservation plans and other water supply plans.

<u>Florida</u>

- Florida has the most extensive water supply planning system of the four states studied. The planning, development and regulation of water supplies has been accomplished through the state Department of Environmental Protection, five regional water management districts (that have taxing authority to support water supply planning), water utilities and local governments.

- A case study of the Southwest Florida Water Management District Regional Water Supply Plan reveals extensive water supply planning with sophisticated analyses of sources of water supply and of projected demands under varying drought scenarios. However, the District's plan uses a normal rainfall year (1995) as the base year for supply forecasting, and does not provide details on the supply options nor the cost implications of an extended drought scenario.

- Florida does more disaggregated analysis of minimum flows and water levels than any of the studied states, reflecting the water districts' concerns about establishing a sound, scientific basis and political consensus for setting minimum flows and levels for each river, wetland, lake and aquifer.

- Under Florida's top-down growth management system, the state has established a set of goals and policy statements became the basis for Strategic Regional Policy Plans prepared by each of the state's 11 regional planning councils. Local governments are required to prepare land use plans consistent with state goals and regional policy plans. A case study examined coordination of water supply and land use planning in the Tampa Bay region, though content analysis of plans by the Southwest Florida Water Management District, Tampa Bay Regional Planning Council, Hillsborough County, and City of Tampa Bay.

- The Tampa region case study indicated that the degree of coordination between water supply planning and regional and regional and local growth management planning, is very strong on paper but quite weak in implementation. A land use attorney contacted by the author noted: "The land-use/water management district linkage expressed in the [local comprehensive] plans is lip service. To date, water has little, if any, effect on land use decisions. Everyone expects that to change in the future but the same discussion occurred 12 years ago and nothing happened. It would have the effect of giving water districts -- with an appointed, not elected board – the ability to stop growth in a 16-county area. This is unacceptable to most county governments and developers."

- State legislation in 2002 mandated stronger coordination between land use planning and growth management in Florida. The legislation requires that by 2005, local governments must amend their comprehensive plans to be more closely tied to regional water supply plans. The updated local plans must assess the jurisdiction's "current and protect water needs and sources" for at least 10 years, and include a 10 year work plan for building the requisite water supply facilities. However, key informants note that growth is Florida's state industry, and that while water availability in some parts of the state is recognized as a serious issue, local governments usually do not regard it as a limiting constraint. The Southwest Florida Water Management District has helped subsidize construction of a desalinization plant in Tampa Bay, reflecting what one observer calls the "come hell or low water" determination for continued growth.

New Jersey

- New Jersey has had a state growth management system since the late 1980s, but that system appears to be incapable of ameliorating severe, land-use related challenges to the state's water supply. The state's water supply challenges are caused by pollution of water resources from industrial and wastewater discharges, and from development-induced, large-scale disruption of surface and groundwater recharge. Groundwater supplies drinking water to half of New Jersey's residents. Fully one-half of the water that New Jersey uses leaves the state, much of it in the form of stormwater and treated wastewater that is dumped into the ocean.

- Surface water supplies are managed by the New Jersey Department of Environmental Protection and through inter- and intra-state water commissions. The department has the power to determine the adequacy of the ground and surface water supplies and to develop methods to protect aquifer recharge areas.

- The Department of Environmental Protection prepares a state water supply plan, last updated in 1996. The plan analyzes water deficits and surpluses in each of 23 planning areas, using a water inflow/outflow model in which aquifer recharge and surface water "safe yields" are were balanced against in-area demands, out-of-area transfers, and reuse within the area. Forecasts of new water availability were made for each planning area and count for the years 2000, 205, 2010, 2030 and 2040. (Climate change was not factored into the states water supply and demand modeling.) The plan then analyzed alternative water supply options for each area and recommended watershed and aquifer protection strategies, improved water allocation, and water conservation strategies. The plan forecasted water deficits for 9 of the 23 planning areas by the year 2040, although critics have disputed these findings as overstated. A new plan was to be issued in late 2003 but has yet to be released by February 2004.

- In terms of growth management, the New Jersey State Legislature approved a State Development and Redevelopment Plan in 1992, updated in 2001. The state plan includes a statewide map that identifies regions where local officials should channel growth and those areas in which land should be preserved. The plan designates five categories of planning areas, with policy objectives and desired development patterns for each. However, responsibility for land use planning and regulation lies with 566 cities and towns, and compliance with the State Development and Redevelopment Plan is voluntary.

- In 2000, New Jersey Future, a non-partisan research and advocacy organization, conducted a survey of the natural resource conservation policies and regulations of 44 townships containing some of the state's most valued and fragile natural resources (including prime farmland and pristine ground and surface waters). The report found that the towns were not adequately protecting streams and wetlands. Among the report's conclusions were that the towns' reliance on property tax

revenues for the lion's share of their income contributes to tension between environmental preservation and town fiscal needs; and that all privately held, environmentally-important land in the state is zoned for development, usually with minimum lot sizes of one and three acres.

- Investor owned purveyors supply over 42 percent of the state's residents. The for-profit United Water company (now owned by Suez Lyonnaise des Eaux, a French multinational firm) is the parent of United Properties, a real estate development company that has been developing land along watershed forests adjacent to reservoirs. Some local governments have been attempting to purchase watershed land from United Properties, and other landowners, to protect the water quality – a strategy that would not be necessary if the towns' land use zoning restricted development densities on important watershed lands.

- Under New Jersey's Municipal Land Use Law, a municipality is not required to have a plan in place to protect aquifer recharge areas or watersheds for surface waters, but does need to verify that a proposed development within its boundaries has an adequate water supply. No definition of "adequacy", planning laws, nor the length of time for it is to be secure, is included in the legislation.

- In January 2004, in a bold step that recognized the inadequacy of the state's growth management system to protect water sources, Governor James McGreevey announced a set of new stormwater management rules that would be used to protect Category I waters (defined by Department of Environmental Protection as those with exceptional ecological, water supply, recreational, shellfish resources or fisheries significance). The new rules require a 300-foot buffer around more than 6,000 miles of Category I waters and their tributaries within the immediate watershed boundary, impacting 300,000 acres of stream-side property. Other rules require municipalities, large public complexes (such as highway systems, prisons and hospitals) to development stormwater management programs though New Jersey's Pollutant Discharge Elimination Permit System permit program.

- The New Jersey Highlands, a mostly forested area stretching across seven counties and nearly 90 towns, provides water for half the state's residents. At the time of this writing (February 2004), a task force appointed by Governor McGreevey is close to recommending a regional commission that would have powers to regulate land development and preservation activities in the Highlands in order to protect water supplies.

- Another way the state is compensating for inadequate land use planning to protect water supplies is though government land and easement purchases. In August of 2002 Governor McGreevey signed a bill that gives highest priority in the state's open space purchase program to lands that protect water quality and relieve flooding.

- It is not known whether initiatives by the governor since 2002 will lead to greater coordination between water supply planning and growth management in New Jersey.

Maryland

- Early growth management efforts in Maryland were driven by concerns about water *quality* -- not of drinking water supplies, but of sedimentation and point and non-point pollution of the Chesapeake Bay estuary. Land use programs initiated in Maryland in response to the deteriorating water quality in the Bay include the 1982 Stormwater Management Act (requiring on-site measures to control nonpoint-source pollution in new development); the 1984 Critical Area Act (that requires watershed-protection zoning within 1,000 feet of the Bay and its tidal tributaries); the 1989 Non-tidal Wetlands Act; and the 1991 Forest Conservation Act. Also, "Tributary Strategies" are being developed in ten watersheds to comply with a 1992 order of the Chesapeake Bay Executive Council.

- More recent growth management efforts, such as the 1992 Economic Development, Resource Protection and Planning Act and the 1997 Smart Growth Areas Act, are intended to control suburban sprawl. The latter initiative targets state funding for infrastructure, economic development and housing to areas automatically meeting state criteria (such as existing municipalities and areas inside the Washington and Balimore beltways), and to growth areas designated by counties using state criteria.

- Unlike Florida and New Jersey, Maryland does not conduct state-level, long range water supply planning or modeling. The only long-range forecasts of water supply and demand are done by the two of the river basin commissions that provide water to portions of the state's three most populous jurisdictions. The Interstate Commission on the Potomac River Basin incorporated a "one-in-ten" drought year as part of its forecasting, and found that storage in the Potomac reservoirs would be nearly depleted given the "most likely" forecast of year 2020 demands and a reduction in streamflow resources of 10 percent.

- Absent long-range forecasting by a state agency, Maryland relies on Maryland Department of Environment permit-by-permit review of applications from certain categories of surface and ground water users.

- Maryland Department of Environment personnel in charge of water permit review, assert that the state's permit-by-permit analysis cannot answer the question of whether there will be sufficient water in the state for the next 20 years, and say that more resources need to be devoted to the following research activities: placing gauges on more streams so that officials will eventually have continuous flow records for a greater number of surface water sources; developing minimum flow levels for streams that based on particular stream characteristics and management objectives; establishing a better network of monitoring wells so there is more information on aquifers; developing better modeling tools for water supply determination; conducting more funded studies of water sources; and analyzing data

provided by permittees in order to acquire information such as the number of community water systems in a given county that use water from a particular aquifer.

- Following a drought of 1999, the then-governor appointed a Statewide Water Conservation Advisory Committee. The report of that that committee led to regulations outlining a four- staged process for defining drought and a set of state-mandated water use restrictions for each stage. However, other than a requirement that water-conserving appliances be installed in new home construction under the Maryland Water Conservation Plumbing Fixtures Act, there is no state guideline for water conservation in non-drought conditions.

- Some water supply forecasting is required of county governments in state-mandated,10-year water and sewer plans. However, the quality of these plans varies by jurisdiction and most of the plans are not kept current. Water demand and supply forecasting in the water and sewer plans currently are not required to include analyses and program responses under a prolonged drought situation under expected and higher-than expected population growth scenarios.

- Many existing water and sewer plans were written prior to passage of the Smart Growth Areas Act, and so were not created to be consistent with that legislation. Interviews with Maryland Department of Planning staff members in the Fall of 2002 indicate that the water and sewer planning program has not been fully reviewed to (a) evaluate the degree to which it is actually coordinated with the Smart Growth initiatives; and (b) identify ways in which such coordination could be improved. There is currently no state money to assist counties in updating water and sewer plans, so the planning requirement is an unfunded mandate. In addition, a Maryland Department of Planning spokesperson observes that the plans are often treated as simply a regulatory hurdle to be addressed when water/sewer service to new areas is desired or requested.

- In response to state legislators' requests for a comprehensive study of the Maryland's water supply and the relationship of that supply to Smart Growth, Governor Ehrlich signed an executive order in March 2003 to create a Water Resource Management Advisory Committee that will produce a report, with recommendations, by the end of May 2004. However, missing from the list of research needs under that executive order, is an explicit statement regarding analysis of the degree to which the state's water resources are capable of supporting short-term and long-term growth Smart Growth and Priority Funding Areas), given projected demographic and economic forecasts and permitted densities in those designated growth areas. Research is also needed on the extent to which land development patterns in recent years are <u>not</u> consistent with Smart Growth, and on the specific water quantity and quantity implications of such growth patterns.

Key Findings

The case studies from Oregon, Florida, New Jersey and Maryland reveal the following key findings related to the relationship between water supply planning and growth management.

- The studied states differ greatly in the manner and degree to which water supply planning is conducted. Florida and New Jersey prepare statewide water plans; Oregon and Maryland do not. For the most part, the resources devoted to state water supply planning, along with the available detail on minimum flows and water levels, reflect the relative differences in each state's perception of the severity of its water supply problem.

- There is wide variation in the degree to which the four states (or local governments or interstate river basin commissions) attempt to incorporate potential climate change into their water supply planning. Climate change would have significant impacts on water supplies and demand in general, affecting particular areas in a state more than others. Chronic drought scenarios need to be included in water demand and supply forecasting and planning.

- In all four states, there currently is a poor level of coordination between water supply planning and growth management planning. The cases show that having a statewide water plan -- or a water crisis – are neither necessary nor sufficient conditions for good local water supply planning and for coordination of that planning with growth management planning.

- The case-study state in which land use planning and water supply planning could be most closely coordinated – Maryland – has a low level of water supply / growth management coordination and, of the four states, has the *least* amount of water supply planning. County governments are responsible for land use planning (including designation of Priority Funding Areas for new development) *and* for preparing 10-year water and sewer plans. However, the study finds that, thus far, the water and sewer program planning requirements for county governments has *not* been well coordinated with the Priority Funding Area component of Maryland's Smart Growth.

- One major reason for the poor level of coordination between water supply planning and growth management planning is that local government priorities often lead to local land use decisions that are inconsistent with water source limitations, even when knowledge of water scarcity is available. A state water resources official in Oregon asserts: "It is difficult for any community to really view water as a finite resource and to look at alternatives to what they are doing now."

- Another factor contributing to problems in coordinating water supply planning and growth management is that state agencies are sometimes unwilling or unable to enforce existing regulations or to deny new water permits even when water supply limitations are known (due to political pressure from developers, municipalities and other stakeholders). Having a good system for water supply planning and for coordination of that planning with local growth management, will only produce sound results when there is sufficient funding for competent plan preparation and adequate state-level enforcement of permitting / planning requirements.

- Inadequate coordination between state water supply planning on one hand, and utility company commitments to service new development on the other, is complicit in the growth-accommodating orientation of state growth management programs.

Implications of the Case Studies for Maryland

The case studies provided herein have several lessons for Maryland as officials in that state undergo their review of water supply planning and management.

- The Maryland Department of Environment needs better information on the state's water resources. Additional funding is needed to support more extensive stream gauging, strategic test-well drilling, and the enhancement of hydrological models that can boost our understanding of complex ground water systems. Such resources will help generate reliable information on minimum flows and water levels in various parts of the state, and on the surface water / groundwater interaction in particular areas. For example, information could be generated on the recharge rate and area of a specific unconfined aquifer. Such improved data will enhance the county water and sewer plans.

- While the state does not need a statewide water supply plan akin to those of Florida and New Jersey (profiled herein), the Maryland Department of Environment should be the lead agency that ensures that studies are done, on major water sources currently not covered by river commission planning, which are of broader scope and longer planning horizon than 10 years – since the planning and deployment of supply alternatives could take several years. The Interstate Commission on the Potomac River Basin conducts such long-term studies for the Potomac River, but similar studies need to be conducted for other water sources. In conjunction with the Governor's Water Resource Management Advisory Committee, the Maryland Department of Planning can develop a strategy for generating needed studies and for ensuring consistency among the forecasting techniques used. The Advisory Committee can recommend sources of funding for such studies. Consistency in data bases, forecasting scenarios and projection techniques used by river commissions and by counties in their water and sewer plans, will improve overall water supply *and* growth management planning.

- The water supply-related components of county water and sewer plans need to be strengthened, and tied more closely to planning for Smart Growth and Priority Funding Areas. The plans should include projections of water supply and demand under alternative growth and climate change scenarios, so that a high growth, long-term drought scenario is included in the forecasting - - with implications for water supply alternatives and their financial costs and environmental impacts. The water and sewer plans should disaggregate the forecasts so that they show the water supply demand projections for distinct hydrological regions in the county. The plans and the forecasts should also discuss the consistency of water supply planning and growth management planning (i.e. Priority Funding Areas) in the county. The Maryland Department of Planning should not accept any plan unless it includes such commentary. (It should be noted that neither the Anne Arundel County nor the Frederick County water and sewer plans forecasted the types of water supply emergencies that each area would face shortly after plan publication (in southern Anne Arundel County and the city of Frederick, respectively). Upgrading the planning requirements could help prevent such disparities between plans and actual conditions.)

- Another required element of the water and sewer plans should be a water conservation strategy with specific objectives for reductions in per capita water consumption (similar to Oregon's requirement for water management and conservation plans). The Maryland Department of Environment would review the objectives before approving the plan. Updates of the plan would then compare actual reductions in per capita use to the objective. A county not meeting its objectives would need to explain the reasons for the underperformance and outline steps for improvement. The Maryland Department of Environment could withhold approval of the updated plan if the department was not satisfied with the local plan, and provide technical assistance if needed.

- Where appropriate, county water and sewer plans should discuss the findings and recommendations of the tributary strategies being prepared by direction of the Chesapeake Bay Executive Council, and their relevance to the water and sewer plan.

- This improved, state and local planning, along with attaining water conservation goals, will require increased state funding for Maryland Department of Environment studies, local water and sewer plan preparation, and for publicizing water conservation objectives and strategies to local residents. According to COMAR 26.03.01.02(F), "the planning part of the Sanitary Facilities Fund established under Environmental Article, §9-218 of the Annotated Code of Maryland, shall be available to the Department to finance planning . . . including the preparation, amendments and revisions of county [water and sewer] plans."

- The county water and sewer plans need to be informed by the long-term water supply and demand forecasts for rivers and aquifers that cross county and state boundaries (discussed above). Maryland Department of Environment should

review each county's updated water and sewer plans for consistency / compatibility with other counties that share the same river or aquifer as a water source.

- The Maryland Department of Environment should use improved data on minimum water levels in making and enforcing water permit decisions, so that water withdrawals are limited to the particular aquifer's sustainable yield. As noted by Robert Summers (2003), Director of the department's Water Management Administration, there is a need for department staff to enforce permits by using administrative penalties when necessary, which will require the hiring of additional compliance staff.

Concluding Comments

- Land use regulations derived from concerns over water quantity and quality can avoid due process complaints if they are based on solid, scientific evidence. The Florida case illustrated how expert-panel peer review is a high-profile aspect of the setting of minimum surface water flows and of minimum water levels in aquifers. Water agency spokespersons in all four states underscore the need for more sophisticated models. As more information is available, an important role for planners will be to help communicate hydrological knowledge to elected officials and the public.

- More research is needed on the impacts of alternative development patterns on those flows and levels. Although hydrologists acknowledge that impervious surfaces redirect stormwater runoff to streams rather than to groundwater, case-by case analyses are needed to determine how much of that runoff is removed from local water sources. In addition, more research needs to be conducted on the degree to which so-called "smart" development patterns (including urban infill, higher density development) produces better water quantity/quality outcomes than other development patterns for a given area. Experimentation to improve pervious pavement, "green roofs" and other innovations can provide more environmentally-friendly options for smart growth.

- If their growth trends continue and drought conditions become more frequent, states like Oregon, Florida and New Jersey will soon have difficult policy choices to make. Sufficient water will not be available where most of these states' growth is occurring. It remains to be seen how high a price customers will be willing to pay to for desalinization, new pipelines, and other heroic solutions to their water supply problems; or what water users will tolerate in terms of water-use restrictions; or what trade-offs customers will allow between water for agriculture, versus development, versus wildlife; or how water will be rationed between current and future users. These are choices that are already being made by some states in the arid West. The next era of growth management in many

other parts of the country may very well be shaped by these water-based dilemmas.

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I. Introduction

I.A. Purpose and Methodology of the Study

In February of 2002, as aquifers, streams and reservoirs in many parts of Maryland reached record lows, 72 members of the state's General Assembly signed a letter to then-Governor Parris Glendening requesting that he create a special commission to investigate ways of stemming the decline of water supplies. At the same time, members of the Chesapeake Environmental Protection Association, a non-profit citizens group, urged the state to commission a scientific study to determine how much water an aquifer can lose before risking depletion, and whether future development in the state needs to be restricted to maintain adequate water supplies.

What was particularly striking about the General Assembly's letter is that, even in the state that has earned a national reputation for its pioneering environmental programs and Smart Growth Initiatives, Maryland local officials appeared to have scant information on the adequacy of water supplies to support future development. Water limitations to growth will become more compelling if droughts occur with more frequency, as many experts are predicting. This led the author to ponder the two main questions. 1) What is the state of the science in determining how much water is available to support additional growth in a given area? 2) What is the state of the planning practice in using the results of such water supply analyses, in making local growth management decisions? The author was particularly interested in the nature and degree of coordination between water supply planning and local land use planning, in states that have earned reputations for growth management.

Four states were selected for case study: Oregon, Maryland, Florida and New Jersey. Over the past decade, these have arguably been the most frequently mentioned in review articles and other literature on state growth management efforts. Key statutes, regulations, state and regional plans and reports, selected local plans and ordinances, and other official documents on growth management and on water supply planning in each of the four states were examined. Interviews were conducted with relevant state officials and with other knowledgeable stakeholders and analysts (such as hydrologists and land use attorneys) to gain perspectives pertinent to the two research questions. Additional information was derived from relevant books, journals, newspapers and websites. The report's major findings, and the implication of those findings for Maryland's current efforts (in early 2004) to improve water supply planning, are presented below.

I.B. Overview of Growth Management in the Four States

The four states vary in the nature of their state and local growth management systems, although all are intended to prevent urban sprawl and promote efficiency in public infrastructure and service provision. Oregon has 18 statewide land planning goals that must be addressed in local land use plans, including the creation of urban growth boundaries. One of the Oregon goals (urbanization) calls on each municipality to establish and maintain urban growth boundaries -- revised every five years to contain a 20-year supply of land -- within which all projected growth is to be accommodated and

outside of which nearly all growth is prohibited through zoning. Florida has state and regional policy statements with which comprehensive plans must be consistent, and requires local governments to ensure that the provision of services (including water) is "concurrent" with new development. New Jersey has state planning goals but local governments' land use plans and decisions are not required to be consistent with the state's goals. Maryland has eight visions that local comprehensive plans must address, and an incentive-based "smart growth" program that limits state infrastructure funding to cities, inner-beltway areas and priority funding areas -- growth areas designated by counties using state criteria.

I.C. Overview of State- and Local-Level Water Supply Planning in the Four States

To varying degrees, each of the studied states has faced water supply stresses in particular locations in the past few years. Each has a state-level agency that performs the following functions: issuing permits for, and regulating, diversions of surface or groundwater exceeding a certain threshold; developing standards for, and procedures intended to maintain, minimum water levels and flows of surface and groundwater; regulating well drilling and pumping installations; and declaring water supply shortages and drought emergencies, and issuing water allocation plans and water use restrictions in the event of such emergencies. In only two of the states, Florida and New Jersey, do state agencies also prepare a statewide water plan. No matter the level at which water supply plans are prepared - - by a state government agency, interstate river commission or regional water supplier or local government - - only in rare instances is potential climate change factored into water use projections.

I.D. Overview of Coordination Between Water Supply Planning and Local Growth Management in the Four States

The four studied states differ in the degree to which state governments require water supply planning to be coordinated with local land use planning. The coordination was examined in terms of availability of water supplies to support expected growth, and protection of existing water supplies from polluted runoff from existing and future development. As examples in each state will show, the level of coordination actually occurring is usually much lower than the level required by state law. Oregon requires all municipal water suppliers to prepare "water management and conservation plans" that are supposed to be consistent with local land use plans. Florida requires coordination between local land use plans and the water supply plans of water management districts. New Jersey has little local-level coordination between land use and water supply planning; so little that in early 2004 the state intervened to establish mandatory buffers and other policies to protect water quality in nine drinking-water reservoirs and several river and stream segments. Maryland requires the state's counties to prepare 10-year water and sewer plans that are supposed to be coordinated with local land use plans and Priority Places. However, these water and sewer plans are uneven in quality and not adequately coordinated with local growth management planning.

1.E. Organization of the Report

The paper begins with a brief discussion of a "hydrological model" framework for defining "water supply". The hydrological model provides a context for analyzing the

water-supply aspects of state growth management efforts. This paper then profiles the four states in terms of: the sources of water supply for the state and the recent condition of that supply; the policy framework and institutional structure with which the state does water supply planning and makes water allocation decisions; the data and methodology used for water supply and demand estimation; the policy framework and institutional structure through which growth is managed; and the nature and degree of coordination between water supply planning and local growth management. The paper concludes with a discussion of findings and general implications of the case studies, with particular emphasis on lessons for Maryland.

II. A Framework for Water Supply Analysis

The hydrological cycle provides a conceptual framework for examining the relationship of water supply to growth management. The hydrological cycle is the continuous circulation of water between the earth and the atmosphere, encompassing many interrelated sub-cycles (Heath 1987; New Jersey Department of Environmental Protection [NJDEP]1996). In the cycle (which has no beginning or end), water evaporates from vegetation, exposed wet surfaces (including the land surface) and the oceans, and then forms clouds that return the water to the earth's surface in the form of precipitation. Under a pre-development scenario, precipitation takes one of three paths. First, most precipitation (or inflow) is "recycled" to the atmosphere through evapo-transporation. Second, most of the remaining precipitation is absorbed into the earth as groundwater "recharge", and much of this water later becomes the "baseflow" of streams In coastal areas, some of the groundwater recharge flows underground to the ocean at the freshwater/saltwater interface. The third path of the precipitation inflow is surface runoff, or water that runs off the land and directly into streams during and immediately after a precipitation event (NJDEP 1996).

Human activities alter or interrupt the natural flow paths of the hydrological cycle, through such activities as development, water consumption or use, and wastewater management. Development activities create impervious surfaces that impede the recharge of groundwater (Arnold and Gibbons 1996, American Rivers et al, 2002). Instead, the surface runoff flow is increased, resulting in polluted runoff that has adverse impacts on water quality and on stream morphology and ecological functioning. Water use or consumption that does not return the water near the point of withdrawal, removes the water from the localized flow path. If such water use exceeds the recharge of the aquifer, stream or other water source, it can result in lowering of groundwater levels and of surface water levels and flows. Lowering water levels and flows beyond certain limits, in turn, can have negative, localized impacts such as creating surface level instability ("sinkholes"), damage to wildlife habitat, and, in coastal areas, the intrusion of saltwater into groundwater. In addition, groundwater can infiltrate into "leaky" regional stormwater and sewage collection systems, leading to reduced stream base flows (NJDEP 1996). In terms of water quality, inadequate sewage treatment can pollute the watercourse in which the treated sewage is discharged.

Addressing the negative impacts of development on the hydrologic cycle is necessary in order to minimize harm to watershed ecosystems and avoid depletion and contamination of water supplies. These concerns are even more critical given the increased frequency of droughts and the possibility that global warming will aggravate water supply problems in certain areas. A recent report by three environmental organizations (American Rivers et al. 2002) argues that, in 20 metropolitan areas studied, impervious surfaces created by sprawling development patterns have disrupted groundwater recharge, thereby aggravating water supply problems in times of drought. Also, rising sea levels resulting from climate change could also result in increased saltwater intrusion into groundwater in coastal regions.

The above considerations lead to numerous planning challenges. One is to shift from a supply-oriented approach to water management (i.e. the building of large dams and conveyance systems to meet user needs) to an "integrated water-resources management" approach that balances the traditional supply-management orientation with demand management options (Baumann et al. 1998; U.S. Geological Survey website 2002). The latter approach incorporates such strategies as water conservation, recyling, reuse, and improved water efficiency.

A second planning challenge is to manage new development and redevelopment in such a way that water sources are protected from both pollution and overuse. This paper focuses on how Oregon, Florida, New Jersey and Maryland are addressing this second planning challenge. More specifically, the question examined is the degree to which their state growth management systems incorporate water supply considerations.

III. Oregon Case Study

III.A. Overview of Oregon Water Supply Issues

While Oregon is widely perceived as a state that soaks up heavy winter rains and then gradually releases the supply gradually through the summer, the reality is that the state's water supply continually falls short of demand. In the year 2000, a third of the Oregon's most important rivers had flows below the state's legal minimum levels (Oregon Public Broadcasting [OPB] 2003. Most rain falls on the western half of the state because the Cascade Mountains block rain-carrying clouds from moving eastward. However, 82 percent of the state's water consumption is for irrigation, mostly for eastern Oregon's farm and ranches, while less than five percent is for domestic use in the state's more heavily-populated west (Cooper 2002; OPB 2003). Of the water diverted for irrigation purposes, 91 percent is from surface water and only nine percent from groundwater.

The doctrine of "prior appropriation" allocates water rights in Oregon (see below). Domestic water use is increasing in Oregon due to a population growth rate that was twice the national growth rate in the 1990s. Conflict between the water rights of farmers and those of fish and wildlife have arisen due to federal law requiring that state and federal governments consider the water needs of endangered species. In addition, Native American tribes in Oregon have water rights that, if fully enforced, would severely

impact non-Indian water users (OPB 2003). Since 1987, Oregon has also been issuing water rights to public agencies for the protection of fish and wildlife, water quality recreation. All of these factors complicate water management in Oregon. In some regions, these characteristics of water supply and use have important implications for the state's renowned growth management system.

II.B. Water Supply Planning in Oregon

The Prior Appropriation Doctrine and Its Relation to Water Supply Planning. As in other western states, water use in Oregon is based on the doctrine of "prior appropriation," which means that the first person to obtain a obtain a water right from a water source is the last to be shut off in times of low flows or levels. The prior appropriation doctrine differs the "riparian doctrine". Usually applying to all states east of the Mississippi river, the riparian doctrine holds that only landowners with water flowing through their properties have claims to the water. The prior appropriation doctrine was formally established in Oregon under the state's 1909 Water Code, under which the state's water is owned by the public. With some exceptions, all users – such as municipalities, farmers, ranchers and factor owners – must obtain a permit or water right from the Water Resources Department to use surface water or groundwater.[1]

Oregon's Water Code contains four fundamental provisions (Oregon Water Resources Department [OWRD] 2001a, 6): 1) surface water or groundwater may be legally diverted for use only if it is used for a beneficial purpose without waste; 2) the date that a water right is secured determines the holder's priority for water in times of shortages; 3) a water right is attached to the land on which the right was first established and goes with the land to the new owner; and 4) once established, a water right must be used as allowed at least once every five years. With some exceptions stipulated in the Water Code, after five consecutive years of non-use a water right is cancelled. Since 1909 Oregon has issued about 80,000 water rights (OPB 2003).

Oregon Water Resources Department Decision-making on Water Rights. Water rights are obtained by following a standard process. The first step is for a water right seeker to apply for the right from the OWRD. The department reviews the application to ensure that allowing the proposed use will not cause injury to other users or to public resources and that water is likely to be available for the proposed use. Among the factors that the department is required to include in its review are local land use restrictions; impacts on sensitive, threatened or endangered wildlife species and on water quality; and other state and federal policies (OWRD 2001,18). By regulation, the state's water rights process must comply with the statewide planning goals established by the Department of Land Conservation and Development (discussed below). Public comment on any water right application is allowed during OWRD's review period.

[1] Single or group domestic use of groundwater is exempt from the water right requirement if the use does not exceed 15,000 gallons per day (OWRD 2001a, 9). The effect of this provision is to allow most rural home sites to obtain well water without securing a water right permit, though they still might be subject to regulation in times of water shortage.

Oregon statutes direct the state to take water availability into consideration in its permitting decisions (Bastasch 1998, 65). Regulations issued by the Water Resources Department state that surface waters shall be allocated to new out-of-stream uses only during months or half-month periods when the allocations will not contribute to over-appropriation (subject to certain exceptions based on high public interest and protection of instream values). Under a rule adopted by the Water Resources Commission in 1992, *out-of-stream* appropriations for consumption (such as municipal use, irrigation and livestock) and any in-stream demands (for tribal water rights and scenic waterway requirements) cannot be more than the 'live" natural stream flow occurring at least 80 percent of the time.[2] This means that, at full appropriation, the most junior user can expect to have water available at least 80 percent of the time (Cooper 2002). The 1992 rule also requires that for *in-stream* appropriations from "live" flows, the amount of water left in the stream cannot be less than the natural flow that occurs at least 50 percent of the time. For the most heavily-used surface waters in the state, the OWRD maintains a database on the amount of water available for appropriation, and uses the database to evaluate applications for new water uses.

Similarly, OWRD may allocate new groundwater to new beneficial uses only when the allocations will not contribute to over-appropriation of groundwater sources (OAR 690-410-0070(2)). Over-appropriation of groundwater is a condition in which "the appropriation of groundwater resources by all water rights exceeds the average annual recharge to a groundwater source over the period of record or results in the further depletion of already over-appropriated surface waters" (OAR 690-400-010). OWRD utilizes the expertise of in-house groundwater hydrologists to assess groundwater availability, using records it possesses of wells built in the state.

To determine surface water availability according to the above requirements, the OWRD determines the natural flow of streams and then subtracts the flow that is taken for consumptive uses (including water lost to evaporation or transpiration), and for storage or for in-stream uses. For some streams, the natural levels are determined directly from guage records from the time period of 1958 through 1987. Most streams, however, are unguaged and other streams have gage records that cover only a portion of the 30-year base period. For ungauged streams, the flows are estimated using a regression model that includes such independent variables as size of the drainage area, mean slope and elevation, mean January and July precipitation, and mean soil permeability. For streams with incomplete gage records, the OWRD calculates natural flow by matching the recorded flows of those streams with those of "index" streams -- in similar watersheds -- which were gauged over the 1958 to 1987 period.

Once the natural flow of a stream has been determined, OWRD subtracts from that water volume the amount of water that is a) reserved for storage; b) reserved for in-stream uses; and c) being taken through consumption. Water diverted for irrigation is the largest consumptive use. OWRD determines the amount of this water consumption by taking a census of the actual number of acres irrigated in the stream watershed and the acreage of

[2] "Live" steam flow is that arising from natural hydrologic process, and not augmented from stored water (Cooper 2002).

particular crops grown, and then calculating the consumptive use based on the water requirements of the given crops.

For municipal consumptive uses, the current demands are based on the actual diversions of the municipality, multiplied by 'consumptive use coefficients" particular to different water use basins in the summer and winter. For example, the consumptive use coefficients for all Coastal basins is 0.10 in the winter and 0.15 in the summer, while the coefficient for the Rogue and Umpqua basins is 0.15 in the winter and 0.64 in the summer. This means, for example, that 64 percent of water that is used by municipalities in the Rogue and Umpqua basins in the summer months is "lost" to the stream as a result of consumption (such as through transpiration by watered vegetation or evaporation from lawn sprinkling). ODWR estimates that other consumptive, out-of-stream uses - - such as industrial, commercial, and livestock – are minor in comparison to municipal use and irrigation, and are also minor in comparison to stream flow. For such uses, actual consumption is determined by multiplying a consumptive use coefficient by the maximum diversion rate allowed for the water right (Cooper 2002). For example, the consumptive use coefficients for industrial and commercial uses are 0.10 and 0.15, respectively. The assumption is that only 10 percent of water diverted for industrial use is not returned to the stream.

According to Dwight French, an OWRD water rights specialist, the department's review focuses primarily on the adequacy of water sources to serve the specific party applying for a permit, rather than the collective availability of water sources to accommodate multiple prospective users (Personal communication, October 7, 2003). French noted that Oregon law limits the amount of time the Department may take to evaluate a permit application, which makes it difficult to routinely assess cumulative demands on water sources. Nevertheless, French maintains that OWRD has a fairly good understanding of long-term surface water availability. However, French is less confident of OWRD's grasp on long-range groundwater availability, noting that potential shortages may go undetected until an actual problem arises. The Department is attempting to get funding for additional groundwater studies.

Since municipalities and other water suppliers are not exempt from the requirement that water rights must be obtained in order to appropriate water, cities and counties may have to plan for and secure new water rights in order to ensure a sufficient water supply to accommodate forecasted growth. However, municipal water use is subject to a number of preferences under Oregon water law. For example, municipalities do not have to initiate construction of surface water diversion works within one year of obtaining a permit, and they can obtain a water right certificate for part of the permitted amount and keep the rest in permit status (Bastasch 1998, 81). Collectively these preferences enable cities to reserve significant amounts of water for future growth, and some cities maintain significant undeveloped water rights (Bastasch 1998, 82-3).

Requirement for Water Conservation and Management Plan Preparation. In November 2002, OWRD adopted a policy requiring major water users and suppliers – those serving more than 1,000 people -- to prepare "water management and conservation plans

(WMCPs)" in order to be eligible for water permit extensions (OAR 690-315). Such plans had been required since 1994, but the new policy adopted in 2002 expanded the scope of these plans. The OWRD issued regulations that provide standards for the preparation of the new plans (OAR 690-086).

The new WMCP regulations require the plans to contain "a reasonable and appropriate schedule with five-year benchmarks for implementation of conservation activities" (OAR 690-086-0130). OWRD is to use the suppliers' reported outcomes in meeting their benchmarks, as the basis for department decisions on permit extensions or issuance of new water rights. OWRD can extend a water permit for a municipal supplier for 50 years or more, if there are relevant circumstances and sufficient documentation of need (Economic and Engineering Services, Inc. 2003).

OAR 690-086 contains little direction in terms of the specific methodology to be used by suppliers in preparing their plans. In order to help ensure that the water management and conservation plans use consistent research and reporting methodology, the OWRD, the League of Oregon Cities and two other organizations contracted with a consultant to produce *Water Management and Conservation Plans: A Guidebook for Oregon Municipal Water Suppliers*. Published in May 2003, the guidebook provides a step-by-step outline for preparation of each element required in the plan. The guidebook also includes two appendices, one containing a sample plan for a large municipality and the other a plan for a small one.

Methodology in the Oregon Guidebook for Determining Future Water Demand: Climate Change Not Explicitly Factored In. The *Guidebook* contains suggestions for preparing long-range water demand forecasts, pointing out that projections using simple use breakdowns (residential, non-residential and non-revenue water[3]) are easy to prepare, they are less accurate than more disaggregated forecasts (with separate projections for single-family residential, multi-family residential, commercial, industrial, schools, parks, government customers, irrigation meters and non-revenue water (Economic and Engineering Services, Inc. 2003, 44). The guidebook contains a short section describing advanced forecast modeling that uses statistical techniques, but has no instructions for preparing such forecasts. Instead, the guidebook's appended sample plan illustrates the result of such disaggregated forecasting, and the guidebook also includes a bibliography of several books and manuals addressing the subject of demand forecasting. Whether global climate change is incorporated into the plans will depend on the forecasting technique used by the water supplier. The guidebook notes that using mathematical models allows for water use projections to be related to "a series of independent variables such as population, climate and price", and indicates that coefficients for the independent variables can be determined by regressing "known data over a given period of time (say five to ten years)" (Economic and Engineering Services, Inc. 2003, 44). If the years used to model the coefficient contain a number of drought years, then the forecasted use may more closely approximate the water use scenario that would occur under a global warming scenario. However, the extent to which the plans include a prolonged drought scenario will vary due to the lack of uniform instructions from OWRD.

[3] Non-revenue water is water use that is recorded by customer meters (due to leaks in water pipes, etc.).

Relationship of Oregon Water Supply Planning to Local Land Use Planning. Oregon regulations now require that future water use estimates be consistent with land use and populations projections. Accordingly, water suppliers are to use the projections contained in the local comprehensive plans of the relevant jurisdiction(s). The regulations require that a supplier's water management conservation plan be submitted to each affected local government along with a request for comments on how the plan matches the government's comprehensive land use plan (OAR 690-0876-0120(7) and (8)). Consistency with local land use plans is one of the factors that OWRD is to consider in reviewing the municipal water supplier's plan (OAR 690-086-0130(2).

The policy of requiring conservation and management plans of major suppliers (especially as applied to municipal suppliers seeking permit extensions) would seem to provide a promising avenue for long-range water supply planning. The availability of such plans could give local governments and the public access to useful information comparing projected demands with anticipated supplies.

Few WMCP's have been submitted to OWRD under the 2002 regulations. However, based on the plans that have been received under the old and new regulations, the results are not very encouraging according to Doug Perrow, a natural resources specialist of OWRD's Field Service Division (who reviews the plans). Perrow states that he "wouldn't characterize many of [the WMCPs] as being particularly good." "It is difficult for any community to really view water as a finite resource and to look at alternatives to what they are doing now." Perrow says "a shift in perspective and philosophy is needed" in order for there to be more emphasis on conservation. (As described below, a consortium of water providers in the Portland area decided to create their own regional water supply plan for that region, published in 1996.)

Some observers, such as Kate Kimball of 1000 Friends of Oregon, question whether OWRD will demand more than minimal compliance with the requirements and whether the plans will be linked adequately with land use planning. Even if WMCP projections are consistent with population and land use forecasts in local plans, it is not known whether the water or the land use plans will recognize water-supply limits to growth, and whether OWRD will turn down municipal requests for water permit extensions or requests for new water rights. OWRD's Doug Perrow admits: "We don't have the political will to cut off new water." Perrow believes that change in water planning will occur incrementally, as five year progress reports of the WMCPs are submitted, reviewed, and criticized.

It should be noted that regulations allow suppliers to meet the WMCP planning requirements under OAR 690-086 by submitting the water supply element of a public facilities plan if the latter plan substantially meets the requirements of the new rules. The public facilities plan is a required element of local comprehensive plans that are mandated by Oregon's state growth management system, discussed below.

III.C. Oregon Growth Management Regulations Related to Water Supply Planning

Oregon's celebrated system of land use planning rests on the legal foundation established in 1973 with the enactment of Senate Bill 100, the Oregon Land Use Act. SB 100 created the seven-member Land Conservation and Development Commission (LCDC) as well as the LCDC's administrative arm, the Department of Land Conservation and Development (DLCD). The law required that all cities, counties, regional agencies with planning authority, and other state and local agencies that affect land use prepare coordinated, comprehensive land use plans, consistent with 19 state goals established by the LCDC (Knaap and Nelson 1992). SB 100, the state's goal framework, and subsequent laws and policies have resulted in a land use planning program that does the following: mandates urban growth boundaries around every Oregon city; requires that counties and municipalities facilitate affordable housing by "upzoning" residential land to allow for higher densities; reduces automobile dependency through urban design and through changes to the transportation network; protects farming, forestry and ranching through state zoning of rural resource land and requires protection of other key natural resources; and establishes a system of state review of local comprehensive plans (Liberty 1998).

LCDC reviews all comprehensive plans to determine if the plans satisfactorily address the goals. The issue of water supply is relevant to several of the state planning goals, as outlined below.

The current Oregon state code defines comprehensive plans, in part, as follows:

> "Comprehensive plan" means a generalized, coordinated land use map and policy statement of the governing body of a local government that interrelates all functional and natural systems and activities relating to the use of lands, including but not limited to sewer and water systems, recreational facilities, and natural resources and air and water quality management programs. …… "Land" includes water, both surface and subsurface, and the air" (ORS 197.015(5)).

The legislature's definition of "land" as including both surface water and groundwater has the effect of making water use subject to comprehensive planning, and the definition of "comprehensive plan" makes clear that such plans have to address water systems. Oregon law further provides that locally elected governing bodies must prepare and adopt public facilities plans (including coverage of water systems) as well as other functional plans governing transportation, recreation and economic development (ORS 197.712(2)(e)). In addition, state law brings "special districts" (defined to include "water control districts, domestic water association and water cooperatives" (ORS 197.015(19)) under the framework of the comprehensive planning requirements by requiring counties and Portland's Metropolitan government (Metro) to perform coordinative functions and to enter into cooperative agreements with such districts, describing how the districts will be involved in comprehensive planning (ORS 195.020(2)-(4)). Special districts are required to exercise their planning responsibilities affecting land use in accordance with the state planning goals (ORS 195.020(1); 197.250).

Of the 19 land use planning goals adopted by the LCDC in 1975, four are relevant to water use planning and water supply systems: Goal 5 - Open Spaces, Scenic and Historic Areas, and Natural Resources; Goal 6 - Air, Water and Land Resources Quality; Goal 11 - Public Facilities and Services; and Goal 14 – Urbanization. The following discussion will highlight the relevance of these four goals to water supply planning.

Goal 5 – Open Space, Scenic and Historic Areas, and Natural Resources – requires local governments to "adopt programs that will protect natural resources . . . for present and future generations" and requires that certain resources be inventoried. The resources subject to the inventory requirement include (among others) riparian corridors; including water and riparian areas and fish habitat; wetlands; and groundwater resources. The guidelines for Goal 5 say that plans providing for open space and natural resources protection "should consider as a major determinant the carrying capacity of the air, land and water resources of the planning area. The land conservation and development actions provided for by such plans should not exceed the carrying capacity of such resources."

The DLCD has issued extensive regulations explaining how Goal 5 is to be implemented (OAR 660-016, 660-023), including specific requirements applicable to riparian corridors and groundwater resources. The requirements applicable to riparian corridors appear designed to safeguard the ecological integrity and function of such areas to the extent reasonably possible. The requirements applicable to groundwater resources appear designed primarily to ensure the adoption of land use programs to protect "significant groundwater resources" so that "reliable groundwater is available to areas planned for development and to provide a reasonable level of certainty that the carrying capacity of groundwater resources will not be exceeded" (OAR 660-023-0140(1)(c)). The term "significant groundwater resources" refers to areas which have been officially designated as critical groundwater areas or groundwater-limited areas under ORS 537.505 et seq. (The Goal 5 rules do not apply to other groundwater resources). The rules require local governments to amend their comprehensive plans to inventory and protect significant groundwater resources. However, the rules do not spell out how local governments are to assess long-term groundwater availability or apply the carrying capacity concept to groundwater.

Goal 6 -- Air, Water and Land Resources Quality – contains provisions that are designed to prevent waste and process discharges from existing and future development from violating or threatening to violate applicable state or federal environmental quality standards. To the extent that water resources are brought into focus in this goal, the emphasis is on water quality rather than on water use and supply. The goal has language similar to that of Goal 5 on carrying capacity.

Goal 11 -- Public Facilities and Services -- has great relevance to water use and supply in that it requires that provisions for key facilities, including water supply systems, be included in each comprehensive plan. As a support document to the comprehensive plan, the goal requires that communities prepare a "public facilities plan" describing the water, sewer and transportation facilities which are to support the land uses designated in the

plan for areas within an urban growth boundary containing a population greater than 2,500. In addition, counties are to adopt a "community public facilities plan" regulating facilities and services for certain unincorporated communities outside urban growth boundaries. Both types of public facilities plans are clearly required to address water services and facilities. Further, state agencies that provide funding for public facilities (including water systems) are required to identify in their coordination programs how they will coordinate that funding with other state agencies and with the public facilities plans of cities and counties. The goal has language similar to that of Goal 5 on carrying capacity.

Goal 14 -- Urbanization -- requires that urban growth boundaries be established to identify and separate urbanizable land from rural land, taking into account (among other factors) the orderly and economic provision for public facilities and services. The requirement for urban growth boundaries is relevant to water use and supply because the expansion of such boundaries often triggers the need for expansion of water system facilities. The regulations say that plans should designate sufficient amounts of urbanizable land to accommodate the need for further urban expansion, taking into account the area's growth policy, the needs of the forecast population (an increase in which will place greater demands on the water supply), the carrying capacity of the planning area, and open space and recreational needs. The goal has language similar to that of Goal 5 on carrying capacity.

Despite the statutory and regulatory language linking land use planning with water use, Bastasch points out that local planners for the most part have tended to focus more closely on issues like the setting of urban growth boundaries and the protection of farmland than on water use and supply. "Consequently," he says, "today most local plans are not well coordinated with local water supply or water management realities" (Bastasch 1998, 218). Bastasch goes on to state, however, that the requirement for public facilities planning is an exception to this rule. "The Department of Land Conservation and Development directs [communities that are required to prepare public facilities plans] to identify the amount of water necessary to serve their areas. This identification occurs through public facilities plans which must address water sources and treatment needs; pumping, storage and distribution requirements; and storm-water disposal routes, including streams, ditches, and retention basins." Although the statutes and rules do not explicitly tie water facility planning to the state's water planning and management system, the public facilities plans "at least raise for public debate the suitability of future water sources, the costs of piping water to existing and future residents, and the role of existing water providers in meeting the demands of growth" (Bastasch 1998, 219).

A perusal of DLCD's public facilities planning regulations indicates that the term "public facility systems" covers water supply systems, including water sources, treatment systems, storage systems, pumping systems, and primary distribution systems (OAR 660-011-0005(7)). The rules also require that the projected timing of public facility installation be linked to a "general estimate" of when the need for project development would exist (taking into account population projections) and that the timing of such facilities be consistent with the acknowledged comprehensive plan's projected growth

estimates (OAR 660-011-0025). However, the regulations do not specify the level of analysis or forecasting that is required in support of planned expansions of water supply systems; nor do they contain an explicit requirement for a quantification of water supply needs. The DLCD's review of public facilities plans focuses on the required content of the plans and whether the plan is consistent with the acknowledged comprehensive plan (OAR 660-011-0050).

The DLCD's contact person for goals 11 (public facilities) and 14 (urbanization) was asked whether the DLCD reviews the extent to which the entity developing the public facilities plan (or other submission such as an urban growth boundary expansion proposal) has analyzed the availability of water sources to support planned growth. According to DLCD's Jim Hinman, the department does review the adequacy of local water supply planning, although the level of review on this issue is generally not detailed nor does it involve engineering analysis. The department looks for indications that water supply forecasts have been adequately coordinated with population projections, based on the delineation of urban growth boundaries. Hinman explained that DLCD reviews the overall consistency of the public facilities plan with the applicable comprehensive plan and that this consistency determination involves looking at such factors as the congruence between the area to be served with water supply facilities and the urban growth boundary, the existence of coordination agreements with the relevant water provider, and whether the water system is sized appropriately for the population that is to receive water service. The Department, he said, generally accepts the engineering analysis provided by the city or county in its underlying water system master plan. Although public facilities plans are sometimes remanded to the local government for additional work, Hinman states that water supply is rarely a constraining factor for the department in approving public facilities plans or other submissions. Hinman also said that the issue of carrying capacity -- as referenced in all four of the state goals described above -- does not come into play as a distinct regulatory test or requirement.

Bastasch notes that "Oregon's land use laws state that all plans, programs, rules, or regulations affecting land use adopted by special districts must comply with the statewide planning goals" (Bastasch 1998, 219). As mentioned previously, water suppliers are generally considered special districts and thus are subject to the planning goals. "Explicitly making water providers key participants in land use planning," says Bastasch, "would seem to set the stage for successful land and water coordination, especially in local urban areas. However, few special districts have fully participated in land use planning, nor have any substantive agreements been struck between water districts and local governments" (Bastasch 1998, 219). Some water suppliers, though, have taken a proactive role in long-range water supply planning. The efforts of the Portland-area "Regional Water Providers Consortium" (consisting of more than 25 of the area's largest water providers) to plan for future water supply to serve the area's projected growth, are described below.

III.D. Oregon Land Use and Water Supply Planning in Practice

It is difficult to make broad generalizations about the extent to which land use planning is coordinated with water supply planning in Oregon. The public officials and external

observers contacted during this research did not speak with one voice on this issue. Generally the public agency representatives were more sanguine about the state of land use and water supply planning than were the outside commentators. People like Jim Hinman of the DLCD and Dwight French of the ORWD generally believe that reasonable provisions exist for agency review of public facilities plans (and other local government submissions) and water rights applications, to ensure that there is enough water available for the proposed activities. Both Hinman and French qualified their remarks, however, in important ways -- Hinman by saying that DLCD's review is non-technical in nature and French by noting that his agency does not routinely analyze cumulative impacts from water rights applications nor does it possess the amount of information it would like to have on groundwater resources. Although some Oregon statutes and regulations seem to connect land use and water supply planning, they are not very specific about the level and detail of planning and forecasting that are required. On the other hand, Lorna Stickel, chief planner for the Portland Water Bureau, asserts that state land use goals and guidelines require close linkage between growth management and water supply planning throughout the state.

Observers like Bastasch tend to be more skeptical about the extent to which land use and water supply planning are linked in practice. Similarly, some representatives of public interest groups are especially critical of the current planning practices of the Water Resources Department. Karen Russell, a senior staff attorney at Waterwatch (a public interest group dedicated to protecting natural flows in Oregon rivers), writes that "instead of planning . . ., the state is responding to crises and requests for long term guarantees of water on a case by case basis, giving away water (both new permits and extensions of undeveloped permits) on a day to day basis without any strategy or vision for the future. The problem is exacerbated by [the Water Resource Department's] unwillingness to say no – which in some cases you have to do based on the best interests of the state" (Russell undated, 2)." Russell asserts that the connection between water and growth in Oregon is not very clear and that the linkage between land use and water supply planning is more theoretical than real. Russell's comments are echoed by Kate Kimball, 1000 Friends of Oregon representative in the high-growth Bend area, and by Mary Kyle McCurdy, who works on Smart Growth issues for 1000 Friends.

However, there does seem to be some official recognition that water supply planning is a matter of some importance in view of the limited extent of the state's water resources. The 2001-2003 Strategic Plan issued by the Water Resources Department puts the situation in remarkably strong terms: "each year the state's water supply falls far short of the demands placed on it. Across Oregon, many streams are dry in the summer and fall months. Adequate natural flow reserves for new and expanded uses do not exist. In many places, sufficient flows for *existing* users do not exist – and haven't for decades. In more and more areas, we are facing uncertainties about ground water reserves. . . . Put very simply, there is not enough water where it is needed, when it is needed, to satisfy both existing and future water uses" (OWRD 2001b). Yet, the Department's statement was tempered significantly by Dwight French, who states that many water suppliers are finding ways around the problem of fully appropriated summertime surface water flows. Other options that may be available to suppliers include tapping groundwater resources,

building water storage reserves with winter flows, purchasing water from other suppliers, and implementing mitigation measures like buying someone else's water rights and transfer-ring the rights in-stream (discussed below in relation to the Bend situation).

Bastasch sums up the state's overall efforts at water supply planning in the following words: "If a plan is an ordered sequence of policy-guided actions undertaken to meet specific objectives, then Oregon does not have a recognizable water supply plan. Various attempts at all-purpose water planning have been made over the years, but each has come up short in terms of achieving all but the most general of ends. …. Oregon's water would seem a state asset still in search of a good plan – a search that began nearly half a century ago" (Bastasch 1998, 213). It remains to be seen whether the regulations issues in 2002, strengthening requirements for water management and conservation plans, will result in water supply planning that exceeds Batasch's assessment.

III.E. Two Oregon Cases: the Portland and Bend Areas

Portland Case Study. This study examines the actual extent of coordination between land use and water supply planning by examining two specific cases: those of the Portland metro area and the Bend – Deschutes County region. Portland, the state's largest city, and its metropolitan region have a unique, elected metropolitan governance structure, known as "Metro." Portland has achieved national recognition for the degree to which it is attempting to implement forward-thinking growth management policies that emphasize the economical use of limited land resources. Bend, a city of 57,750 people, is a resort and retirement center just east of the Cascade Range in central Oregon. The city is located in Deschutes County, whose growth rate from 1990 to 2000 was the highest in the state. Areas east of the Cascades are much drier than the Willamette Valley and are much more dependent on large-scale irrigation.

The Portland metropolitan area has a number of different water suppliers and sources. The water supply system operated by the City of Portland currently serves about half of the region's population, drawing primarily on surface water sources located in the Bull Run watershed east of the city. The Bull Run reservoirs are supplemented in times of drought by municipal wells near the Columbia River. The rest of the Portland area is served by a large number of smaller water districts that rely on surface water sources – particularly the Clackamas and Trask/Tualatin River systems – and on groundwater sources. The Regional Water Providers Consortium, formed in 1996, attempts to coordinate water supply planning and delivery within the metropolitan area. Its website says that the Consortium currently includes as members 22 water providers as well as Metro. The City of Portland provides staffing to the Consortium; Lorna Stickel is the chief planner for both the Portland Water Bureau and the Consortium.

It seems clear that Portland area water suppliers have engaged in serious long-range water supply planning in recent years and that the planning efforts are continuing. One of the functions of the Regional Consortium is to implement the *1996 Regional Water Supply Plan (RWSP)*, a comprehensive report on water supply and conservation options for meeting the region's needs through the year 2050. In its 277 pages (plus appendices), the Plan describes the current water supply situation in the region, projects increases in

water demand over the coming decades, identifies and analyzes a variety of water supply and conservation options and recommends an overall strategy for keeping pace with the region's growth. The plan concludes that new water resource options will be needed after the year 2017 but takes a generally optimistic view of the capability of new and existing water sources to meet forecasted demand. Options recommended in the plan include increased conservation; water reuse, recycling and non-potable direct source options; and use of new sources, including an aquifer storage and recovery option and a Clackamas River option. Late in the planning period, it may become necessary to begin tapping the Willamette and/or Columbia Rivers or to construct new storage capacity on Bull Run. However, there is some resistance in the region to using river water for drinking purposes owing to concerns about water quality. Members of the Regional Consortium are currently working on an update to the 1996 plan.

Portland Regional Water Supply Plan Methodology in Determining Future Water Demand; Considerations of Climate Change. The RWSP calculated annual, seasonal and peak-day water demand forecasts for the region as a whole and for each of the three counties comprising the Portland region (Clackamas, Multnomah and Washington). To accomplish this, individual forecasts were developed for each of the 47 municipal providers in the area. For each provider, a "status quo" (or trend) forecast of water sales through 2050 was calculated for the customer classes of residential, commercial, industrial, municipal, agricultural, etc. The trend forecasts were based on results of econometric models that related water sales in each class (in several years prior to 1992) to variations in seasonal patterns, temperature and precipitation. The projected growth in water demand was made for low, medium and high population and employment projections provided by Metro planners through the year 2050. The forecasted demand under the three growth scenarios was then adjusted as a result of estimates of "naturally occurring conservation on gross water demand" (Water Providers of the Portland Metropolitan Area 1996).[4] The third step in the demand forecasting process was to factor in the estimate effects of increases in the inflation-adjusted price of water on water consumption. The final step was to estimate water demand on the peak day of the year for each water district for each of the three growth scenarios. Peak day demand was calculated by combining historically-based information on the ratio of peak day to average day demands with the forecast of price-net water demand for each water district. Unlike the trend analysis, the peak-day water demand projection was intended to estimate demand that was 95 percent of the historical, peak-day demand.

In other words, the 1996 Portland RWSP took more advanced steps to estimate water demand under a climate change scenario than those suggested in the 2003 *WMCP Guidebook*. The RWSP found that under the high growth, peak-day demand scenario, the Portland area would have sufficient water until the year 2017.

[4] "Naturally occurring conservation" was defined as conservation that would occur "regardless of conservation programs introduced by the providers, as a result of changes in water service technologies, building codes, appliance standards and the competitive marketplace (Water Providers of the Portland Metropolitan Area 1996, 44-5).

Assessment of the Relationship Between Water Supply Planning and Growth Management in Portland. The relationship between these water supply planning efforts and growth management actions by Metro is not fully defined although it appears that a real and significant connection does exist. Metro has incorporated the 1996 RWSP into the "Regional Framework Plan," its regional growth management blueprint. The Framework states that future Metro policies relating to water supply will primarily concentrate on (among other things) "promoting the coordination between regional growth management programs and water supply planning" and "promoting the coordination between land use planning and achieving the goals of the Regional Water Supply Plan" (Portland Metro 1997,102). The section on water resources describes various policy exercises and documents in which water supply was an important consideration. Metro took part in the planning study that led to the issuance of the water supply plan, and the Framework states: "Metro has endorsed the Regional Water Supply Plan and the Metro Council has stated that this plan will be the basis for future Metro water supply planning and coordination throughout the Region" (Portland Metro 1997, 110). However, the Framework does not specify how or to what degree Metro will effectuate the promised coordination between growth management / land use actions and water supply planning.

The clearest indication of linkage between water supply and growth management planning is the central role that Metro's forecasting plays in water supply planning. As noted above, the RWSP bases its projected water demand on the projected population and employment growth rates provided by Metro for each provider service area. The RWSP asserts:

> the region's water providers recognize Metro's over-arching responsibilities for growth management. The RWSP is developed and will be revised based upon Metro's demographic and employment projections and on adopted elements of Metro's growth strategy. The RWSP also will be evaluated over time to reflect Metro's updated growth projections, the UGB, the Regional Framework Plan, and local comprehensive plans (Water Providers of the Portland Metropolitan Area 1996, 277).

It is apparent that the Regional Consortium relies on Metro to provide the projections and policies that support its water demand forecasts. However, what is less clear is whether the linkage between growth management decisions and water supply actions also runs in the opposite direction; that is, whether long-range water supply forecasts – possibly including cautions about future water limitations -- are significant drivers of Metro's growth management policies. On this point there is less documentary evidence. Apart from some general pronouncements about the linkage between growth management and water supply, the Regional Framework does not put forth any statements about the need to recognize the possibility of eventual supply constraints when adopting regional growth policies.

While Portland Metro recently approved an expansion of Portland's urban growth boundary, according to Metro planner Mark Turpel the planning and documentation

supporting this action did not include any extensive analysis of water sufficiency. Turpel indicated that this was not a major focus because the state's growth management system operates on the basic premise that sufficient land must be made available to take care of projected growth. Although UGB expansion does require an analysis of which areas can be served with public utilities most efficiently, the assumption at all times is that growth must be accommodated somehow. Turpel said that Metro did run its population projections farther into the future than it normally does because the Portland Water Bureau asked for a 50-year planning forecast.

Both Mark Turpel and Lorna Stickel suggest a second reason for the lack of focus on water supply: it appears that the Portland area, with its relatively wet climate, does have an adequate water supply to serve the amount of growth that is anticipated over the coming decades. Stickel said that water constraints are seldom a deciding factor in UGB expansions because water is generally abundant and there are additional options which could be exercised, such as increased use of the Clackamas River, which has excess water rights; further use of groundwater; development of additional storage capacity on Bull Run; and use of the Willamette and Columbia Rivers (the last option is controversial due to water quality concerns). Turpel thought that Portland would have to face water sufficiency issues at some time in the future, but for now supplies seem adequate.

On balance, the Portland case study suggests a mixed picture of the linkage between water supply and growth management planning in the Portland area. On one hand, it appears that regional water suppliers are in fact undertaking long-range water supply analysis using population and employment forecasts provided by the metropolitan planning agency. On the other hand, it is not clear that Metro is basing long-range growth management decisions with any in-depth analysis of water supply. However, Metro does seem to have consulted water suppliers about the long-range adequacy of water supplies and has received some assurance that water supply options are sufficient to support the growth management actions taken by the agency.

Bend Case Study. The water supply situation in the Bend area offers an interesting contrast with Portland because it illustrates the challenges of dealing with strong growth pressures in an environment that is not as water-rich (in terms of surface water, anyway) as the northern Willamette Valley. Bend is a city of some 57,750 people located just east of the Cascade Range in a relatively dry part of the state. The area's splendid scenery, pleasant climate and easy access from the population centers of western Oregon have made surrounding Deschutes County – population 126,500 – the fastest growing in the state. Flowing through the county is the Deschutes River, a popular fishing and rafting venue with important wildlife and ecological values. The lower stretches of the river comprise a state-designated scenic waterway, a status which carries significant regulatory implications. Under a 1988 court decision (Diack v. City of Portland), the state Water Resources Commission must find that scenic waterway flows will not be significantly impaired before issuing new water rights (OWRD 1998).

Increasingly, the growth pressures in the Bend area are encountering potential limitations in the capacity of water resources to support all-out development while also protecting

instream values and established water uses. The Deschutes River system has long been tapped extensively for agricultural irrigation, and today, the combination of agricultural and development-related water uses is stretching the system's resources to – and even beyond – the limit. The Deschutes system is currently over-appropriated, and no new surface water rights are being issued. Stream flows within the system are significantly depleted. According to the environmental group Waterwatch, "state scenic waterway flows and instream water rights are regularly not met in the summer and fall months. In the summer, the middle section of the river often has too little water to float an inner tube, let alone a raft. During the winter, much of the seasonal flow of the upper river is impounded for later irrigation. And, nearly year round, flows in the lower Deschutes do not meet the flow standards set by the state for fish, wildlife and recreation" (*Waterwatch* undated, 1).

With surface waters closed to further appropriation, the Bend area has turned increasingly to groundwater resources to support the demands placed on the system by growth. Yet, this course has problems of its own. Although groundwater reserves are generally plentiful, a study completed by the U.S. Geological Survey in 2001 found a clear hydraulic connection between the surface and groundwater systems in the upper Deschutes basin. The study stated that "ground water and surface water … are directly linked, and removal of ground water will ultimately diminish streamflow" (*Waterwatch* undated, 2). Since most of the groundwater in the upper basin discharges into the rivers and becomes surface water, the placement of further demands on groundwater will have the effect of further diminishing surface water flows. This potentially puts new groundwater withdrawals in conflict with the restraints posed by the scenic waterway protections. To the extent that such withdrawals "measurably reduce" scenic waterway flows – with measurable reduction defined in terms of specific flow rates and volumes – those new groundwater uses must be denied unless adequate mitigation is provided. The mitigation measures must "ensure the maintenance of the free-flowing character of the scenic waterway in quantities necessary for recreation, fish and wildlife" (*Waterwatch* undated, 2).

The combination of natural resource limitations and legal restrictions on further appropriations has placed the city and county in a situation, some say, in which it may soon need to consider stepped-up growth management measures. A 1998 paper by the Water Resources Department concluded that " … if it is necessary to mitigate [groundwater] demands on surface water resources, additional supplies of water will be necessary to accomplish the mitigation. It is unlikely that sufficient water exists in the Deschutes Basin to satisfy all these needs", although the paper also said that the Department "is committed to finding ways to supply water necessary to accommodate growth while protecting instream values represented by scenic waterway flows and instream water rights" (OWRD 1998, 5). Kyle Gorman, regional manager for the Department, states that the water issue is getting close to the point where growth management will have to be considered, although there is no crisis for now.

Some observers believe that, although water may become costlier in the future, the menu of available mitigation and conservation options should allow the Bend area to continue

its free-growing ways. The Water Resources Department has recently released new rules that define the types of measures that will count as adequate mitigation for new ground-water withdrawals (OAR 690-505). The rules indicate that, generally, mitigation projects may include: certain allocations of conserved water, certain transfers of an existing water right to an instream use if the water right to be transferred is also lawfully eligible for transfer to another out-of-stream use, certain artificial recharge actions, certain releases of stored water for instream uses, and "other projects approved by the Department that result in mitigation water" OAR 690-505-0610(3). In addition, "mitigation water must be provided within the general zone of impact identified by the Department, legally protected for instream use prior to permit issuance, and committed for the life of the permit and subsequent certificate(s)" OAR 690-505-0610(4).

Workgroups organized by the Water Resources Department had previously identified a variety of mitigation measures that seemed worth pursuing, such as short-term (and possibly long-term) water leasing, purchase of water rights (generally from farmers) for transfer instream, irrigation canal lining and/or piping to reduce seepage/evaporation, consolidation of irrigation ditches, groundwater recharge from surface water that is in excess of needs, operational and/or structural changes to existing projects, and increased efficiency or conservation.

Kyle Gorman asserts that short-term leasing of irrigation water could do much to alleviate the water supply situation if it were pursued on a wide enough scale, but some observers say that it would be unwise to base a mitigation program on a measure that is subject to year-to-year fluctuation and uncertainty. Permanent sale of water rights would eliminate this uncertainty, but Gorman said that this option is more controversial than short-term leasing because it would permanently retire agricultural land from production, a consequence that many people wish to avoid. The option of lining irrigation canals to reduce water loss was highly recommended at the workgroup level, but environmental groups, joined by the U.S. Bureau of Land Management and U.S. Forest Service, have pointed out that canal lining for mitigation purposes would actually yield a net reduction in streamflow because the water currently leaking from canals eventually ends up as surface water anyway; thus no additional water (on a net basis) would be dedicated to instream use to compensate for the new water rights made possible by the "mitigation" scheme. The BLM and Forest Service have also questioned whether storage releases should qualify as mitigation measures if the water to be released to the river is not currently being allocated to consumptive uses.

Waterwatch has filed suit against the new mitigation rules, charging that they fail to comply with the state scenic waterways statute. According to spokesperson Kimberly Priestley, Waterwatch contends that the rules fail to ensure that mitigation water will be provided to the rivers during times of low flow, when the river is in greatest need of augmentation, or that water will reach the river at or above the point at which its flow is impacted by surface water withdrawals; thus, the rules do not provide assurance that new groundwater rights will be adequately offset by mitigation measures. In addition, Waterwatch takes the position that any mitigation program that accommodates new development should not only offset further surface water depletions but also meet state

objectives for streamflow restoration. Priestley says that the group considers permanent transfer of irrigation water rights to instream uses to be an effective mitigation measure, but this is the option that Gorman described as being politically sensitive.

The effect of the uncertainty over the legality of the mitigation rules and the ultimate effectiveness of various mitigation measures is to create some doubt about the viability of continued headlong growth in the Bend area. Although local leaders are confident that water will continue to be available – albeit at a higher price – it is possible that the mitigation scheme devised by the Water Resources Department will be thrown out by the courts or that the only mitigation measures that will suffice in the long term are ones that are not politically acceptable. Either of these eventualities could effectively place some restraints on the rate or extent of growth in the area. However, Kate Kimball believes that the state legislature might provide a way out for Bend by amending the scenic waterways act in the event of a court ruling for environmentalists. She also thinks that local jurisdictions would ultimately choose to retire farmland rather than accept any curtailment of growth.

The water supply situation in the Bend area, then, may be somewhat more tenuous than the situation in Portland, where prospects for enhancing long-term water supply to serve growth seem to be on a firmer footing. To some extent, this disparity may reflect differences in the degree to which the jurisdictions are focusing on water supply issues in conjunction with land use planning, with Portland having an advantage due to the size and sophistication of both its land use planning agency and its major water supplier. But it does not seem that local governments in the Bend area are entirely failing to coordinate water supply and land use planning. According to George Reed, Community Development Director for Deschutes County, although the county's current comprehensive plan and public facilities plan do not focus on the water supply issue, this will change when the plans are updated. Kate Kimball says it is not clear what the city or county could do to manage growth more effectively if that means slowing or limiting growth, since local governments in Oregon are required to provide for a 20-year supply of land within their growth boundaries to accommodate population increase. Cities cannot simply "freeze" their UGBs at a fixed location nor do they have the right to impose annual growth caps, although temporary growth moratoria can be declared if necessary services are not available. In principle, it might be possible for the county to further downzone some of its rural areas, but county zoning – reflecting state policy--already requires very large lot sizes in most rural areas (in some the minimum lot size is 80 acres). Agricultural land-owners in the Bend area would likely resist a further major downzoning.

III.F. Summary of the Degree of Coordination between Water Supply Planning and Growth Management in Oregon

The Oregon case study provides a mixed review on the link between water supply planning and growth management in Oregon. At the state level, while the Oregon Water Resources Department does not prepare and implement a statewide water plan, it does administer the state's prior appropriation doctrine under its *2001-2003 Strategic Plan*, reviews water permit and water rights applications, and reviews water suppliers' water

management and conservation plans. The OWRD admits that "there is not enough water where it is need, when it is needed, to satisfy both existing and future water needs." The 2001-2003 plan concludes that that "careful adjustments in the water law, combined with strategic management actions, incentive-based programs and an improved information base, will guide Oregon water management into the 21st Century" (OWRD 2001b).

However, several key informants for this study, including the OWRD official in charge of reviewing Water Management and Conservation Plans, question whether the State has the political will to deny new water rights and permits requested by municipal suppliers. It remains to be seen whether: the required WMCPs will contain realistic alternatives to current surface and groundwater withdrawal practices; whether the plans will contain forecasts and ensuing strategy alternatives under a scenario in which "peak-day" episodes become more frequent than in the past; whether OWRD will apply pressure to municipal providers that do not provide adequate reasons for failing to meet their 5-year progress benchmarks; and whether local jurisdictions will base growth management decisions on WMCPs and other water supply plans.

In fact, there may be an inherent conflict between the state's growth management policies and its water supply planning, even though the several of Oregon's statewide planning goals implicitly or explicitly call for coordination between land use and water supply planning. For example, jurisdictions are mandated to provide sufficient land within urban growth boundaries to accommodate anticipated growth. The Bend case study illustrates that two of the major strategies proposed to obtain water needed for additional growth have consequences that undermine other growth management goals and produce politically controversial results. First, buying groundwater rights from agricultural landowners could result in the loss of productive farmland. Second, lining irrigation canals and using other mitigation accounting practices could result in depletion of surface water flows in some critical parts of a river -- due to the connection of groundwater and surface water – leading to declines in water levels and damage to native fish populations and scenic recreational uses.

The Portland case study provides an example of regional water supply planning that incorporates a peak water-demand scenarios and utilizes population and economic forecasts provided by Metro, Portland's regional planning agency. However, it is not clear whether the planning coordination extends in the opposite direction; whether Portland Metro incorporates water supply forecasts into its growth management planning. The latter question is not pressing at the moment since the Portland region benefits from ample precipitation and has a number of alternative supply sources. Nevertheless, under a high growth, peak-demand scenario, The Regional Consortium forecasts that water demand in the Portland region will exceed supply by the year 2017. In short, in the state with the most comprehensive state-wide growth management system, there are many unanswered questions about the actual, effective link between growth management and water supply planning.

IV. Florida Case Study

IV.A. Overview of Florida Water Supply Issues

Since the 1970s, Florida has been in the national forefront with regard to both water planning (through the Florida Water Resources Act of 1972 and amendments in 1997), and in growth management (through a series of land use acts beginning with the Environmental Land and Water Management Act of 1972 and the Local Government Comprehensive Planning Act of 1975). The state's population has grown from slightly less than 5.0 million in 1960 to nearly 16 million in 2000, and this absolute growth over that time period is higher than every other state except California. Rapid growth has produced adverse impacts on the state's water resources.

> The State of Florida has a unique relationship with water. As a peninsula, the state is nearly surrounded by the sea and has thousands of miles of coastline. Moreover, the quality of life in Florida is inseparably linked with its water resources. The majority of today's population and the trend of present growth patterns reflect coastal settlement, where fresh water is least abundant and natural systems such as estuaries and wetlands are most vulnerable. As a result, water management beyond 2000 involves the challenge of balancing sometimes competing priorities to provide adequate water supplies for human needs, appropriate flood protection, and sound management of water quality and natural systems. (Southwest Florida Management District 2001, 1-1).

The planning, development, and regulation of water supplies has been accomplished through the State Department of Environmental Protection, five regional water management districts, water utilities and local governments. Growth management primarily has been the responsibility of the State Department of Community Affairs, nine regional councils, and local governments. While coordination between water planning and growth management has been mandated in the laws creating and refining these two concerns, efforts to foster more coordinated planning continues to be a legislative priority.

IV.B. Water Supply Planning in Florida

Under the Florida Water Resources Act of 1972 (Florida Statutes [F.S.] Title XXVII, Ch. 373), the Florida legislature empowered the Department of Environmental Protection (DEP) to regulate the withdrawal, diversion, storage and consumption of water (as well as the construction and operation of stormwater management systems). Recognizing that the state's water resource problems vary from region to region, the legislature gave DEP the authority to delegate appropriate powers to five water management districts created by the 1972 act.[5] The five districts were determined on the basis of watershed and other natural, hydrologic and geographic features. Each water district has a governing board of

[5] In its declaration of policy, the legislature stated: "Because water constitutes a public resource benefiting the entire state, it is the policy of the Legislature that the waters in the state be managed on a state and regional basis" (F.S. 373.016[4][a]).

9 members appointed by the governor and confirmed by the Florida State Senate.[6] In 1976, Florida voters approved a constitutional amendment giving the water districts the authority to levy property taxes at the rate of one dollar per $1,000 of assessed valuation (Southwest Florida Water Management District Website, 2002).

Water districts in Florida process permit applications for water use and well construction, monitor permitted activities, and enforce compliance. District permits are needed for uses that meet or exceed certain thresholds, as measured in such terms as amount of water used per day or diameter of wells. For example, any proposed use involving 100,000 gallons or more per day requires a district permit. The district can require a permit for uses that do not meet the thresholds if it anticipates that such uses could harm water-related resources, such as groundwater withdrawals in coastal areas that might lead to saltwater intrusion into an aquifer.

With regard to water supply development, the Legislature's intent is that "sufficient water be available for all existing and future reasonable-beneficial uses and the natural systems, and that the adverse effects of competition for future supplies be avoided" (F.S. 373.0831[2]). The roles of the water management districts in ensuring a sufficient water supply are primarily in planning and in water resource development. The Water Resources Act defines "water resource development" as encompassing such activities as collection and evaluation of water resource data, construction and operation of major public works facilities for water storage and flood control, and technical assistance to water utilities (F.S. 373.019[19] F.S.). "Water supply development", on the other hand, is primarily the responsibility of water utilities and other water users, and includes the planning, design, construction, operation and maintenance of public or private facilities for water collection, treatment and distribution for sale, resale or end use (F.S. 373.019[21]). The Act stipulates that water supply development projects be paid for through local funding sources, and that the costs of such projects be borne by projects' direct beneficiaries (F.S. 373.0831[c]). However, water management districts contribute significant amounts of funds for water supply projects.

As mandated by the 1997 amendments to the Water Resources Act, each of the five water management districts must develop a water management plan that addresses the issues of water supply, water quality, flood protection and floodplain management, and natural system maintenance. The regional plan, which must have at least a 20-year planning horizon, is to be updated at least once every five years (F.S. 373.036[2][a]).

Among the components to be included in the district water management plan is a list of minimum flows and levels for watercourses, surface waters and aquifers within the district, along with a discussion of the scientific methodologies for establishing those minimum flows and water levels. The legislation defines "minimum flow" for surface

[6] The legislation allows the Southwest Florida Water Management District to have 11 members on its governing board. Selected members are to have "significant experience" in one or more of the following areas, which include (but are not limited to): agriculture, the development industry, local government, government-owned or privately-owned water utilities, law, civil engineering, environmental science, hydrology, accounting or financial business (F.S. 373.073(2)).

watercourses as “the limit at which further withdrawals would be significantly harmful to the water resources of the area”, and defines “minimum water levels” as “the level of groundwater in an aquifer and the level of surface water at which further withdrawals would be significantly harmful to the water resources of the area” (F.S. 373.042[1][b]). By November of 1997 each water management district was to provide DEP with a priority list and schedule for the establishment of minimum flows and levels within the district.

The DEP, a district governing board or any person “substantially affected” by the establishment of given minimum flow or water level by a water management district, is entitled to request a scientific peer review of the scientific and/or technical data, methodologies and models used to establish minimum flow or levels. The peer review must be done by a panel of “independent, recognized experts in the fields of hydrology, hydrogeology, limnology, biology, and other scientific disciplines . ..” relevant to the flow or level determination (F.S. 373.042[4][a]).

In preparing the water management plan, a district may designate one or more planning regions within its jurisdiction. The plan for the district and each region (if any) must include an assessment that (a) identifies existing legal uses, reasonably anticipated future needs, and existing and reasonably anticipated sources of water and conservation efforts; and (b) determines whether the projected water sources and conservation efforts will be adequate to supply water for all existing legal uses and reasonably-anticipated future needs. For those areas in which the district determines that existing water sources are inadequate to meet projected demand by 2025, a separate regional water supply plan (RWSP) must be prepared.

A RWSP for regions facing future water shortages is to include the following: a quantification of water supply needs; a list of water sources options for water supply development that will exceed the identified needs; for each water supply option, the estimated amount of water to be made available and the estimated costs; and a list of water supply development projects. The water supply development projects that are to given funding priority by the district are those that meet one or more of the following state-established criteria: supports the establishment of a dependable, sustainable supply of water that is not otherwise financially feasible; provides “substantial environmental benefits” by preventing or limiting adverse water resource impacts, but which requires funding assistance in order to be economically competitive with other options; contributes to the sustainability of regional water sources by utilizing reuse, storage, recharge or conservation of water; and helps replace existing sources in order to help implement a minimum water flow or level (F.S. 373.0831[4][a]-[b]).

IV.C. A RWSP - - the Example of the Southwest Florida Water Management District

Overview of the Florida Case Study Area. The state of the science of water supply determination in Florida is illustrated in the following profile of the Southwest Florida Management District (SWFWMD). The SWFWMD encompasses all or part of 16 counties on the west-central coast of Florida, from Levy County in the north to Charlotte County in the South, and from the Gulf of Mexico on the west to Polk and Highland

Counties on the east. Containing a land area of approximately 10,000 square miles, the district area encompasses 98 local governments. The district's population was estimated at 3.8 million in 1998, and is expected to increase by 30 percent by the year 2020 (SWFWMD 2000). The district includes urban areas (including the cities of Tampa, Sarasota and St. Petersburg), agricultural land, industrial and mining operations, and the Green Swamp. Public water use, including public supply and domestic self-supply, constitutes 43 percent of the district's freshwater use, followed by agriculture (37 percent), industrial and mining (15 percent) and recreational/aesthetic use (five percent) [SWFWMD 2000]. The SWFWMD area encompasses a variety of surface water features, including rivers, lakes, streams, canals and estuaries.

About 80 percent of water used in the SWFWMD area is groundwater. The district's hydrogeology has two major characteristics that pose challenges for continued land development and its concomitant water use. First, in some parts of the district the water-soluble limestone in the earth's subsurface has dissolved, causing the land surface to collapse and thereby creating a "sinkhole". These holes can range from a few yards in diameter to over a half-mile. Second, groundwater and surface water are closely linked. Groundwater levels impact water levels in lakes; spring flow and water seepage from aquifers form the base flow of many streams; aquifers are recharged by water infiltration from freshwater wetlands that retard and store floodwaters; and stream discharges to estuaries are vital in maintaining the salinity balance (SWFWMD 2000,1-7). Damage to any part of this water system - - whether through over-pumping of groundwater, wetlands destruction or point and non-point pollution - - is thereby a threat to any other component. For example, over-pumping of groundwater near the coastline can lower the water level to the point where saltwater intrudes into the groundwater system, making the water undrinkable.

SWFWMD Methodology for Predicting Water Demand. The SWFWMD has identified three sub-regions in the district that currently do not have sufficient supplies of water to meet their projected water needs to the year 2020. The sub-regions encompass a ten-county area extending from Pasco County in the north to Charlotte County in the south, including the cities of Tampa, Sarasota and St. Petersburg. The SWFWMD Water Supply Plan (RWSP) for those sub-regions, published in August 2001, provides an example of the state of the science, in Florida, of determining water availability, and the state of the planning practice in using such projections in land use planning. The RWSP used 1995 as the base for which demand would be projected, because that year "typical climatic conditions occurred, resulting in 'normal' water usage" (SWFWMD 2001, ES-3). Another parameter used was the "1 in 10 year drought" as the water demand condition for which future water supply capacity needs would be planned. The RWSP defines a 1 in 10 drought as "an event that results in an increase in water demand of a magnitude that would have a 10 percent probability of occurring during any given year" (SWFWMD 2001, ES-3). The demand projections to the year 2020, based on the 1 in 10 year drought, represent the estimated total quantity of water that would be needed. No attempt was made to reduce the demand by including projections for further water conservation, since conservation is considered a water source and therefore is included in the "sources" portion of the plan.

To estimate demand the RWSP separated water use into four basic categories: agriculture, public supply, commercial/industrial and mining/dewatering, and recreation/aesthetic. The SWFWMD identified and analyzed factors that determine water use within each category. The parameters were determined through data collected from such sources as the district's own regulatory database, consultant research, other publications, and surveys of permittees. The methods and assumptions for assessing future demand for each category is discussed below.

Agriculture. In each of the ten counties covered by the RWSP, SWFWMD determined water use for irrigation for each the following crops: citrus; field crops; sod; vegetables, melons and berries; greenhouse/nursery, and pasture. Water use for non-irrigated farm operations, such as aquaculture, dairy and poultry, was aggregated. Estimates were made of the acreage to be used for each of the specific commodity categories listed above, and this acreage estimate was then multiplied by the irrigation requirements to derive an estimated annual water use. Draft acreage projections were first submitted to a range of sources for comment, such as commodity group representatives, county cooperative extension agents, individual growers, and the district's Agricultural Advisory Committee (SWFWMD 2001,39).

The district then calculated crop irrigation requirements for each commodity using the AGMOD program (SWFWMD 1992), a computer model that utilizes historical temperature, rainfall and solar radiation data. For each county, the AGMOD program incorporated typical site conditions for each crop, including location, climatology, soil type, irrigation system and length of growing season. Annual water use projections were made through the year 2020, for the normal year (i.e. 1995) conditions and for the "1-in-10" scenario. No acreage estimates were made for the non-irrigated commodities; projected water use was based on historic data and projected to the year 2020, with no water-use difference assumed between "normal" and "1-in-10" scenarios (SWFWMD 2001,41).

Public Supply. The SWFWMD divided the "public supply" category into three components. The first, which the districts labels "true" public supply, includes those residential, commercial and industrial customers receiving water from public and private utilities that serve domestic and secondary (e.g. irrigation) water needs. The second component, domestic self-supply, includes residential and commercial users who utilize their own wells for domestic and secondary purposes. The third category included persons who use the public supply system for domestic purposes but who also have private wells used for irrigation purposes.

To calculate future water demand in the public supply category, SWFWMD first calculated base year (1995) population for each county, adjusted for seasonal population factors (such as commuters, tourists and seasonal residents). The number of persons serviced in the base year by private and public utilities was determined for each county using SWFWMD reports along with other sources. The number of persons using domestic self-supply was calculated as the difference between the total population and the population served by public and private utilities. To determine the number of persons

using private wells for irrigation, the district used its own well construction data base. Per capita water use rates were then derived for the "true" public customers and the domestic self-service population.

To calculate the amount of water withdrawn for outdoor irrigation for wells less than six inches in diameter (and therefore not subject to SWFWMD permitting and recording keeping on water use), the district used a multi-step process. First, the number of such wells in each county was estimated as the difference between all wells coded as "irrigation" in the district's data base and all those with a district permit. Each such withdrawal point was assigned the average number of person per household in 1995. Second, the per capita water use rate for these irrigation wells was estimated using a 1999 study by the American Water Works Association (AWWA) that calculated, for North American cities (including Tampa), the proportion of per-household water use devoted to specific indoor and outdoor use categories. The district modified the 30 percent figure for each county based on information provided by public supply facilities. For example, in Manatee and Sarasota counties, irrigation well water use was calculated using the following assumptions: a lot size of 0.25 acres associated with each well; an irrigation area equal to 65 percent of total lot size; 75 irrigation events per year; and an irrigation application rate of 0.5 inches per irrigation event (SWFWMD 2001,53).

Annual projections to the year 2020 were made for "true" public supply and domestic self-supply for each county by multiplying the per capita water use in 1995 by estimated county populations for each year. Water use for irrigation wells were projected for those years by assuming that a "1-in-10 drought event would produce a six percent in water demand for irrigation purposes.

Industrial/Commercial and Mining Water Demand. Demand in this category was determined by first identifying the number of different water use permits that had been issued for industrial and commercial (I/C) and mining (M) in the years 1995 through 1999. District rules require water use permits for any use reaching the following thresholds: a withdrawal during any single day that is greater than one million gallons; an average annual withdrawal greater than or equal to 100,000 gallons per day (gpd); or a withdrawal from a well having an inside diameter of six inches or more. The district decided to use 0.1 million gpd as the reporting threshold for the I/C and M/D categories for the RWSP. Small commercial operators, such as fast food restaurants, were therefore not included in the I/C category. However, the district assumed that since many of these operators are located in urban areas and obtain their water via the public supply system, their water use would be accounted for under the demand projections for public supply (SWFWMD 2001,47).

Using its own records, the district observed that, during the five-year period from 1994 though 1999, only 56 percent of the water permitted to I/C users was actually used, while the ratio of actual use to permitted use in the M/D category was only 36 percent. The district calculated the base for making demand projections by multiplying the 1999 permitted quantity by the percentage of permitted quantity actually used in the I/C and M/D categories during that year. The district then used a conservative increase in this use

of 3.0 percent for each five-year increment to the year 2020. It should be noted that the district received approval of its Industrial Advisory Committee for this methodology, after demonstrating how it accurately predicted actual water use in this category for the year 2000.

Recreation/Aesthetic. Water use in this category is largely comprised by golf courses, parks, cemeteries, medians, attractions and other large, self-supply green areas. To calculate future use of water for golf courses, the district projected the number of future golf holes in the RWSP area by analyzing data on the actual increase in golf holes in the district from 1984 to 1994. Per-hole water use in 1995 was calculated from the district's Estimated Water Use Report for that year. To obtain water use for "average" precipitation years, the per hole use was then multiplied by the projected number of golf courses for each year out to 2020. To calculate golf course water demands for the "1-in 10" drought scenario, the district applied the AGMOD model in each county and incorporated typical site conditions for grass (including location specific data on climate, soil type, irrigation system and length of growing season).

Summary of Projections in the Florida Case: What is Included and What Is Not. Though the above analysis, the district found an overall projected increase in demand of 364.1 mgd in the RWSP areas by the year 2020 in the "average" scenario, and an increase of 739.2 mgd in the "1-in-10" scenario. Table 1 indicates, for each of the four sectors, the projected increase in demand for 2020 under the "average" and "1-in-10" scenarios, and the percentage of total RWSP area increase in demand that is attributed to that sector.

Table 1. Projected Increase in Water Demand for Four Sectors, from 1995 to 2020, for Southwest Florida Regional Water Supply Plan Area.

Sector	Projected Increase (mgd): Average	"1-in-10"	Sector's % of Total Increase: Average	"1-in-10"
Agriculture	122.9	430.5	33.8%	58.2%
Public Supply	180.8	219.2	49.7%	29.7%
Indus./Comm. & Mining	19.8	19.8	5.4%	2.7%
Recreation/Aesthetic	40.6	69.7	11.1%	9.4%
TOTAL	364.1	739.2	100.0	100.0

Source: Adapted from SWFWMD (2001, ES-5).

Table 1 indicates that the public supply sector has the greatest projected increase in the "average" rainfall scenario, accounting for nearly half of the projected water use increase. However, in the "1-in-10" drought scenario, agriculture has the highest absolute increase in water use over the 25-year planning period. The agricultural sector is projected to account for over 58 percent of the increase in water demand in the SWFWMD RWSP area from 1995 to 2020 under a "1-in-10" drought scenario.

A category not included in the above calculations is environmental restoration, consisting of the quantities of water that may be needed to be developed in order to restore surface waters and aquifers to future-determined minimum flows and levels. As the district notes

in the RWSP, it is not possible to project water demand for this category because the future minimum flow levels, and the related recovery strategies, have yet to be determined for all water resources in the planning region (SWFWMD 2001, ES-4).

SWFWMD Methodology for Projecting Water Supply Sources. For water supply planning purposes, the SWFWMD lowered the 364.1 mgd projected water demand to 215.5 mgd of needed additional supply. The district derived this number by first adding 68 mgd - - the amount of water that must be restored to groundwater in the northern Tampa Bay area to allow for environmental restoration there. This produced a water demand of 432.1 mgd by 2020 under the average scenario. The district then subtracted 215.5 mgd that is accounted for by projects that are already under development or planned with secured funding, leaving 215.5 mgd of water demand needing to be supplied by 2020 under the "average" rainfall scenario.

In its RWSP, the SWFWMD highlights four major categories of sources for increased water supplies to meet projected water demand: conservation; desalinization; reclaimed water; and surface water / stormwater. Table 2, below, indicates the amount of water that the district estimates will be available in the RWSP area by 2020.

Table 2. Potential Amounts of Water Available in the SWFWMD RWSP Planning Area (in mgd).

	Conservation		Desalination		Reclaimed Water	Surface Water/ Storm Water	Total
	Agricultural	Non-Agricultural	Seawater	Brackish Ground Water			
Total	41.3	95.4	100.0	29.5	168.1	243.8	678.1

Source: SWFWMD (2001, ES-7).

The district identifies ten types of agricultural conservation practices that it believes will produce water "supply" (i.e. reduced water use making water available for other uses). The savings from this category could amount to 6.1 percent of the projected water supply. Among these options are water conserving irrigation systems, automatic pump controls, and seepage interception systems. A range of non-agricultural conservation strategies are listed in the RWSP, limited to those that are economically feasible (i.e. cost less than $2.00 per 1000 gallons of water saved) and that can be implemented similarly across the region. As a result, some conservation options -- such as water-efficient rate structures, ordinances and education – were not included in the option list "because they must be evaluated and quantified on a case-by-case basis" (SWFWMD 2001, ES-8). Among the eight options that *were* listed were plumbing retrofit kit giveaways, ultra low volume toilet rebates, and rebates for rain-sensitive sprinkler systems. The district estimates that these non-agricultural conservation practices could "produce" the equivalent of 14.1 percent of new water supplies.

Saltwater desalinization is projected to provide 100 mgd of water supply by 2020 (or 14.7 percent), through construction of four desalinization plants. While there were no

saltwater desalinization plants in the planning region in 2001, the SWFWMD is providing $85 million towards the capital cost of one of the plants, facility to be co-located with an electric power plant on Tampa Bay. (For a description of the efficiency features of this combined power / desalinization facility, see Brown [2001]). The district estimates that the facility will produce potable water at a cost to the consumer of $2.08 per 1,000 gallons over a 30-year period, which is from one-fourth to one-half of the historical price of desalinated water. Jehl (2002) notes that the price that Tampa Bay Water will pay for the desalted water will be four times what it current pays for water from some of its rural wells, translating into an estimated, average monthly increase of $7.50 on a household's water bill.

The district proposes that desalinization of brackish ground water (i.e. water with impurity concentrations less than sea water but higher than drinking water standards) will provide a modest amount (6.1 percent) of water supply needed in the RWSP region by 2020. The planning area already has 12 brackish water desalinization facilities.

Reclaimed water is water that can be reused for non-potable purposes (such as irrigation of golf courses and community green spaces) after receiving at least secondary treatment at a wastewater treatment facility. The district proposes that such water can provide nearly 25 percent of the planning area's water supply by the year 2020. Since 1990 the district has provided more than $120 million in grant funding to assist in the establishment of over 125 reclamation projects in the planning area (SWFWMD 2001, ES-7). The benefits of reclamation is that it reduces reliance on potable water supplies and decreases the amount of wastewater treatment plant effluent that is discharged to surface waters.

As shown in table 2, the district expects surface water and stormwater to constitute the largest source of additional water supply (36 percent of the supply by the year 2020). The district determined surface water availability based on analysis of historic water flow and withdrawal data, mostly from the years 1965 to 1998. Since the district has not computed the minimum flows for many of the planning area's rivers, it developed interim criteria in order be able to make projections of potential supply. Surface water contribution to 2020 supply was projected using these criteria, along with the assumption that off-stream surface water reservoirs and aquifer storage systems could hold water during wet times of the year for later use in dry seasons. Determination of minimum flows and water levels is discussed below.

Cost of Developing Needed Water Sources by the Year 2020 in the SWFWMD RWSP. The SWFWMD estimates that, of the total 432.1 mgd of *additional* water supply needed by the year 2020 in the RWSP area, 215.5 mgd of supply is already being developed, or is planned for development with secured or pledged funding of $1.025 billion. Of the remaining 216.6 mdg needed, the district estimates the cost at $1.3 billion (determined by assuming a cost of $6 million for each mgd to be developed (SWFWMD 2000, ES 15-17). The total cost of developing the additional water supplies for the RWSP area is therefore $2.325 billion. Using the district's estimate of 1.3 million new residents in the

planning area by 2020 (up 27 percent over the 3.5 million population in 1995), this represents a cost of slightly over $2,000 for each additional resident.

An example of the cost of supplying water to a local area is provided by the three-county area served by the Tampa Bay Water (TBW) Authority. In 1998 the TBW and SWFWMD signed a partnership agreement under which TBW committed to reduce its groundwater withdrawals in order to alleviate environmental distress in the Tampa Bay region. For its part, SWFWMD agreed to provide up to $183 million to fund alternative water supply projects outlined in TBW's master plan, including projects to develop drought-proof supply from surface water and desalinated sea water sources. The cost of supplying these water sources will be assessed to property owners in the 16 counties served by SWFWMD.

Assumption of No Climate Change in Demand Projections in the SWFWMD RWSP. Although the district estimated water demands for the "1-in-10" drought year, there was no assumption that the frequency of droughts might change due to global warming. Recall that 1995 was used as the base year for projections because it was a "normal" rainfall year. Thus the RWSP assures the reader that sufficient water will be available for the "1-in-10" event, because "many future water supply development projects will incorporate aquifer storage and recover and/or aquifer recharge components to meet water demands" (SWFWMD 2000, 76). However, the RWSP indicates that if the "1-in-10" scenario became the "normal pattern", then total water demand by the year 2020 would not be 364.1 mgd, but 739.2 mgd. Curiously, the plan discusses neither the water supply options nor the supply costs for a chronic "1-in-10" scenario. It would have been instructive for the plan to address these questions. If minimum flows and levels need to be maintained during drought years, the costs of supply would, no doubt, be much higher.

Determination of Minimum Flows and Water Levels in the Florida Case Study. The purposes and policies of, and rules for, establishing minimum flows and levels in the SWFWMD are outlined in Chapter 40D-8 F.A.C. The rules express the district's concern about establishing a sound, scientific basis and a political consensus for the minimum flows and levels.

> The Minimum Flows and Levels . . . are based on the best information available at the time the Flow or Level was established. The best available information in any particular case will vary in type, scope, duration, quantity and quality and may be less than optimally desired. In addition, in many instances the establishment of a Minimum Flow or Level requires development of methodologies that previously did not exist and so are applied for the first time in establishing the Minimum Flow or Level. The District has many ongoing environmental monitoring and date collection and analysis programs, and will develop additional programs over time. The District intends to coordinate with local governments, Tampa Bay Water, government-owned and privately-owned utilities, environmental regulation agencies, Tampa Bay Estuary Program, public interest groups and other affected and interested parties to design, create and implement the program. Together will

> all the parties' designated experts, a long-term independent scientific peer review team shall be included in the programs. These programs will supplement the District's available information upon which Minimum Flows and Levels can be established and reviewed (40D-8.001[5] F.A.C.).

The following are brief descriptions of the methodologies that the district has used so far to established minimum flows and levels for different types of water sources.

Rivers. A minimum flow for a river is that which "is equaled or exceeded 85 percent of the time" (SWFWMD 2001, 79). A surface water source cannot be used for water supply when flow is below that level. The second criterion for determining surface water availability is that total withdrawals from a water source be limited to 10 percent "of the total daily flow at the point of the withdrawal." The RWSP notes that this criterion is consistent with an ecological standard used by the district to evaluate potential surface water withdrawals in the 1980s and early 1990s.

As an example, effective August 2000, the district rules mandate that minimum flow for the Lower Hillsborough River be set "at the rate of flow of ten (10) cubic feet per second (cfs) at the base of the [City of Hillsborough's] dam, measured at the Rowlett Park Drive bridge gauging station" (F.A.C. 40D-8.041[2]). Through the end of the year 2007, the City is required by district rules to maintain this minimum flow by releasing water from its reservoir, as long as the reservoir level is above a specified level. When the reservoir level is below its own district-specified minimum level, then the Lower Hillsborough River is to be replenished by diversion from other surface waters. The 10 cfs flow rate for the river could be modified following the completion of a study currently being conducted by the city and the water management district.

Wetlands. Minimum water levels for wetlands have been established only for one category of wetlands (palustrine cypress) due to data constraints. The district developed the levels based on an analysis of data from 36 wetland sites that met the following criteria: water-level data had been collected, at least monthly, over the years 1989 to 1995; the wetlands had no significant alterations of drainage patterns that might account for altered water level fluctuations; the sites were greater than 0.5 acres; and the sites were accessible for collection of a variety of ecological data. Using data from the 36 sites, the district conducted statistical analyses (using Spearman rank correlation) of various ecological indicators and water level. The analyses led the district to conclude that the health of palustrine cypress wetlands are impaired when the water level is lowered to a level that is 1.8 feet below the median water level of each wetland (SWFWMD 2001).

Lakes. So far, the district has developed minimum levels for three categories of lakes. A Category I lake is a cypress wetland-fringed lake that has either no man-made control structure, or has a control structure that does not prevent the median lake stage from reaching 1.8 feet below the median water level of the fringing cypress wetlands" (SWFWMD 2001,29). For this category, the district has adopted the guideline that the

lake is determined to be "significantly harmed" when the lake's water level is 1.8 feet below the median water level of the fringing wetlands.

A Category 2 lake also is fringed with cypress, but has man-made structures that prevent the lake's median water level from falling 1.8 feet below the median water level of the fringing cypress wetlands. The district has determined that a water level in the fringing wetlands that falls below that level will cause significant harm to the lake.

A Category 3 lake is defined as a lake that is less than one-half acres in size and fringed, not with cypress wetlands but "a forested hardwood or a herbaceous wetland with emergent and floating leaved vegetation" (SWFWMD 2001,29). For these lakes, the district determines minimum levels for each by using a methodology that correlates changes in lake levels with several ecological variables.

Aquifers. The first area for which minimum water levels were established for aquifers was in the North Tampa Bay Area, where the district believes the threat of saltwater intrusion is the most serious. The district first assessed the current status of saltwater intrusion into the area's aquifer, and then established the goal that minimum water levels be those below which further saltwater intrusion would occur. The district then assessed well monitoring data for seven wells in the Upper Floridan aquifer, wells that were judged to be best capable of providing early signs of saltwater intrusion into the region. The minimum aquifer levels were established for each well by calculating the average water level over a time period that accurately reflected the groundwater withdrawal rate for that well (with time periods ranging from six to 10 years. The minimum water level for the well was determined to be the median level. The district asserts that, due to the unique hydrological conditions in the North Tampa Bay area, other methods for determining minimum water levels will be used in other parts of the RWSP area.

Scientific Peer Review of Minimum Flow Levels in the SWFWMD RWSP Area. In 1999, three entities (Tampa Bay Water, the Environmental Protection Commission of Hillsborough County, and the City of Tampa) requested a scientific peer review of the 10 cps minimum flow level that had been established by SWFWMD for the lower Hillsborough River. The final report of the peer review panel (Montagna 1999) reflects the state of science in determining minimum flows. On the one had, the panel found "little scientific support" for the 10 cfs minimum flow determination. It cited shortcomings in some of the data analysis and criticized SWFWMD's technical report and supplemental documents for not stating clear management objectives for establishing the minimum flow rule (such as objectives related to salinity levels, fish species protection, etc.). On the other hand, the peer review panel asserted that the data presented by SWFWMD "appear to be complete and the best available at the time of determination", and that "the data, approaches to analyzing the data and the dynamic salinity model are scientifically valid" (Montagna 2002,1). The panel concluded the 10 cfs rule was "an improvement over the current condition and an experience in adaptive management." By "adaptive management", the panel meant that SWFWMD should establish clear management goals (such as "maintaining 1 or 2 km of oligohaline habitat during certain seasons"), monitor the impact of the 10 cfs minimum flow level on those

objectives, and use information from the monitoring to make any necessary adjustments to the minimum flow rule.

IV.D. Growth Management in Florida and Relation to Water Supply Planning

Overview of Florida's Growth Management System. In 1971, spurred by the negative impacts of unplanned growth and a significant drought in South Florida, Governor Askew organized an assembly of 100 citizens to make recommendations on state laws and policies related to water, growth and planning (DeGrove 1986; Starnes 1992). The citizen assembly's recommendations were eventually transformed into several statewide planning laws in 1972, including the Environmental Land and Water Management Act, the Land Conservation Act, and the State Comprehensive Planning Act. Revisions and expansions of Florida's growth management system were later implemented through the Local Government Comprehensive Planning Act (LGCP) of 1975, the Florida Regional Planning Act of 1980, the State and Regional Planning Act of 1984, and amendments to the LGCP in 2002.

Under Florida's current, "top down" growth management planning process, the State prepares a State Comprehensive Plan (first completed in 1984), consisting of a series of goals and policy statements. Regional planning is done by eleven Regional Planning Councils (RPCs). The RPCs have such responsibilities as strategic plan creation, review of local comprehensive plans, review of developments of regional impact, and conflict resolution among local governments.[7] Each RPC prepares a Strategic Regional Policy Plan that describes the demographic, social, economic and natural characteristics of its multi-county region, and contains goals, issues and policies in the areas of comprehensive/strategic planning, dispute resolution, economic development, housing and environmental protection. Local governments are required to prepare comprehensive plans according to guidelines prepared by the State Department of Community Affairs (DCA). The local plans are reviewed by its RPC for consistency with the Strategic Regional Policy Plan, and then reviewed by the State DCA for consistency with the State Comprehensive Plan. Local governments are required to ensure "concurrency", in the sense that services (including potable water, sewer, drainage, solid waste, recreation and transportation) must be provided concurrently with new development.

Goal #8 of the Florida State Comprehensive Plan focuses on water supply, stating:

> Florida shall assure the availability of an adequate supply of water for all competing uses deemed reasonable and beneficial and shall maintain the functions of natural systems and the overall present level of surface and groundwater quality. Florida shall improve and restore the quality of waters not presently meeting water quality standards (Ch. 187, Section 201 F.S.).

Among the 14 policies under this water resources goal are four that are directly related to local land use planning: "(2) identify and protect the functions of water recharge areas

[7] Membership of the Regional Planning Commissions boards of directors consists of one-third elected officials, one-third local citizens drawn from constituent counties and cities, and one-third citizens appointed by the governor. Each RPC has a professional planning staff.

and provide incentives for their conservation;" "(5) ensure that new development is compatible with existing local and regional water supplies;" "(8) encourage the development of a strict floodplain management program by state and local governments designed to preserve hydrologically-significant wetlands and other natural floodplain features;" and "(12) eliminate the discharge of inadequately treated wastewater and stormwater runoff into the waters of the state."

IV.E. Example of the Level of Growth Management and Water Supply Coordination in the Tampa Bay Region

Using the Tampa Bay Regional Planning Council and the SWFWMD as examples, it would appear that, at least on paper, that there is coordination among the state's growth management and water supply institutions. For example, the State Plan's water supply goals are reflected in the goal and policy statements of the Tampa Bay Regional Planning Council, and in the objectives and task statements of the SWFWMD's Water Management Plan.[8]

The Tampa Bay Regional Strategic Policy Plan contains a number of goals related to the State's water supply goal, and to the goals of the SWFWMD. Among those RPC goals are "(4.1) Protect the quality of surface and groundwater in the region;" "(4.3) Assure an adequate supply of water to meet all projected human and natural needs;" "(4.4) Manage stormwater and reclaimed wastewater as valuable regional resources;" and "(4.11) Incorporate the protection of regionally-significant natural resources in planning for future growth within the region" (Tampa Bay Regional Planning Council 2001).

Among the Tampa Bay RPC policies intended to implement these water-related goals are three which explicitly relate to growth management: "(4.1.10) Prohibit land use and transportation planning and development decisions which result in unacceptable degradation of existing groundwater and surface water quality;" "(4.3.8) Link water management with growth management / land use planning;" and "(4.6.9) Protect the water storage and water quality enhancement functions of wetland, aquifer recharge and floodplain areas through the adoption of appropriate land use planning / growth management techniques, the acquisition of priority properties and/or the application of Best Management Practices" (Tampa Bay Regional Planning Council 2001).

One of the State-required components of local comprehensive plans is a "Conservation and Aquifer Recharge" element. For this element, the City of Tampa's Comprehensive Plan appears to be consistent with the goals and policies of the State Plan and the Tampa Bay RPC. The plan calls for directing development away from wetlands and 100 year floodplains, and states that "scientifically-defensible land use regulations and performance standards for development activities in areas of high recharge / contamination potential must be developed by the appropriate agencies to protect groundwater quantity and quality for future generations" (Tampa Comprehensive Plan, 1998, 22). The Plan's policy statements call for "restricting development or land alteration activities which breach the confining layers of the Floridan aquifer;" "protect

[8] The Tampa Bay RPC is used as the example herein because all four of its constituent counties are also included in the SWFWMD, and these counties comprise the bulk of SWFWMD area population.

water quality by restricting activities and land uses which would adversely affect the quality and quantity of identified water sources . . .;" and "through the land planning and development review processes, consider the requirement of aquifer recharge easements where such mitigation is appropriate." Other policy statements call for measures to decrease potable water demands though conservation, reuse and protection and enhancement of groundwater and surface water supplies.

While local comprehensive plans are to be consistent with regional strategic plans and the State Comprehensive Plan, a bigger challenge is for consistency between County and local comprehensive plans and those of water management districts. On paper, it would appear that such coordination is taking place between the City of Tampa, Hillsborough County, the Tampa Bay RPC and the SWFWMD. For example, in the Tampa Comprehensive Plan's Conservation and Aquifer Recharge Element, several statements are made with regard to coordination with the SWFWMD. In the SWFWMD Water Management Plan, numerous references are made to the linkage between local land use planning and water supply protection. For example, the SWFWMD plan states that "the water management activities of the District and the land-use planning and management activities of local governments must be coordinated in order for either to be effective and efficient in accomplishing their respective objectives" (SWFWMD 2001, 3-2). To accomplish this objective, the district Plan's task list calls for such activities as district review of local comprehensive plans and updates, cooperatively funding appropriate land and water linkage studies and projects, and coordinating with local governments in developing and implementing flood protection agreements (SWFWMD 2001, 3-8).

The 1997 amendments to the Water Management Act specify a range of technical assistance that water management districts are to provide to local governments, to assist those local governments in preparation of the comprehensive plans. Among the information to be provided to local governments are: an overview of the district's regulations and programs; a description of surface water basins, including (but not limited to) such information as the location of flood-prone areas, surface runoff characteristics, the topography of floodplains, wetlands and recharge areas; a description of a range of groundwater aquifer characteristics; projections of regional water demand and of supply sources for the next 20 years; an identification of existing and potential district land acquisitions; and information on the minimum flows for surface water courses and minimum water levels for aquifers needed to prevent harm to water sources and ecosystems.

Water districts are able to purchase land and or conservation easements in order to protect water quality and supply, through funds derived from Florida's Save Our Rivers Program and the Preservation 2000 Program. The Save Our Rivers Program, established by the legislature in 1981, created a Water Management Land Trust Fund that is funded by a tax on real estate sales. The Preservation 2000 program, created by the legislature in 1990, raises funds though bond sales (annually totaling $300 million through the 1990s). Water management districts are entitled to 30 percent of the funds, which they use to purchase lands that are important for protecting or recharging groundwater, and that are in imminent danger of subdivision (Northwest Florida Water Management District website,

2002). In 1999 the Florida state legislature passed the Florida Forever Program as a successor to the Preservation 2000 program, allowing the issuance of up to $3 billion in bond issuance for land acquisition over a 10 year period. These programs can be used to support conservation and aquifer recharge elements of local comprehensive plans.

IV.F. Recent Attempts to Better Integrate Land Use and Water Supply Planning in Florida

In April 2002, Florida Governor Jeb Bush signed legislation making a number of changes to state growth management and transportation planning (Chapter 2002-296, Laws of Florida). With regard to water supply, the law requires local governments to amend their comprehensive plans to better integrate those plans with the regional water supply plans prepared by water management districts (§ 163.4177 F.S.). By January 1, 2005, the local government's "general sanitary sewer, solid waste, drainage, potable water and natural groundwater aquifer recharge" element must include a work plan, covering at least a ten-year period, for building water supply facilities that the local plan identifies as necessary to serve existing and new development and for which the local government is responsible § 163.3177[4][c] F.S.). In addition, the new law requires that, in its conservation element, a local government must assess its current and projected water needs and sources for at least a 10 year period, "considering the appropriate regional water supply plan . . . or, in the absence of an approved regional water supply plan, the district water management plan" (§ 163.3177[4][d]).

The law also amended Florida § 403.064, adding a new section stating:

> In order to aid in the development of a better understanding of the unique surface and groundwater sources of this state, the water management districts shall develop an information program designed to provide information concern existing hydrologic conditions of major surface and groundwater sources in this state and suggestions for good conservation practices within those areas (403.074 Section 38).

The education program was to be developed by the end of 2002. Beginning in January of 2003, the water districts were to provide the information on a regular basis (at no more than six-month intervals) to every Florida state senator and state congressperson and to local print and broadcast media.

IV.G. Summary of the Degree of Coordination between Water Supply Planning and Growth Management in Florida

The fact that the state legislature passed legislation in 2002 mandating coordination between water supply planning and land use planning suggests that the coordination expressed in the above-mentioned planning documents was overstated. The author's interviews with several planners and attorneys in southwest Florida who were familiar with the legislation, confirms that lack of connection. John Parker, a SWFWMD spokesperson, said that, despite concurrency requirements, Florida's local governments are approving development proposals "regardless of whether or not water is available to serve them" (Parker 2002). A land use attorney who advises SWFWMD claims that

there is a "huge disconnect" between growth management and water supply availability, and that local governments had applied concurrency requirements to transportation but never to water. Another land use attorney contacted by the author asserted the following:

> The land-use/SWFWMD linkage expressed in the [local comprehensive] plans is lip service. To date water has little if any effect on land use decisions. Everyone expects that to change in the future but the same discussion occurred 12 years ago and nothing happened. It would have the effect of giving water districts -- with an appointed, not elected board – the ability to stop growth in a 16-county area. This is unacceptable to most county governments and developers.

The explanation for this disconnect is that, as mentioned by several informants, is that growth is Florida's state industry. While water availability is recognized as an issue, local governments do not appear to seriously regard it as a limiting constraint. The Hillsborough County Comprehensive Plan reflects this stance. In the Potable Water Element of it Plan, the county describes how it administers its concurrency management system. At one point, the Plan states:

> Certificates of Capacity are issued for new development upon the finding that sufficient capacity, from raw water supply through potable water treatment, storage, and distribution to the point of delivery, is available. *Through Governance, Tampa Bay Water must provide water supply to meet Hillsborough County needs.* Available capacity is compared to existing use and future committed use . . . (Hillsborough County [FL] Potable Water Element, 2001, 17). Emphasis added.

In essence, what the county plan is stating is that yes, we have a process for concurrency evaluation, but is really does not matter because Tampa Bay Water has an obligation to supply us with whatever water is needed. There is no hint in the county's comprehensive plan that water constraints might be a development-limiting factor.

Water districts in Florida have considerable power, and their influence may increase should additional supply problems occur. While the districts do extensive water supply modeling and planning, they are not factoring global climate change into their predictive models. This means that the financial, ecological and water supply implications of drier-than-normal conditions and of saltwater intrusion from rising sea levels, is not considered in their current planning.

In sum, it appears that at present, the coordination between water supply planning and local growth management in Florida appears is on paper, but not on the ground. For the time being, water will be provided to support new growth, even if an area (such as the Tampa Bay region) has overstrained its water supplies. The main question seems to be, what will be the financial cost and environmental impacts of that supply to any given area.

V. New Jersey Case Study

V.A. Overview of Water Supply Issues in New Jersey

New Jersey has had a state growth management system since the late 1980s, but that system appears to be incapable of ameliorating severe, land-use related challenges to the state's water supply. The state's water supply challenges are caused by pollution of water resources from industrial and wastewater discharges, and from development-induced, large-scale disruption of surface and groundwater recharge. Fully one-half of the water that New Jersey uses leaves the state, much of it in the form of stormwater and treated wastewater that is dumped into the ocean (New Jersey Department of Environmental Protection (NJDEP) 1996, 54).

Northern and central New Jersey relies heavily on intrastate surface waters and their associated reservoirs. The Passaic River and its tributaries is the most extensively used river system in that part of the state, followed by the Raritan and Hackensack Rivers. Southern New Jersey is dependent upon groundwater and the Delaware River to meet most of its water supply needs. Overall, surface water sources supply about 72 percent of the state's annual water withdrawals. Groundwater provides 28 percent of total water withdrawals, but nearly one-half of the state's drinking water.

The drought of 2002 strained the state's water supplies. In March 2002, Governor James McGreevey signed an executive order declaring a statewide water emergency, authorizing the NJDEP to develop mandatory water restrictions and conservation measures such as the banning car washing and lawn watering. The NJDEP commissioner reported that some reservoirs were as much as 45 percent below normal levels (New Jersey State Government website, 2002). Drought is also aggravating the threat of saltwater intrusion into coastal aquifers, a problem with led to the construction of a $5 million desalination plant in Cape May on New Jersey's south shore. As occurred in 1999, during the 2002 drought treated sewage constituted nearly all of the Passaic River flow (Chambers 2002a).

Over 22 percent of New Jersey's land area is included in the New Jersey Pinelands, a National Reserve created in the late 1970s to protect the area's significant ecological and agricultural resources. Underlying the Pinelands are the Cohansey and Kirkwood aquifers, which together contain an estimated 17 trillion gallons of water. The two aquifers feed most of the Pineland region's streams, supports its agricultural industry (especially blueberries and cranberries), maintain the ecological balance of the state's coastal estuaries, and provide drinking water to the region's residents (New Jersey Pinelands web-site, 2002). The two Pinelands aquifers have sufficient water to cover the state with over 10 feet of water. However, very little of the Pinelands water is exported from the region due to the ecological, agricultural and scenic importance of the land and water sources that are fed by the aquifers. In September of 2002, Governor McGreevey invoked his powers under the statewide drought emergency to freeze development in three of the Pinelands' designated growth communities, on the basis that increased development was threatening the quality of the region's water supply (Barlas 2002).

New Jersey has been under fire for several years from the U.S. Environmental Protection Agency for violation of the Clean Water Act, due to the state's failure to establish pollution limits for hundreds of rivers, streams and lakes. In September of 2002 the state agreed to establish, by August 2003, daily limits for 159 different pollutants, including fecal coliform, phosphorus and nickel (Twyman 2002). These pollutants not only prevent the waterways from being used for fishing and swimming, but require the water to be subject to expensive treatment before use as tap water (Barry 2002). Sewage treatment operators who have made costly upgrades to their facilities argue that more state and local government effort should be devoted to limiting pollution emanating from farms and residential development.

V.B. State Agency and Interstate Commission Roles in New Jersey Water Supply Planning

Under the Water Supply Management Act of 1981 (N.J.S.A. 58:1 A-1 et seq.) the New Jersey Department of Environmental Protection (DEP) has been given the power to manage the state's water supply. Among the purposes of the 1981 Act are to ". . . ensure an adequate supply and quality of water for citizens of the State, both present and future, and to protect the natural environment of the of the waterways of the State" (N.J.S.A. 58:1 A-2). Among the DEP's powers are the following: issuing permits for, and regulating, any diversion of the state's surface or ground water exceeding 100,000 gallons per day; developing standards and procedures to be followed in order to maintain minimum water levels and flows; declaring a water supply shortage in all or any part of the state and issuing water allocation plans and water use restrictions on all water users in such an event (not just permittees); regulating well drilling and pump installation; and preparing a statewide water supply plan, to be revised and updated every five years. The water supply plan, last issued in 1996, identifies existing water supply sources and current water usage; projects statewide and regional water supply demands; makes recommendations for improving the state's water supply facilities, construction of additional facilities and interconnecting or consolidation existing supply systems; and makes recommendations for legislative and administrative actions to maintain and protect the state's watershed areas (N.J.S.A. 58:1A-13).

In addition to the above powers the DEP can, following notice and public hearings, designate a region of the state as an "area of critical water supply concern" based on DEP determination that excessive ground water diversion has led to an unsafe diminution of water supply (N.J.S.A. 58:1-6(b)). In such areas (of which there are currently two), the DEP is mandated to identify appropriate water supply management strategies and water supply alternatives.

Ground water constitutes the water supply for about half of New Jersey's residents. The 1981 Act empowers DEP to evaluate and determine the adequacy of ground and surface water supplies and develop methods to protect aquifer recharge areas (N.J.S.A. 58:1A-15(m)).

Surface water supplies are managed by DEP and through inter- and intra-state water commissions. For example, diversions from the Rahway River are administered through

the Rahway River Intergovernmental Cooperation Committee, whose members include The DEP commissioner and representatives from 21 municipalities in three New Jersey counties (N.J.S.A. 58:1A-20). A separate intrastate commission monitors water quality and develops policies and strategies for protecting Lake Hopatcong, the state's largest freshwater lake and an important source of emergency drinking water. The eleven-member Lake Hopatcong Commission includes six members from municipalities in the lake's watershed, three members appointed by the governor, and two state agency commissioners (N.J.S.A §58:4B-3). One of the responsibilities of the commission is to review and assess the potential impact that municipal land use regulations and specific development proposals would have on the lake and its watershed. The commission then provides its recommendations to the appropriate municipal agency.[9]

The Delaware River Basin Compact, between New York, Pennsylvania, New Jersey, Delaware and the federal government, established a commission to conduct planning, water resource development and water allocation among the states in the Delaware River basin. The commission has the power to modify or deny water diversion permits to avoid depletion of the natural stream flows and groundwater in the basin, when the nature of the depletion is inconsistent with the commission's comprehensive plan or with the interests and rights of the signatory states (Delaware River Water Commission web-site).

The DEP's water supply responsibilities primarily include planning, permitting, monitoring, regulation and enforcement. Another state agency, the New Jersey Water Supply Authority, is mandated to manage existing state-owned water facilities and to acquire, finance, construct, and operate additional water systems. The members of the authority include the DEP Commissioner and six other members appointed by the governor, of whom two are to be "recognized experts in the fields of water resource management and distribution and public finance, respectively" (N.J.S.A. 58:1B-4[b]). The other four gubernatorial appointments to the authority are to represent the agricultural community, industrial water users, residential water users and private watershed associations.

Legislation in1916 had authorized creation of a North Jersey District Water Supply Commission and a separate commission for South Jersey, although the South Jersey commission was never established. The North Jersey Water Supply Commission plans, develops and regulates water supply for 12 northern New Jersey counties. The commission has the power of eminent domain and bonding authority, and can charge municipalities for their share of the cost for the reservoirs, pipelines, mains, pumping or filtration plants and other facilities (N.J.S.A. 58:5-16).

V.C. The 1996 New Jersey Water Supply Plan

The 1996 New Jersey Statewide Water Supply Plan (NJSWSP), sub-titled *Water for the 21st Century: the Vital Resource*, reflects the state's watershed planning approach. The plan estimates water supply availability for the various water resources in each of the 23 planning areas. The supply estimates are matched with estimates on water demand in

[9] The Lake Hopatcong Commission is also mandated to collaborate with each municipality in the lake's watershed to develop stormwater and non-point source pollution management plans (N.J.S.A 58:4B-7).

each area, projected to the year 2040. The water supply and demand data bases were used to create a Water Balance Model (WBM), to enable the NJDEP to update data on the demand and supply for water for each planning area. A consultant team helped NJDEP to analyze the water deficits and surpluses in each planning area, using a water inflow/outflow model in which aquifer recharge and surface water "safe yields" were balanced against in-area demands, out-of-area transfers, and reuse within the area. Forecasts of new water availability were then made for each planning area and county for the years 2000, 2005, 2010, 2030 and 2040. The plan then analyzes alternative water supply options for each area, and recommends watershed and aquifer protection strategies, improved water allocation, and water conservation strategies.

By the year 2040, the NJWSP projected water deficits for 9 of the state's 23 watershed areas, and a total deficit of nearly 30 million gallons per day. These estimates have been disputed by critics who think that consumption estimates are overstated. The next Water Supply Plan, containing revised estimates, will be released in early 2004.

V.D. Data and Methods for Water Supply and Demand Estimation in New Jersey

The 1996 NJSWSP estimated per capita water use by first using the combined demands for purveyor-supplied residential, industrial and commercial uses from 1986 through 1988. These years were used because they included both wet and dry years. Per capita use was then determined and then projected to the year 2040. Also included in the calculations of demand were the self-supplied (from wells) population's per capita use in 1996 and the water demands of self-supplied commercial, industrial and agricultural users.

Water availability estimates were a combined effort of NJDEP, the U.S. Geological Survey, and consultants to NJDEP. Notes the NJSWSP (43):

> The estimation of water availability has grown more complex over time. Legitimate questions have been raised regarding both methods and modeling assumptions for estimating both surface and ground water supplies, the inter-relationship between these two sources, the impacts on water supplies caused by regional sewer systems, and the complex inter-relationship of withdrawals and their effects on the ecosystem. Innovative water management techniques such as conjunctive use (where multiple surface and groundwater supplies are drawn upon at different times to supply the same water user) and wastewater re-use confound the old definitions of water availability.

Later in the report is the following summary of the reliability of water availability predictions (NJSWSP, 48):

> Information plays a vital role in managing the balance between availability and demand. Though the primary rivers that are used for water supply have extensive stream flow gauging stations, many other smaller or less-used streams and rivers do not. And, those streams that have gauging stations may not show accurate historical information of true natural stream flow, as

> sewage plants have come on or gone off line over time, farmers may have stopped pumping water from the stream, or depletive uses may have increased throughout the period of record. Precipitation estimates are based on a relatively limited number of stations. Drought estimates are based on a few events over a relatively short period. Groundwater studies that seek to accurately quantify aquifer yields and characteristics are relatively recent, expensive and regional in scale. In short, all parties must rely on statistical analysis of various levels of confidence to make use of the data, and must rely on planning assumptions where data are lacking. It is extremely important that all interests recognize the dynamic nature of water availability estimates. They are not yet definitive and will change as new concepts, models and research are developed.

Potential for Climate Change Not Factored into NJ Water Supply Planning. Climate change currently is not factored into New Jersey water supply and demand modeling, although the NJSWSP acknowledges that it could be a factor at some point in the future (NJSWSP, 65).

> Global warming theoretically could, in the decades to come, affect both water availability and demand. Warming might raise sea level and cause saltwater intrusion into the state's estuaries and aquifers. Extended warmer temperatures would substantially increase demand. It is, however, too early to formally act on this issue until debate over the theory evolves to consensus.

Water supply estimates were based on "safe yields" for surface water supplies and "dependable yields" for aquifers, defined as these yields that are capable of being sustained through periods of stress. More specifically, a safe yield for a surface water system is defined as the water yield that can be continuously supplied "throughout a repetition of the most severe drought of record for the relevant watershed, after compliance with requirements for maintaining minimum passing flows . . ." (p. 43). "Dependable yield" of a ground water resource is defined as the water yield "maintainable by a ground water system during projected future conditions, including both a repetition of the most severe drought of record and long-term withdrawal rates, without creating undesirable effects" (p. 44). The NJSWSP notes that dependable yield values were not available for all regions of New Jersey. Accordingly, the plan used the figure of 20 percent of annual ground water recharge as the surrogate value for the annual dependable yield for the state's ground water resources.

<u>V.E. The New Jersey Water Supply Plan: Relation to State and Local Land Use Planning</u>
Authority for land use planning and regulation in New Jersey rests with 566 municipalities (cities and towns), with the state's 21 counties having a relatively minor role. The planning roles of local governments are outlined in the state's Municipal Land Use Law (N.J.S.A. 40:55D-1 et seq.), modified somewhat after passage of the New Jersey State Planning Act (N.J.S.A. 52:18A-196 et. seq.). The State Planning Act and the Fair Housing Act were both passed in 1985, in the wake of the New Jersey State Supreme Court's ruling in the Mt. Laurel II case (92 N.J. 158, 456 A.2d 390, 1983). The Mt.

Laurel II court had ruled that each of the state's municipalities in the state was to plan for its "fair share" of affordable housing. The court's decision essentially requires the state to maintain a plan that identifies growth and limited growth areas, and to create an agency and a process for using the plan to determine each local government's affordable housing obligations (Epling 1992).

Fair Housing. The Fair Housing Act created a Council on Affordable Housing that defines housing regions, estimates low and moderate income housing needs, sets criteria and guidelines for municipalities to determine their fair share numbers and meet their affordable housing targets, and reviews and approves optional housing elements of comprehensive plans that are prepared by local governments. If local governments do submit housing elements and receive certification from the Council, they are shielded from developers' lawsuits. Such lawsuits, often filed against jurisdictions that do not have housing elements and/or Council certification, often result in "builder's remedies", defined as four market rate units allowed to be built for each low- and moderate-income unit (New Jersey Council on Affordable Housing Website 2002).

Growth Management. Under the New Jersey State Planning Act, the State Planning Commission created the State Development and Redevelopment Plan (SDRP), first adopted by the New Jersey legislature in 1992 and last updated in 2001. The overall purposes of the SDRP are: to reduce sprawl; to encourage development, redevelopment and economic growth in locations that are well suited for such growth and to discourage development "where it may impair or destroy natural resources or environmental qualities"; and to promote development and redevelopment in a manner that reflects sound planning and that promotes efficient expenditure of public funds (N.J.S.A. 52:18A et seq.). The Plan identifies eight goals reflective of the legislation's purposes (e.g. Revitalize the State's Cities and Towns; Conserve the State's Natural Resources and Systems; Protect the Environment, Prevent and Clean Up Pollution; etc.). The SDRP designates five categories of Planning Areas -- metropolitan, suburban, fringe, rural, and environmentally sensitive – with specific policy objectives and desired development patterns for each area. The Plan includes a statewide map that identifies those regions in the state where local officials should channel growth and those in which land should be preserved.

The New Jersey SDRP reflects the strong home rule powers of New Jersey's local governments. Accordingly, the SDRP is indicative, intended to guide public and private investment, promote growth management, and foster coordination among state agencies and among different levels of government. Local compliance with the plan is not compulsory. The New Jersey Municipal Land Use Law (N.J.S.A. 40:55D-1 et seq.), which stipulates the required and optional elements of local comprehensive plans, lists 14 elements for those plans, of which only three are mandatory: a statement of objectives, principles and policies underlying the plan; a land use element; and a policy statement indicating the relationship of the municipality's master plan to those of contiguous municipalities, the county in which the municipality is located, and the SDRP (N.J.S.A. 40:55D-28).

One of the twelve optional land use elements in municipal land use plans is a conservation element. As defined by the Municipal Land Use Law, the conservation element provides for the preservation, conservation and utilization of natural resources. "Open space", water supply" and "rivers and other waters" are included among the natural resources that may be included in the conservation element which, if included in the plan, is to systematically analyze the impact of each other component and element of the master plan (such as land use) on that resource.

Although New Jersey's Municipal Land Use Law does not require a conservation element in local plans, it does stipulate that a municipality's subdivision and/or site plan regulations include provisions ensuring "adequate *water supply*, drainage, shade trees, sewerage facilities, and other utilities necessary for essential services to residents and occupants" (emphasis added, N.J.S.A. 40:55-D38). Thus, a municipality is not required to have a plan in place to protect aquifer recharge areas or watersheds for surface waters, but does need to verify that a proposed development within its boundaries has an adequate water supply. No definition of "adequacy", nor the length of time for which it is to be secured, is included in the legislation.

The success of the SDRP is dependent on the degree to which local government land use planning and development review is consistent with state goals. Critics of New Jersey's growth management system maintain that achievement of the SDRP planning goals and objectives is stymied by fragmentation of local land use planning and the reliance of municipalities on the local property tax for the lion's share of their own-source revenues. Jacobs (2001) reports that 98 percent of local government revenues in New Jersey are derived from property taxes, compared to the national average of 75 percent. Property taxes account for 75 percent of <u>all</u> local revenues in New Jersey, compared to a national average of 50 percent. High dependence on property taxes creates incentives for encouraging high tax ratable development, often on greenfield sites.

In the New Jersey State *Water Supply Plan*, several references are made to the growth management plan. In some instances the NJSWSP suggests that while the growth management plan emphasizes the redevelopment of existing urban centers and the efficient development of suburban corridors and centers, DEP believes that there will be continued growth in the suburban areas anyway, and that water planning will adjust accordingly (p. 24). At one point the NJSWSP states that the SDRP may be seen "as delaying and not ultimately avoiding the development of water supply watersheds" (my 136). In other sections the NJSWSP, DEP asserts that the growth management plan might actually be in conflict with the state water supply plan. The conflict would occur where the development corridors parallel major Interstate and State highways and pass through water supply watersheds (p. 161). The DEP urges that future updates of the SDRP recognize these potential conflicts.

<u>V.F. Wastewater Planning; Watershed Planning in New Jersey</u>

Under the 1977 New Jersey Water Quality Management Act (N.J.S.A. 58:11A et.seq.), New Jersey's governor is given the power to designate waste treatment planning areas, that are "to the maximum extent practical" to conform to county boundaries. When the

planning areas conform to county boundaries, the county legislature becomes the designated agency responsible for preparing a 20-year Water Quality Management Plan, updated annually. The plan is to include: identification of municipal and industrial waste treatment facilities, waste water collection systems and urban stormwater runoff systems; establishment of construction priorities for treatment facilities; and establishment of a regulatory program to control point and non-point sources of water pollution

In 1996 New Jersey voters overwhelmingly approved an amendment to the state's constitution, dedicating the equivalent of 4.0 percent of the Corporate Business Tax for a range of water resource protection and pollution control programs. The measure paralleled a shift in DEP orientation from its permit-based approach to that of watershed-based planning (N.J.S.A. 58:29-2). The state is divided into 20 watershed areas. In each area, watershed management plans will be prepared to improve (or prevent further degradation of) the condition of the area's water quality and quantity. A watershed plan can be developed by DEP, the New Jersey Pinelands Commission or a "watershed group" recognized by DEP. To be recognized by DEP, a watershed group must include, at a minimum, local and county government officials and at least one representative from: water purveyors; wastewater utilities or authorities; the business community; the development community; and the environmental community (N.J.S.A. 58:29-3). Watershed Management Plans (WMPs) adopted by DEP are meant to be substantive modifications to Water Quality Management Plans, in that the WMPs are to be used to identify actions to protect water resources in watershed areas (New Jersey Future website 2002).

In 2000, the NJDEP prepared, and then retracted, a new rule that would have strengthened both wastewater planning and watershed planning, along with coordinating both with the land use planning objectives of the SDRP. The retracted NJDEP rule would have (a) restricted development to only those areas of the state that the SDRP identified as suitable for development; (b) established criteria for determining maximum daily pollution loads for water bodies; and (c) modified water quality management plans and strengthened restrictions on developments using septic systems (Wolfe 2002; New Jersey Future Web-Site 2002). The proposed rule was withdrawn due to local government opposition to the development restrictions.

V.G. Privatization of New Jersey's Water Provision: Implications for Watershed Protection and the State's Affordable Housing Act

In the Spring of 2002 the U.S. Forest Service released a draft study on the New Jersey Highlands, a forested area in New Jersey and New York which are the headwaters for many of New Jersey's Rivers (Sullivan 2001). The study reported that over 300,000 acres of land in the Highlands that have high-value water sources, were also threatened by development. While state legislation gives state agencies the authority to acquire land to protect important watersheds, state and local governments are increasingly finding themselves competing for such lands with developers - - including those affiliated with private water companies.

Of the four states profiled in this paper, New Jersey has experienced, by far, the most privatization of its water utilities. By 1996, investor-owned water purveyors were supplying over 42 percent of the state's residents (NJDEP 1996). The state has a history of private water company involvement in questionable land deals, leading to development that many critics believe is threatening water quality and quantity. As reported by Hennelly (2002), the privately-owned Hackensack Water Company used its eminent domain power in the early 1900s to acquire hundreds of acres in the Highlands. In 1983, that same company convinced the state's Public Utilities Commission (PUC) to let it sell 700 acres of woodlands -- next to its two major reservoirs in Bergen County -- to its unregulated real estate subsidiary for the price of one dollar. As Hennelly notes, for decades the company had convinced municipalities, for tax purposes, to assess the acreage as essential conservation land. Notes Hennelly:

> [A]s late as 1984, a Hackensack Water Company brochure was informing the public that 'each of our reservoirs is encircled by undeveloped land, left in its natural state, shielding the water supply from possible pollutants.' Meanwhile they were telling state utility regulators and local land-use officials that thanks to new treatment technologies they no longer needed to hold the same amount of land.

Normally, the state's PUC enforces a requirement that any land or asset belonging to a regulated utility be sold, in a sealed bidding process, to the highest bidder. The purpose of this requirement is to assure that the utility gets the highest possible price for the land in order to reduce the likelihood that its rates will have to be raised in the future. The requirement seems particularly reasonable since the utility was able to acquire the land as a state-sanctioned monopoly (Hennelly 2002). The one-dollar transaction not only placed the PUC in an unfavorable light, but also called attention to the fact that the state DEP had no regulations dealing with the allowed proximity of development to a reservoir.

Some of the 700-acre virgin forest abutting the company's reservoirs has been preserved. In exchange for a $25 million increase in its water rates, the company agreed to preserve about 400 acres (Hanley 1999). The towns of Old Tappan, Haworth and River Vale spent $6 million in local, county and state taxpayers' money to buy an additional 58 acres to prevent housing development next to the reservoirs. In 1988 the state legislature passed the Watershed Moratorium Act, intended to temporarily prevent sales of additional watershed lands in certain areas. The purpose was to give the legislature time to develop subsequent legislation that would help safeguard public water supplies through the protection and preservation of watershed lands in targeted areas. However, such legislation has not been established to date, despite the passage of 15 years and several lawsuits brought by disgruntled property owners. For years, municipalities impacted by the moratorium have received annual payments from the legislature to offset the loss of tax revenues that might have accrued through development from some of the watershed acreage.[10]

[10] The legislation to reimburse the towns was introduced in May 1999 as Senate Bill 1960. Text of the bill was obtained from http://www.njleg.state.nj.us/9899/Bills/s2000/1960-i1.pdf.

The Hackensack Water Company has since been acquired by United Water, which itself is owned by Suez Lyonnaise des Eaux, a French multinational firm that is the world's largest water company. United Water is the parent of a real estate development company, United Properties Real Estate Group. In 2002, United Properties proposed a 100-unit residential development in River Vale township that would require destruction of 44 acres of watershed forest along the Tappan Reservoir. The company told the town that if the development is not approved then it will file a "builder's remedy" lawsuit against the town under the state's Fair Housing Act. However, instead of building affordable housing on the development site, United Properties has offered to pay the town so that affordable housing could be built elsewhere.

United Properties also used the builder's remedy argument in the summer of 2000, in trying to convince the town of Emerson to approve a residential development on 19 acres of watershed forest. A watershed activist group, Bergen Action, calls this strategy the "affordable housing trick card" that is "exploited by builders for the advancement of profitable and environmentally devastating developments" (Bergen Action website 2002). The group has called for: preservation of the 44-acre River Vale site; a development "amnesty" for all watersheds owned by United Water Resources and United Properties; and the ending of the water company's real estate business. The group charges that "there is an apparent conflict of interest when those entrusted with our natural resources stand to substantially profit from their decimation" (Bergen Action website 2002). For its part, United Water has claimed that the town's wastewater treatment plants are able to protect quality in the Tappan Reservoir when watershed land is developed (Hanley 1999).

Local governments would not be in the position of having to purchase watershed land from United Properties, or other landowners, if their land regulations restricted important watershed lands. For example, in 1999 River Vale town officials tried to convince United Water not to sell 35 acres of pine forest, on the western shore of Lake Tappan, to a developer who wanted to build 265 town houses (Hanley 1999). The town's zoning was allowing a gross density of nearly 8 units per acre, hardly an environmentally-protective regulation.

V.H. New Jersey Future's Assessment of Local Natural Resource Planning

A non-partisan research and advocacy organization, New Jersey Future (NJF), conducted a study of natural resource conservation policies and regulations in a sample of New Jersey townships in the year 2000.[11] The organization selected 44 townships throughout the state containing some of the state's most valued and fragile natural resources, including prime farmland, pristine ground and surface water, wetlands and estuaries, woodlands and wildlife habitat, and scenic terrain. NJF project staff first identified and documented the important environmental features in the regions within which the towns were located. They then visited each town, interviewed town officials, and reviewed the town's master plan and land development provisions -- focusing the provisions dealing

[11] Based on its mission statement, activities and executive board member composition, New Jersey Future seems similar to 1000 Friends of Oregon. Both organizations are committed to successful implementation of their state's growth management system.

with the key environmental resources. NJF staff then rated each town in terms of the extent to which it regulated its farmland, steep slopes, limestone terrain, aquifers and recharge areas, stream corridors, fresh and saltwater wetlands, woodlands, wildlife habitat and critical ecosystems.

NJF established a four-scaled rating index for the extent to which the townships regulated each of the above-listed environmental features/resources. The ratings ranged from "not addressed", to "attention given", to "significant action", to "exemplary". The ratings system used by NJF distinguished between ordinance provisions with a presumption *for* and those with a presumption *against*, development impacting the resource. For example, the following language in the *Pinelands Comprehensive Management Plan* reflects a strong presumption *against* development: "No development shall be carried out unless it is designed to avoid adverse impacts on habitats that are critical to the survival of . . . threatened or endangered animal species . . ." The following example from the Barnegat Township land development code expressed a presumption *for* development.

> "Natural features such as trees, brooks, swamps, hilltops and views, shall be preserved wherever possible. On individual lots, care shall be taken to preserve selected trees to enhance soil stability and the landscape treatment of the area."

In terms of watersheds and aquifer recharge areas, the ratings of local ordinance protection were as follows. A strong statement of purpose regarding watersheds and water resource protection, without any regulations, was rated as "attention given" (but a presumption for development). The use of five-acre zoning to protect such areas, along with flexibility provisions such as cluster development, maximum lot sizes and transfer of development rights, would earn the township was rated as "significant action" and a presumption against development. Township regulations that delineated, and/or had quantitative standards for, headwaters, sensitive watersheds and aquifers, were judged as exemplary and having a presumption against development.

New Jersey Future's ratings of township protection for streams and wetlands were particularly low. Of the 44 towns studied, not one earned an "exemplary" rating and only ten were judged to have taken "significant action". Streams and wetland protection was "not addressed" in 24 of the towns. Of the 31 studied towns that had aquifers in their borders, none earned an exemplary rating and only two were judged to have taken "significant action", while 14 had not addressed the resource through their regulations.

Using this rating system, the New Jersey Future study reached the following conclusions about township protection of valuable environmental resources (New Jersey Future 2002).

- Municipal policies are disconnected from regional and statewide conservation goals, with township reliance on property tax revenues contributing to the tension between environmental preservation and township fiscal needs.

- All privately-held, environmentally-important land in New Jersey is zoned for development, usually with minimum lot sizes of between one and three acres.
- There is a "checkerboard" of environmental commitment among municipalities, in which one town's environmentally protective program can be undermined by development-oriented land use decisions of its neighbors.
- Municipal conservation policy is rarely based on an ecosystems or water-cycle approach to environmental conservation.
- Many towns express the desire to close the gap between environmental preservation and actual land use regulations, but have difficulty doing so due to statewide tax and land-use policies.

Based on its survey findings, New Jersey Future made the following recommendations to foster more effective environmental resource regulation by the state's municipalities.

- Providing municipalities with user-friendly natural resource data, examples of "best practices" from other jurisdictions, and provision of technical support.
- Amending the Municipal Land Use Law to require stronger master plan elements and enhance town powers to enact resource conservation measures. For example, at the present time the use of transfer of development rights is restricted to the Pinelands region, and to Burlington County in a "demonstration project".
- Defending municipal land use actions that are consistent with the SDRP, either by providing legal support from the State Attorney General's Office or by offering full financial indemnification by the state against landowner or builder lawsuits.
- Streamlining the process of State Planning Commission endorsement of municipal land use plans, so that endorsed municipalities can get, in a more timely manner, higher priority for discretionary state funds for planning assistance and for infrastructure improvements.
- Adopting a more regional approach to land use governance, by having counties play a stronger role in regional planning.
- Integrating watershed and wastewater planning with growth management at the state and local levels, by amending the Municipal Land Use Law, the County Planning Enabling Act and related statutes. This recommendation would effectively reinstate a NJDEP rule that would have restricted development to areas of the state that the SDRP criteria indicate are suitable for development.
- Utilizing state land-acquisition funds strategically, so that critical masses of a region's farmland, forest ecosystem or critical watershed are protected.

V.I. Recent Actions to Protect Drinking Water Sources

None the New Jersey Future's recommendations, listed above, had been implemented by February 2004. However, since April of 2002, several actions have been taken by state or local governments to enhance protection of the state's drinking water sources. First, on Earth Day (April 22, 2002), the governor announced that nine drinking water reservoirs and six river and stream segments would be classified as Category 1 waters to

protect them from future pollution sources.[12] The designation enables the state to establish special regulations to prevent any measurable change in the current high quality of these water bodies. Under the new policy, the DEP has authority to alter or deny development proposals that would degrade the water quality of any of the Category 1 sources.[13] McGreevey's announcement is a concrete step in developing the regulations that were supposed to be the outcome of the 1988 Watershed Moratorium Act. The governor also directed the state DEP to set clear standards that can be used to identify additional reservoir and river/stream segments that should receive Category 1 designations.

In January 2004, the State announced a set of new stormwater management rules that would be used to protect Category I waters. The new rules require a 300-foot buffer around more than 6,000 miles of Category I waters and their tributaries within the immediate watershed boundary, impacting 300,000 acres of stream-side property. Other rules require municipalities, large public complexes (such as highway systems, prisons and hospitals) to development stormwater management programs though New Jersey's Pollutant Discharge Elimination Permit System (NJPDES) permit program (New Jersey Governor Home Page, 2004). All permittees (including townships) will be required to establish stormwater management programs applicable to new development.[14] A town can reduce the 300 foot buffer to 150 feet if it passes stormwater management plans that meet state standards. The stormwater management rules also establish the goal of maintaining 100 percent of the average annual groundwater recharge for new development projects.

Second, in August of 2002 Governor McGreevey signed a bill that gives highest priority in the state's open space purchase program to lands that protect water quality and relieve flooding (Cannon 2002). Under the new law, parcels that are critical in replenishing and protecting streams, aquifers and other water resources will be given three times the weight as other open space uses, such as farmland. The bill amends the Garden State Preservation Trust Act, by altering the spending priorities for purchasing open space with $3 billion in sales tax revenue over a 30 year period. The governor's efforts were bolstered in November of 2003 when the state's voters approved a ballot initiative that increased the bonding capacity of the Garden State Preservation Trust by $150 million, allowing for at least one-third of the extra money to be used for purchasing open space in the Highlands (the drinking water source for more than one-third of the state's residents). In addition, in February 2004 a task force appointed by the governor is close to recommending a regional commission that would have powers to regulated land

[12] Category I waters refer to surface waterways that that "exceptional" ecological significance, water supply recreational, shellfish resource or fisheries significance (New Jersey Department of Environmental Protection Web Page, 2004).

[13] In the Earth Day press conference, Governor McGreevey stated: "We all have a responsibility to be stewards of New Jersey's drinking water sources. The current drought reminds us of the price we pay if we neglect our water resources. We must take action to ensure that our communities have clean and plentiful water supplies now and in the future" (New Jersey State Government Home Page, 2002).

[14] In urban areas many of the rules will be streamlined or waived in order to promote urban redevelopment while minimizing environmental harm (New Jersey Governor Home Page, 2004).

development and preservation activities in the Highlands in order to protect water supplies.

Third, in October 2002, NJDEP commissioner Bradley Campbell announced the state's intention to overhaul of the entire watershed planning program. As noted above, plans for stabilizing or improving the water quality in 20 watershed areas were to be developed by DEP, the Pinelands Commission or a DEP-recognized "watershed group". In taking over the program, Campbell was responding to criticism from local and regional groups. In August of 2002 the chairperson of the New Jersey Council of Watershed Associations spoke on behalf of 38 civic groups, asserting that "sweeping changes are needed in New Jersey's watershed management planning program" (Barry 2002). A survey conducted in 2002 by the Center for Environmental Communication at Rutgers found that many participants in the watershed planning process believe that DEP parceled out work to various agencies in order to 'shirk responsibility" for "tackling land use issues, or generally making tough decisions" (Barry 2002).

Fourth, in September 2002, NJDEP announced that it would begin stringently to enforce the state's 1976 Spill Compensation and Control Act, a law originally intended as a safeguard against oil spills off the New Jersey shore. Because the state presumes ownership of water contained in underground aquifers, it intends to files claims for damages to the water supply caused by discharges of hazardous substances. DEP officials say that the amount of the damages claims will be based on such factors as how crucial the aquifer is to the state's long-term water needs, the extent and duration of the pollution, and the rate at which the aquifer is recharged by rainwater. Critics of the DEP announcement contend that it will be nearly impossible to assign responsibility for polluted groundwater to any given source, since hazardous substances had been dumped for decades prior to laws banning such actions. Industry officials say they will challenge the DEP in court (Brown and Barry 2002).

A fifth recent event in water supply protection was the passage of a wellhead protection ordinance by Washington Township in September 2002. While a small number of towns in northern New Jersey have such laws, Washington township ordinance is the first of its kind in southern New Jersey. The town's ordinance creates concentric zoning classifications around six wells that pump water from the Kirkwood-Cohansey aquifer. In the first tier, the ordinance bans 26 types of industrial activities that use any type of chemical that could spill on the ground. Examples of such banned land uses in the first tier would are medical laboratories, dry cleaning and photo processing. In the second tier many of the activities banned in the first tier would also be disallowed, but permitted uses would include golf courses and above-ground gas storage. The third tier permits most of the activities prohibited in the first tier, by still restricts heavy manufacturing, the keeping of livestock, and underground oil tanks (Wagman 2002). Passage of this ordinance could spur other New Jersey jurisdictions to explore similar wellhead protection measures.

V.J. Summary of the Degree of Coordination between Water Supply Planning and Growth Management in New Jersey

The New Jersey case study indicates a poor degree of coordination between local growth management and water supply planning. The main factor in this inadequate coordination is the voluntary nature of the SDRD, which itself reflects the strong home-rule powers of local government in New Jersey, and those governments' heavy reliance on property taxes for local revenue. The above-discussed study by New Jersey Future suggests the limited degree to which townships are addressing water supply issues through land use regulation. Environmentalists have described the Plan as "a nebulous, unenforceable wish list" (Chambers 2002b), and the director of New Jersey's Sierra Club likens the State Planning Commission to "the dance band on the Titanic" (Jacobs 2001). The former director of the State Planning Commission says that an increasing number of towns are accepting the state plan, and that some builders have seen the wisdom of building in cities and older suburbs (Chambers 2002b). However, the same individual says that continued annual loss of 18,000 acres of open land in New Jersey will eventually trigger greater public demand for more compliance with the plan.

On October 25, 2002, McGreevey sponsored an invitation-only "Sprawl Summit" at the College of New Jersey, attended by a diverse group of state officials, developers, environmentalists, and local elected officials. At the summit, McGreevey outlined a lengthy list of financial incentives designed to steer development into areas targeted for growth and redevelopment under the SDRP, and ordered state agency officials to alter policies and permit procedures to facilitate such development (New Jersey State Website 2002b). However, McGreevey's proposals omitted reference to the property tax issue (even though he acknowledged that the tax question was "the 800-pound gorilla under the tent" (as reported in Nussbaum 2002). Also, the governor's proposals did not include the types of local land use reform measures that were recommended by New Jersey Future in their above-mentioned study.

It is therefore unknown whether the recent initiatives by the governor and state agencies in New Jersey in 2002 will lead to greater coordination between water supply planning and growth management, and to greater state regulatory oversight on local land use planning. The concerns over United Water's real estate development might be alleviated through state purchase of the key watershed lands owned by the facility, facilitated by the increased priority on watershed protection for use of the state's open space funds. Nevertheless, the controversy will continue on whether a multi-national corporation should have such power over the fate of water provision and watershed protection.

VI. Maryland Case Study

VI.1. Overview of Maryland Water Issues

Early growth management efforts in Maryland were driven by concerns about water *quality* -- not of drinking water supplies, but of the water content of the Chesapeake Bay, North America's most productive estuary and habitat for dozens of endangered species. A report of a 6-year, $27 million study by the U.S. Environmental Protection Agency (1983) documented alarming trends in the Bay's ecology, and a subsequent study

indicated that population growth and sprawling development patterns were important factors in the Bay's decline (Report of the Year 2020 Panel,1988).

The EPA study provided the impetus for Maryland's passage of the 1984 Critical Area Act, that established new, watershed-protective, land use planning and zoning requirements for every jurisdiction with land within 1,000 feet of the Bay and its tidal tributaries (covering about 10 percent of the state's land area). Later to follow were the 1989 Non-tidal Wetlands Act and the 1991 Forest Conservation Act. In the early 1980s the state had already passed a Stormwater Management Act (1982), requiring new developments to incorporate measures for on-site treatment of stormwater unless they met certain waiver conditions.

In a Chesapeake Bay Agreement in 1987, signed by Maryland, Virginia, Pennsylvania, the District of Columbia, the U.S. Environmental Protection Agency and the Executive Council of the Chesapeake Bay Program, the signatories pledged to achieve a 40 % reduction in the nitrogen and phosphorous reaching the Bay by the year 2000, using 1985 as a base year. In 1992, the Executive Council directed all signatories to development "tributary strategies" – watershed based plans to reduce nitrogen and phosphorous entering the bay from point and non-point source pollution. There are ten tributary watershed planning areas in Maryland, with nutrient-reduction plans being developed in each area through participation by representatives from state and local government agencies, agriculture, business, environmental organizations, and citizens. While the tributary strategies are dealing with water quality, their efforts have particular implications for water supply in some areas due to interconnections between surface and ground water.

Maryland's 1992 Economic Growth, Resource Protection and Planning Act mandated local governments to add a new sensitive area element to their comprehensive plans, through which jurisdictions would outline measures for protecting steep slopes, the 100-year floodplain, habitats of endangered species and streams and their buffers. The 1992 Act also required the comprehensive plan updates to address seven visions, among which were "development is concentrated in suitable areas"; "sensitive areas are protected"; "stewardship of the Chesapeake Bay and the land is a universal ethic"; and conservation of resources, including a reduction in resource consumption, is practiced" (Article 66B of the Code of Maryland). However, no regulations or guidelines were issued by the state related to how the visions were to be operationalized though local plans. In addition, there has been no systematic evaluation of the effectiveness of local efforts in protecting the sensitive areas identified in the comprehensive plans. The anti-sprawl, 1997 Smart Growth Initiatives built upon the 1992 act, in part, by specifying what a "suitable area" for development is and putting restrictions on state funding for infrastructure, housing or economic projects located outside such areas.

Since passage of the Smart Growth Initiatives, increased attention has focused on water *quantity*, in the surface waters and aquifers providing the state's water supply. Over two-thirds of Maryland's residents rely on public water systems that are dependent upon reservoirs on such rivers as the Potomac and the Patapsco, with the Susquehanna River as

a back-up supply for Baltimore City. Groundwater is the main source of water for western Maryland, and for counties on the southern and eastern shores of the Chesapeake Bay (Maryland Department of the Environment (MDE) website 2002a). In the summer of 1999 Maryland endured a severe drought, as a result of which the flow was down by two-thirds in the Susquehanna River and by 50 percent in the Potomac. Following the summer of 1999 drought emergency, Governor Glendening issued an executive order establishing two committees to advise his office on issues related to water conservation and drought management (MDE 2002b). One outcome of the committee reports was a four-staged process for defining drought and a set of water use restrictions for each stage. Drought returned to Maryland two years later, prompting the above-described letter to Maryland's governor from six dozen state delegates. By mid-October of 2002, the three reservoirs serving the city of Baltimore were at 42 percent of their capacity (MDE 2002c).

VI.B. Responsibility for Water Supply Planning in Maryland

Responsibilities for water supply planning is Maryland are divided between the Maryland Department of Environment (MDE); three river commissions; the two utilities serving the Washington and Baltimore metropolitan areas (the Washington Suburban Sanitary Commission and the City of Baltimore, respectively); and local governments though water and sewerage planning requirements. Under the Maryland Annotated Code, Environmental Articles 5 and 9, MDE has a wide range of water-related responsibilities, among which are the following: issuing water appropriation permits for use of surface and ground waters; administering the federal Safe Drinking Water Act; developing the state's ground water protection program; responding to local water supply emergencies; conducting sanitary surveys, and reviewing local water and sewerage plans.

Unlike Florida and New Jersey, Maryland does not have a comprehensive water supply plan prepared by MDE or other state agency. Some analysis is conducted by two of the interstate river commissions that administer water allocation from rivers serving Maryland jurisdictions. For example, The Interstate Commission on the Potomac River, in 2000, prepared a 20-year water demand and availability forecast that addresses its service area (Hagen and Steiner 2000). However, for the rest of the state, MDE's only water supply forecasting occurs when it reviews individual permit applications by certain categories of water users. MDE's authority and review procedures will be outlined following a review of the role of three river commissions.

River Basin Commission Planning. The Susquehanna River Basin Commission, the Interstate Commission on the Potomac River Basin, and the Patuxent River Commission differ greatly in the extent to which they are empowered to regulate growth-related water use and withdrawal in order to protect water availability. These differences in regulatory authority reflect differences in the original compacts that established the agencies.

Of the three commissions, the Susquehanna River Basin Commission (SRBC) has the broadest authority to regulate water use and withdrawal to ensure water availability. The overall mission of the SRBC is to "enhance public welfare through comprehensive planning, water supply allocation, and management of the water resources of the

Susquehanna River Basin" (Susquehanna River Basin Commission Website 2002). To this end, the commission has the power of review and approval over applications for large surface and ground water withdrawals. However, the Susquehanna mainly serves as the water supply backup for the city of Baltimore, and only a small part of the river's watershed lies in Maryland. For this reason, the powers and planning methods of the SRBC are not outlined in this paper.

Compared to the broad powers of the SRBC, the Interstate Commission on the Potomac River Basin (ICPR) has much more limited authority on water supply regulation. In terms of water supply management, the compact creating the ICPR primarily gives the commission authority to collect and disseminate data, cooperate with the signatory bodies to promote uniform laws and regulations, provide liaison among agencies, and review and comment on agency plans. The commission has certain additional powers and responsibilities in the area of water quality.

According to Joseph Hoffman, ICPRB Executive Director, the commission has no regulatory powers of its own. However, by virtue of a low-flow allocation agreement among metro Washington water suppliers, the commission does have the authority to manage the area's water allocation system during low flow events involving the Potomac River or other sources. The commission can, for example, request individual water suppliers to undertake water releases in order to facilitate water system management. The commission has no power to regulate land use to protect water supplies.

The ICPRB does, however, play a significant role in analyzing water supply needs and making water supply forecasts. Through the low-flow allocation agreement, the metro water supply agencies (the Washington Suburban Sanitary Commission and the Fairfax County Water Authority) are required to prepare water supply forecasts every five years. For the last three rounds of forecasting, the commission has executed this responsibility. The most recent ICPBR forecast is profiled in the next section of this paper.

The Patuxent River Commission has little or no power governing water supply, water withdrawal or land use planning, according to commission spokesperson Ken Hranicky. Instead, the commission's focus is on water quality issues. The commission's enabling law grants it certain powers relating to performing environmental assessments, reviewing and commenting on proposed amendments to the Patuxent River Policy Plan and on other plans and reports, reviewing the operation of government bodies that have responsibility for implementing the Policy Plan, and other areas.

Water Supply Analysis by the ICPRB; Consideration of Climate Change
The ICPRB 20-year water demand forecast (Hagen and Steiner 2000) assesses the capability of the Potomac River to supply the water needs for the District of Columbia, and portions of Virginia and Maryland suburbs in the Washington metropolitan area. The forecast is based on projections of single-family, multi-family and employee water uses, using household and employment forecasts from the Washington Council of Governments. The study was modeled so that reservoirs are used "sustainably", and the two other reservoirs in the system are used to augment low flows in the Potomac River.

Emergency demand reduction strategies were modeled, as were the effects of siltation on reservoir over time and the impact of return flows from wastewater treatment plans upstream of the water supply intakes. Average precipitation was used for modeling, and separate models were run under two drought scenarios in which stream flow is reduced by 5.0 percent and by 10.0 percent from July through September.

The ICPRB models examine water resource adequacy under the "most likely" and "high growth" scenarios. The current system of water resources was found to be adequate to meet both the "most likely" and "high growth" scenarios for the year 2020, even if the worst drought of record were to be repeated every year. However, storage in the Potomac reservoirs was nearly depleted given the most likely forecast of 2020 demands and a reduction of streamflow of 10 percent in the Potomac. The report states that the potential effects of climate change were considered but "were not explicitly included [in the report] because there was a lack of any clear climate change result for this region's resources" (Hagen and Steiner 2000, ES-3).

Maryland Department of the Environment Water Supply Planning. Other than the ICPR, no regional or state entity in Maryland is conducting long-range water supply and demand forecasting in Maryland. Except for the Susquehanna River Commission (that impacts a small areal portion of the state), only the Maryland Department of the Environment has regulatory responsibilities for the state's waters. MDE is authorized to control the appropriation or use of both surface and ground waters in order to conserve and protect the state's water resources, as stipulated in Section 5-501 et seq. of the Annotated Code of Maryland (and regulations in section 26.17.06 of the Code of Maryland Regulations [COMAR]). What analysis MDE does conduct, or require of its permit applicants, consists of testing the impact of the proposed water use on groundwater or surface water sources. In other words, at the state level, Maryland water planning is done on a piecemeal basis, confined to an applicant-by-applicant test of the capability of the given water source to support each applicant's requested water use. However, MDE does review 10-year water and sewer plans prepared by the State's 23 counties and the city of Baltimore. As discussed later in this paper, those plans are required to include considerations of water supply and demand.

Maryland regulations designate several categories of persons who must obtain appropriation or use permits from MDE in order to utilize water resources. These categories include: (a) persons appropriating or using water for any agricultural, commercial, institutional, industrial or municipal purpose; (b) persons subdividing land if the subdivision requires appropriation or use of waters of the state whether from a central source or a source located on each subsequently created lot; (c) persons planning to build any structure or impoundment which will horizontally or vertically move water from its source of natural occurrence; and (d) persons appropriating or using surface water or ground water for domestic heating or cooling. The regulations provide exemptions for small agricultural users (with average annual water use of less than 10,000 gallons per day); residential subdivisions of 10 or fewer lots that meet certain conditions (such as water being obtained from individual wells); temporary dewatering during construction

(under certain enumerated conditions), domestic uses other than for heating or cooling; and extinguishing a fire COMAR §26.17.06.03).

No MDE permit is needed for extensions of water lines to new developments served by already permitted water suppliers such as the Washington Suburban Sanitary Commission. Each permit is issued for a maximum of 12 years. According to MDE's Matthew Pajerowski, in November of 2002 there were approximately 13,400 permittees across the state. While only about 1,000 of these permits are for surface water use, about 75 percent of the water used in Maryland is surface water.

COMAR §26.17.05 outlines criteria that MDE must use in approving water appropriation or use permits. In order to approve a beneficial appropriation or use, MDE must conclude that the amount of water to be appropriated is reasonable in relation to the anticipated level of use during the permit period, and that the requested appropriation/use will not have an unreasonable impact on the waters of the state and other users of such waters. The proposed use must also be consistent with local planning and zoning requirements, as well as the county's water and sewer plan. In determining reasonableness, the MDE is required to consider, when appropriate, such factors as "the extent and the amount of harm [the proposed appropriation or use] may cause", "aggregate changes and cumulative impact that this and future appropriations in an area may have on the waters of the state" and "the contribution that the proposed appropriation may make to future degradation of the waters of the state." This determination of reasonableness of water use is the closest that MDE comes to conducting long-range water forecasting.

Upon request by local governments, the United States Geological Survey and/or the Maryland Geological Survey can enter into agreements with those jurisdictions to perform water supply measurement and forecasting. For example, under a contract with Anne Arundel County, the Maryland Geological Survey recently completed an analysis of ground water availability for the southern portion of that jurisdiction.

Water Supply Planning by Local Governments. Maryland requires county governments to prepare 10-year water and sewer plans, updated every three years, under *Environment Article*, Title 9, Subtitle 5 of the state annotated code. These plans cover the provision of water supply systems; sewerage systems; and systems, facilities and procedures for dealing with solid waste. A county water and sewerage plan is "a comprehensive plan for adequately providing [the water, sewer and waste-related facilities/ services] throughout the county, including all towns, municipal corporations, and sanitary districts in the county" (§ 9-501). The plans are to provide for the orderly expansion and extension of those systems "in a manner consistent with all county and local comprehensive plans . . ."

Each county's water and sewer plan must take into account "all relevant planning, zoning, population, engineering and economic information and all State, regional, municipal and local plans", in order to describe "with all practical precision" those parts of the county that are, and are not, expected to be served by water, sewer and waste disposal systems in the upcoming ten-year period (§ 9-505). The law states that, to the

extent that incorporation will promote the public health, safety and welfare, each county plan shall incorporate all or part of the subsidiary plans of each town, municipal corporation, sanitary district, privately owned facility, or local, state or federal agency that has existing or planned development in that county.

Maryland law does not explicitly require that county water and sewer plans be based on long-range planning and forecasting for water supply availability. However, MDE regulations do require that county plans "contain a discussion of ground and surface water resources within the county including the quality and potential quantity of these sources" (COMAR §26.03.01.04E). In addition, the plans must provide summaries of existing and projected water demands; existing sources of pollution or contamination of water supplies, and "a discussion of alternatives and the rationale used in determining the means of providing future water supplies." Because these plans are implicated in the state's Smart Growth planning requirements, they will be discussed later in this paper.

VI.C. Data and Methods for Water Supply Estimation in Maryland

In making decisions on the reasonableness of a request for surface and groundwater appropriation, MDE utilizes definitions of minimum flow and water levels. On the basis of these measurements, MDE may impose various conditions on the permittee. For example, MDE may condition approval of a surface water appropriation or use permit on the permittee's provision of low flow augmentation to offset consumptive use during low flow periods, and the maintenance of a required minimum flow past the point of appropriation to protect other users, as well as the natural environment.

If MDE determines that a proposed appropriation would unreasonably harm the surface water source or the aquifer, it may deny the permit and advise the applicant to file a new application for an appropriation from a different source or aquifer. MDE may not issue a ground water appropriation or use permit for an appropriation from a confined aquifer if the appropriation, either by itself or in combination with existing appropriations, will exceed the sustained yield of the aquifer (COMAR §26.17.05). In addition, the department cannot issue a permit for groundwater appropriation under the following conditions: the proposed appropriation will cause or contribution of saltwater in a freshwater aquifer; the well draws water from more than one confined aquifer; the proposed water use is for heating or cooling but the used water is not returned to the aquifer; the application for the groundwater use is for a housing subdivision in which water will be obtained from wells on individual lots smaller than one acre, and the subdivision is located west of the "fall line"[15].

In practice, according to MDE staff members, MDE rarely denies a permit application for ground water withdrawals. Instead, the applicant may be required to limit the withdrawal to a certain amount of water, and that limit sometimes stops the project. In addition, MDE sometimes requires the applicant to drill to a deeper aquifer because of water sufficiency concerns, as in the current case of the city of Waldorf.

[15] The "fall line" refers to the an imaginary line separating Maryland's coastal plan sediments on the east from the older hardened rock on the west (COMAR §26.17.01).

The situation is similar with respect to proposed surface water appropriations. Although permit applications are seldom denied, MDE may attach conditions to its approval that cause the applicant to withdraw the proposal (although this is unusual). Examples of such conditions include a minimum pass-by flow to protect the watercourse and provision of alternate sources like well fields to address water sufficiency needs. In most cases an alternate source is available.

Definition of Minimum Flow. In making permit decisions related to "minimum flow" of surface water withdrawals, whenever possible MDE refers to historical data on flows provided by stream and river gauges. According to MDE's Matthew Pajerowski, the agency uses the "Maryland Method of Most Common Low Flows", developed in 1984, to define minimum flow of a surface water source. That method defines the minimum flow, as measured in cubic feet per second, that is exceeded 85 percent of the time at the spot of measurement. This is the same standard used in Florida. The logic is that, over the long term, species inhabiting the water source have adapted to fluctuations in the flow level. Maintaining a level of at least 85 percent of that long-term average ensures continuity of the watercourse's ecology, all other things being equal. However, Pajerowski notes that there are many streams for which MDE does not have a continuous gauge record. In cases in which MDE is making a permit decision involving such a stream, MDE looks at flow levels in streams in the same watershed that do have a low record, and that are similar in terms of topography, geology and size of drainage area. On small streams, rather than use a staff gauge, MDE uses a flume in the intake structure that will only allow water to flow to the permittee when the level is above the determined level.

Groundwater. For groundwater, COMAR 26.17.05 stipulates that MDE not issue an appropriation or use permit from a confined aquifer if the appropriation, by itself or in combination with existing appropriations, will exceed the "sustained yield of the aquifer". The latter term is defined as "the availability of water from an aquifer managed in such a way so that total withdrawals do not exceed natural recharge, thus enabling the aquifer to function as an aquifer in perpetuity" (COMAR 26.17.01). Because it is difficult to measure the natural recharge of a confined aquifer, COMAR 26.17.05 defines sustained yield in terms of the maintaining a minimum height of water in a tightly-cased well as a result of pumping, relative to the what the estimated height of the water would have been prior to the onset of pumping in that same location. The height of the water in the well being pumped, must be at least 80 percent of the height of the water in the pre-pumping situation.[16]. Of course, this begs the question of what the pre-pumping height of the water level would have been. According to Pajerowski, the 80 percent guideline was set arbitrarily in the mid 1980s, but has not been the subject of a court challenge.

[16] COMAR 26.17.05 stipulates that "the regional sustained yield potentiometric surface of a confined aquifer may not be lowered below 80 percent of the drawdown available between the top of the aquifer and the historical pre-pumping level of the potentiometric surface". In this regulation, "regional" means an area in which water is appropriated or used from multiple wells located in a common source, or "that location which, as a result of the appropriation, is one half of the distance from a single well to a point where the potentiometric surface is lowered one foot and has stabilized".

For an unconfined aquifer, the sustained yield is based on the estimation of actual recharge to the aquifer. In periods in which there has been no rain, MDE determines the aquifer's recharge in relation to the base flow of the stream associated with the aquifer. This is in contrast to New Jersey's definition of 'safe yield" as 20 percent of aquifer recharge.

VI.D. Growth Management in Maryland; Relationship to Water Supply Planning

Beginning in 1997 the Maryland State Legislature approved a number of laws and programs that became collectively know as Maryland Smart Growth. These initiatives have three major objectives:

- "to save our most valuable remaining natural resources before they are forever lost";
- "to support existing communities and neighborhoods by targeting state resources to support development in areas where the infrastructure is already in place or planned to support it"; and
- "to save taxpayers millions of dollars in the unnecessary cost of building the infrastructure required to support sprawl" (Maryland Department of Planning 2002).

At the heart of Maryland Smart Growth are the following five, core initiatives:

1. The 1997 Smart Growth Areas Act, which directs state funding into already developed areas and areas planned for growth. With certain exceptions, only areas designated as "Smart Growth Areas" or "Priority Funding Areas" may qualify for state funds for transportation, housing, economic development and environmental projects. The Acts intent is to discourage sprawl by denying state subsidies for it, and to promote development and revitalization in cities and inner suburbs.

2. The 1997 Rural Legacy Act, which established a grant program enabling local governments and private land trusts to purchase easements and development rights in "Rural Legacy Areas". The program's intent is to protect regions with agricultural, forestry, natural and cultural resources that, if conserved, could promote resource-based economies, provide greenbelts around developed areas, and maintain the character of rural communities.

3. The Brownfields Voluntary Cleanup and Revitalization Incentive Programs, which attempt to stimulate the reuse of contaminated properties by relieving current owners from retroactive liability, offering loans and grants for site clean-up, and providing a 50 percent tax break on the increased assessment resulting from property improvements.

4. An updated Job Creation Tax Credit Program, originally established in 1996, which encourages businesses to expand or relocate in Maryland by providing tax credits for each new, full-time job a qualified business creates. The tax benefits

are more favorable for businesses choosing to locate in Smart Growth Areas or Priority Funding Areas.

5. The Live Near Your Work Program, which creates incentives for employees to buy homes near their workplaces. State grants match contributions by businesses and local governments that assist employees with house purchases. The program goals are to stabilize targeted neighborhoods by promoting homeownership, and to reduce employee commuting time.

The Smart Growth initiatives build upon the visions and policies created by the state's 1992 Economic Growth, Resource Protection and Planning Act. For the purposes of this paper, attention will be placed on the connection between the Smart Growth Areas Act and water supply planning.

Water and Sewer Planning Relation to MD Smart Growth. Water and sewer planning are heavily implicated in the delineation of Priority Funding Areas (PFAs). In order for an area to be designated a PFA it must one of a number of requirements, as defined in the Annotated Code of Maryland under *State Finance and Procurement* (Title 5, §5-7B03-08 et seq.). Among the areas eligible for PFA designation are the following[17].

- Industrial areas that were either zoned for industrial use prior to January 1, 1997, or zoned for industrial use after that date but located within a designated growth area that is served by public water and sewer.
- Areas where the principal land use is employment, and is served by public or community sewer systems; or are scheduled for public or community sewer service according to the approved 10-year water and sewer plan; or are identified by the county's comprehensive plan as being a designated growth area.
- Communities in existence prior to January 1, 1997 that are within a designated growth area, served by a public or community sewer system, designated for residential use, and having an existing or potential density of 2.0 units per acre.
- Areas other than existing communities, that are within a designated growth area; that are designated for planned service in a locality's 10-year water and sewer plan; and have a permitted average density of at least 3.5 units per acre.

As shown in the above summary, designations of Priority Funding Areas depend to a significant degree on water and sewer service area delineation by county governments. The Maryland Department of Planning (MDP) reviews PFA designations by local governments, in order to determine if they are appropriately sized (given projected population growth over the ensuing 20 years), are consistent with local zoning, and are served by water and sewer or included in the water and sewer plan. However MDP's review at that point is limited to whether the water and sewer *facilities* are, or will be, in place, not whether there is adequate water *supply*.

[17] The list of eligible designations does not include the category of "rural villages" that was identified in the Smart Growth Areas Act, because that category is not relevant to the discussion herein.

Many existing water and sewer plans were written prior to passage of the Smart Growth Areas Act, and were not created with PFAs in mind. Interviews with Maryland Department of Planning (MDP) staff members in the Fall of 2002 indicate that the water and sewer planning program has not been fully reviewed to (a) evaluate the degree to which it is actually coordinated with the Smart Growth initiatives in general and the PFA program in particular; and (b) identify ways in which such coordination could be improved. There is currently no state money to assist counties in updating water and sewer plans, so the planning requirement is an unfunded mandate. In addition, an MDP spokesperson observes that the plans are often treated as simply a regulatory hurdle to be addressed when service to new areas is desired or requested.

MDE's principal contact person for water and sewer plan review, Ray Anderson, notes that the amount of information on present and future water availability in water and sewer plans often depends on the size and level of resources of the entity responsible for the plan. Larger and wealthier jurisdictions often hire engineering consultants to prepare background documents that may address water sufficiency in some depth. Smaller jurisdictions often lack the resources to retain such professionals.

MDE's review of water and sewer plans looks at both long-range and short-range water sufficiency in connection with determining the safety and adequacy of the water supply. An MDE staff member who reviews local plans, Saeid Kasraei, states that when serious water capacity issues come to light during MDE review, the department may conduct a fairly detailed engineering analysis in support of capacity assessment, such as through a water balance analysis or well pump testing. In some cases, MDE has imposed development moratoria on jurisdictions that cannot demonstrate adequate capacity – examples include the communities of Middletown and Braddock Heights in Frederick County and Campus Hill in Harford County. MDE's review is buttressed by a new federal requirement that new water systems must demonstrate adequate financial, managerial and technical capabilities to handle the system. Kasraei added that MDE looks at water supply to some extent in several different phases in the life of a water system: appropriation and use permitting (discussed above), construction and funding review, review of water and sewer plans, and inspection of water systems.

Local preparation and state review of water and sewer plans apparently do not always ensure that water supplies will be sufficient. For example, the most recent water and sewer plan for Frederick County, dated 1999, contains no mention of potential water supply problems for the City of Frederick. In early 2001, the City of Frederick declared a building moratorium in due to the declining water levels in the Monacacy River, the city's water source. Anderson said that Frederick City's water problems were not anticipated in its water and sewer plan but, rather, came to light as the city suffered under a particularly severe drought. This suggests that water and sewer plans need to consider the adequacy of the water source(s) under alternative population growth and drought scenarios. Also, the inclusion of specific planned water supply measures in a water and sewer plan does not guarantee that the measures will be implemented. Water supply can sometimes fall short if local leaders do not follow through on planned measures - -

perhaps because one administration has been replaced by another less eager to facilitate growth.

An evaluation of Maryland's local government water and sewer plans by Hipple (1999) for the Chesapeake Bay Foundation, was designed to determine if such planning efforts were adequate and effectively supporting Maryland Smart Growth implementation. Hipple analyzed the content of all local water and sewer plans using a set of 57 indicators derived from the relevant state regulations (from COMAR §26.03.01-08). He concluded that the regulations, stipulating the required content of the plans, were adequate guidance for the preparation of effective local plans. However, Hipple found that state agency review was not resulting in effective and relevant water and sewer plans. He found that the individual water and sewer plans varied widely in terms of content, format and relevance; that descriptive and statistical information was frequently outdated; and that over a third of the counties were not in compliance with the required three-year review. Hipple and MDP staff members are in agreement that local water and sewer planning efforts need to be upgraded and more closely tied to Smart Growth planning.

A review of a sample of county water and sewer plans as part of the study herein, substantiated Hipple's findings on the variation of plan content and detail. However, the author does not concur with the conclusion that the state's regulations are adequate guidance for plan preparation, in one respect: as noted above, the plans need to a) include projections of demand and supply conditions under a prolonged drought situation under scenarios of expected, and higher-than expected, population growth scenarios; and b) discuss implications for water provision under those scenarios. The recent case of Frederick city exemplifies the need for this kind of prolonged drought scenario in water supply forecasting.

Adequate Public Facilities Requirements. Maryland law clearly gives local governments the power to make short-range growth management decisions – whether to approve a particular housing development or individual house -- based in part on water system adequacy. Indeed, state law provides that a subdivision plat may not be approved or recorded unless the water facilities to serve the property will be completed in time to serve the proposed development and adequate to serve the development without overloading any water supply system (9-512(d)). A building permit may not be issued unless the water supply system is adequate to serve the proposed construction, taking into account all existing and approved developments in the service area, and will not overload any water supply facility (9-512(b)). Thus, local governments are actually <u>required</u> to make specific development approvals contingent on the adequacy of the local water supply system. This requirement, however, appears directed primarily at the *infrastructure* needed to serve individual developments rather than the long-range adequacy of water *supply* to serve all development contemplated under a master plan.

It was under the Section 9-512 authorities that the City of Frederick imposed its recent moratorium on subdivision plat recordation, annexations and building permits (with certain exceptions) due to an acute problem of water supply insufficiency brought on by rapid growth and inadequate planning. The City developed a water-allocation ordinance

that established a panel of city officials who review every proposed development and decide whether the city can allocate water for it. Under the ordinance, 45 percent of surplus water is allocated for new residential developments, 30 percent for commercial and industrial projects and 25 percent for other uses, including government buildings and hospitals. The ordinance is a temporary measure pending completion of a pipeline from the Potomac River.

In Maryland, the statutory provisions that define the required content of local comprehensive plans do not specifically require water sufficiency analysis (Article 66B, §3.05). The law provides that comprehensive plans may include any additional elements that, in the judgment of the planning commission, will further advance the purposes of the plan. As noted above, some jurisdictions do include reasonably in-depth water sufficiency analysis in their water and sewer plans.

VI.E. Local Case Studies of Water Supply Planning and Local Growth Management

As part of the Maryland case study, the coordination of growth management and water supply planning was examined in five additional Maryland jurisdictions -- including Baltimore City and the counties of Montgomery, Anne Arundel, Carroll and Baltimore. The results of those analyses are summarized below.

Montgomery County. David Lake, a regional water supply analyst with the Montgomery County Department of Environmental Protection (DEP), said that the county does have the legal authority to regulate development based on water sufficiency and that master plan approvals require a finding that water resources are sufficient to carry out the plan. Lake asserts that in practice, however, water supply is rarely a significant factor in managing the county's growth because the waters of the Potomac River basin – which supplies the vast majority of the county's water – are adequate to meet the county's short- and long-term needs. Twenty-year forecasts prepared by the Interstate Commission on the Potomac River Basin (see above) suggest that there is no need to restrict growth because of current or future water constraints. This is true even for areas of the county supplied by the Patuxent reservoirs. The county coordinates Potomac and Patuxent water supplies so that when water levels in the reservoirs drop far enough, the county can simply shift to the Potomac filtration plant to meet demand.

The picture in rural areas of Montgomery County that depend on groundwater supplies is much the same. Lake was not aware of any cases in which aquifer limitations have severely constrained growth; percolation requirements for septic systems are a much more important factor in limiting development. However, according to Alan Soukup of the county Department of Environmental Protection, the town of Poolesville's water supply outlook is somewhat tenuous. Due to some contamination problems, the town is drilling for new wells and conservation restrictions have become necessary. However, as far as he knows, there is adequate water supply in the aquifer that serves the town.

Echoing Lake, Soukup stated that water supply is taken into account when local area master plans are adopted but that serious constraints are seldom encountered. The county coordinates with the main water provider – the Washington Suburban Sanitary

Commission (WSSC) – in developing a generalized water service envelope for master plan areas. The WSSC sometimes identifies additional storage and filtration capacity needs, but these relate more to infrastructure than to water supply. The county's annual growth policy includes a water service test that must be met for growth to proceed, but here again, the constraint – if there is one – generally pertains to infrastructure. Thus, the overall situation in Montgomery County is that the positive outlook for water availability limits the extent to which highly detailed water supply forecasts are needed in support of growth management decisions.

Anne Arundel County. In late 2003 Anne Arundel County completed an analysis of the relationship between water supply and growth through a study conducted for the county by the Maryland Geological Survey. The study looked at ways in which growth patterns impact the capacity of private wells to serve areas of the county that are not connected to public water systems. Public water supplies generally are not significantly constrained, as the county taps very deep aquifers with substantial capacity.

According to Elizabeth Dixon of the county's land use and environment office, private water supplies are sometimes of concern because many older homes rely on relatively shallow wells that tend to run dry in times of drought. Some wells are on the Nanjemoy aquifer that is particularly close to the ground surface. Also, there has been some saltwater infiltration in areas close to the Chesapeake Bay.

The county was prepared to consider alterations in policy to address private water supply concerns, if warranted by the Maryland Geological Survey report. For example, the county could have determined that growth be directed to different aquifers than are currently tapped, in order to ease any supply-related problems. However, the results of the study indicated that groundwater supply per se was not be as constrained as expected. The relevant aquifers appear to have an ample recharge area to meet foreseeable needs. The problems that do exist appear to be associated primarily with inadequate well depth, more than with aquifer limitations. As a result, the county does not foresee growth limitations to be adopted as a result of the recent study. The southern portion of the county already has fairly stringent density limitations (generally one housing unit per twenty acres). This zoning primarily reflects a desire to preserve the area's rural character, rather than any need to limit growth because of water supply insufficiency.

Baltimore County. Baltimore County, like Montgomery, is in the fortunate position of having ample surface water supplies to meet foreseeable needs. According to Don Outen of the watershed management component of the county's Department of Environmental Protection and Resources Management, the Baltimore system is generally not supply-limited. Baltimore City – the purveyor of water for the region – conducted studies in the 1950s and 1960s which showed that even with expected population growth, water supplies for the region should be sufficient to meet demand. In part this is because the region's supplies have been bolstered by a diversion of water from the Susquehanna River. Moreover, the degree of population growth foreseen in the early studies has not taken place, and current county master plans do not anticipate much additional growth

before buildout is reached. These factors presumably limit the need for highly detailed water supply forecasts when growth management decisions are being made.

Carroll County. In Carroll County (which borders Baltimore City on the west), the extent to which water supply forecasts are factored into growth management decisions depends in part on whether the relevant area is served by surface water or groundwater supplies, according to Franklin Schaffer, Deputy Director of Public Works. In the case of public water supplies, water availability is taken into account during a process known as concurrency management review, and when master plans are under consideration, projections are always made of the availability of water to serve the level of proposed development. On the other hand, groundwater availability does not receive as much emphasis in growth management decisions. Schaffer said that no comprehensive study of groundwater availability to serve the county's needs has been conducted.

Baltimore – Carroll County Controversy. Baltimore City and Baltimore County both have expressed concerns with certain water management and growth management measures undertaken or planned by Carroll County, a rapidly growing jurisdiction bordering Baltimore County on the west.

Bill Stack of Baltimore City's water quality management unit indicated that the city is concerned about the amount of growth that Carroll County has programmed or planned within the Liberty Reservoir watershed, from which the city obtains some of its water supply. Part of Carroll County's priority funding area lies within the watershed. According to Stack, under a 1984 watershed management agreement, Carroll County is responsible for protecting the watershed from pollution by limiting growth within its boundaries. There was already a considerable amount of development within the watershed when the agreement was signed, but the agreement was supposed to contain further development by providing primarily for infill rather than spread-out growth.

Stack indicated that, for the most part, Carroll County has abided by the language of the agreement, but recent actions and plans have caused some concern. The Carroll County commissioners have developed plans to upzone certain areas within the Liberty watershed and have indicated that they might consider pulling out of the 1984 agreement. Also, the existing zoning within the watershed has not been as protective of conservation and agricultural land uses as the city had hoped. There has been considerable large-lot development on conservation-zoned lands within the watershed and some development even on some agriculturally zoned lands. Stack said that Baltimore City offered to allow Carroll County to withdraw more water from the City-owned Liberty Reservoir on the condition that the county would abide by the 1984 agreement, but that Carroll County turned down the offer. In the 2002 local elections, however, two incumbent Carroll County commissioners were unseated, and the winning challengers appear more sympathetic to the watershed management agreement.

Baltimore County's concerns with Carroll County's plans dovetail to some extent with the City's. According to Don Outen, Baltimore County prepared a 10-page response to a proposed water and sewer plan developed by Carroll County. Baltimore County is

concerned, among other things, that Carroll is planning an excessive amount of growth within the Liberty watershed, potentially threatening some of Baltimore County's drinking water supplies. The rate of growth within Carroll County's portion of the Liberty watershed, said Outen, is more than triple the rate within Baltimore County's share. Baltimore County is concerned that zoning changes undertaken or proposed by Carroll County within the Liberty watershed may be in violation of the 1984 watershed management agreement. Baltimore County recommended that the Maryland Department of the Environment not approve Carroll County's proposed water and sewer plan, citing a range of deficiencies.

Summary of Maryland Local Case Studies. The case studies of Frederick City and the counties of Montgomery, Anne Arundel, Baltimore and Carroll indicate a range of water supply related issues related to growth management. The City of Frederick's case shows that state mandates for local water and sewer planning cannot ensure that local plans will be effective in averting water supply shortages during drought. Jurisdictions like Montgomery and Baltimore Counties seem confident that their ability to rely on major rivers (the Potomac and the Susquehanna, respectively) for major supply or backup enables them to avoid shortages, especially since one of the counties (Baltimore) is nearing build-out. However, neither the State's Smart Growth program nor the local water and sewer planning requirements have averted incompatibility between Carroll County's growth plans (within a Priority Funding Area) and protection of water quality in the Liberty Watershed, upon which Baltimore City and County both depend for part of their supplies. Anne Arundel County is relying on a Maryland Geological Survey study to guide growth management decisions in the county's southern portion that is dependent on groundwater. However, Montgomery and Carroll counties are unsure of the extent to which they can rely on groundwater to support future growth. More in-depth studies are needed in these and other jurisdictions to determine the extent to which, and the specific locations in which, future growth can be accommodated - - especially under prolonged drought conditions.

VI.F. Water Supply-Related Research Needs in Maryland

Mathew Pajerowski, who heads MDE's water permitting unit, observes that the mandate for county water and sewer planning was not intended to be the state's means of determining future adequacy of water supplies. He also asserts that the state's permit-by-permit analysis cannot answer the bigger question of whether there will be sufficient water in the state in 20 years. Pajerowski believes more resources need to be devoted to the following research activities.

- Placing gauges on more streams so that officials will eventually have continuous flow records for a greater number of surface water sources.
- Developing minimum flow levels for streams that based on particular stream characteristics and management objectives.
- Establishing a better network of monitoring wells so there is more information on aquifers, in terms of areal extent, hydrology, transmissivity, and other factors.
- Developing better modeling tools for water supply determination and conducting more funded studies of water sources. Such models would be developed not

simply for research, but as planning and management tools. The Maryland Geological Survey has developed and utilized such models, which allow for sensitivity analysis (i.e. "what if" scenario testing). Pajerowski says there modeling is a powerful tool that MDE has not used because of time and funding limitations.

- Analyzing data provided by permittees, in order to acquire information such as the number of community water systems in a given county that use water from a particular aquifer.

In fact, former Governor Glendening signed an executive order in April 2002 to create a Water Resource Management Advisory Committee that would begin to address many of Pajerowski's concerns (State of Maryland Executive Order 01.01.2002.05). The executive order was drafted in response to the highly publicized letter sent to him by 72 General Assembly delegates in February 2002 (cited at the beginning of this paper). However, the former governor did not appoint the committee by the time he had left office. His successor, Robert Ehrlich, issued his own Executive Order 01.01.2003.08 in March 2003, establishing an Advisory Committee comprised of two members of the legislature; secretaries of five Departments (the Environment, Health and Mental Hygiene, Agriculture, Natural Resources, and Planning); and over a dozen members appointed by the governor to include representation of local government, environmental organizations, the agricultural and business community, research institutions and other persons with relevant interest or expertise. The committee was charged with the following six duties, as quoted verbatim from the executive order:

- "Review the latest information from State, local and federal agencies concerning assessments of the quality and quantity management and protection of the State's ground and surface waters;
- Review the results of ongoing scientific research regarding climate change and its regional impacts on aquifer depletion and recharging models;
- Review local, State and federal laws and regulations and policies related to the management, development, conservation and protection of ground and surface water resources;
- Assess the adequacy of existing governmental resources, regulatory enforcement and monitoring programs that are available for the management, development, conservation and protection of the State's ground and surface water resources;;
- Develop models to assess trends regarding the State's major aquifers; and
- Recommend additional actions, studies, policies, regulations or laws necessary to assure that the management and protection of the State's surface and ground water resources is conducted in a manner consistent with their long-term sustainable use and protection. The Advisory Committee shall provide a cost estimate and funding alternatives for implementation of each recommendation."

The advisory committee is to submit a report of its findings and recommendations by May 31, 2004.

VI.G. Summary of the Degree of Coordination between Water Supply Planning and Growth Management in Maryland

Unlike Florida and New Jersey, Maryland does not conduct state-level, long range water supply planning or modeling. The only long-range forecasts of water supply and demand are done by the two of the river basin commissions that provide water to portions of three of the state's most populous jurisdictions. The Interstate Commission on the Potomac River Basin incorporates a "one-in-ten" drought year as part of its forecasting, and found that storage in the Potomac reservoirs would be nearly depleted given the "most likely" forecast of year 2020 demands and a reduction in streamflow resources of 10 percent. While the commission examined possible effects of climate change on water resources, the results of that sensitivity analysis were not included in the forecast because "there was a lack of any clear climate change result for this region's resources" (Hagen and Steiner 2000, ES-3).

Absent long-range forecasting by a state agency, Maryland relies on permit-by-permit review of applications from certain categories of water users. However, those in charge of the review express the need for more research on minimum flow and water levels for particular water sources to guide their permitting decisions. While some water supply forecasting is required of county governments in their state-mandated,10-year water and sewer plans, the quality of these plans vary by jurisdiction and most of the plans are not kept current. Water demand and supply forecasting in the water and sewer plans currently are not required to include analyses and program responses under a prolonged drought scenario, under expected and higher-than expected growth population growth conditions. Moreover, staff members of the Maryland Department of Planning report that the water and sewer planning program is not adequately coordinated with the state's Smart Growth program.

Following a drought of 1999, the then-governor appointed a Statewide Water Conservation Advisory Committee. The report of that that committee led to regulations outlining a four- staged process for defining drought and a set of state-mandated water use restrictions for each stage. However, other than a requirement that water-conserving appliances be installed in new home construction under the Maryland Water Conservation Plumbing Fixtures Act, there is no state guideline for water conservation in non-drought conditions.

In response to state legislators' requests for a comprehensive study of the Maryland's water supply and the relationship of that supply to Smart Growth, Governor Ehrlich signed Executive Order 01.01.2003.08 (outlined above) in March 2003. However, missing from the list of research needs under that executive order, is an explicit statement regarding analysis of the degree to which the state's water resources are capable of supporting short-term and long-term growth in Smart Growth and Priority Funding Areas, given projected demographic and economic forecasts and permitted densities in those designated growth areas.

Another important task, missing from the list, involves connecting water supply studies to an analysis of land use and growth patterns in the years since full implementation of the

Smart Growth initiatives. Since Maryland Smart Growth is an incentive-based program, it is possible for the state to have land development patterns in some areas that are inconsistent with Smart Growth principles. Research is needed on extent to which land development patterns in recent years are not consistent with Smart Growth, and on the specific water quantity and quantity implications of such growth patterns. Nevertheless, the advisory committee's report will be a vital step for Maryland to generate information needed for managing its water resources.

VII. Conclusion: Findings and Implications of the Case Studies

VII.A. Key Findings

The case studies from Oregon, Florida, New Jersey and Maryland reveal the following key findings related to the relationship between water supply planning and growth management.

1. The studied states differ greatly in the manner and degree to which water supply planning is conducted. Florida and New Jersey prepare statewide water plans; Oregon and Maryland do not. For the most part, the resources devoted to state water supply planning reflect the relative differences in each state's perception of the severity of its water supply problem. Florida has the longest history of the four states in dealing with drought-related water supply problems, and this is reflected in the breadth and depth of the analyses conducted by its five water management districts (as illustrated in this paper's summary of the Southwest Florida Water Management District's *Regional Water Supply Plan*). New Jersey has had a range of water supply problems for several years. In many parts of Oregon, the water allowed by permits and "rights" exceeds the amount of water available during dry periods. While Oregon does not have a statewide water plan, it requires water supply plans of all municipal water providers. Relative to the other states studied, Maryland does not have a long history of water supply problems. Maryland's counties do prepare 10-year water and sewer plans, reviewed by the state, that are required to include assessments of water supply adequacy, but supply concerns were not the primary reason such plans were mandated.

2. At the core of good water supply planning in a jurisdiction is a solid understanding of the characteristics of the various water sources in the area and the impact that population growth and climate change may have on each of those sources. For the most part, the level of detail on minimum surface water flows and groundwater levels being sought by the four states, seems to vary directly with the urgency of their water supply concerns. For example, in southwest Florida - - where frequent drought and the extensive pumping of groundwater have been long-recognized problems - - the Southwest Florida Water Management District is attempting to establish minimum flows for each river, and minimum water levels that are specific to given categories of aquifers, lakes and wetlands. In Maryland, which has not been experiencing the same level of water quantity and quality concerns as Florida or New Jersey, there has been relatively fewer state resources devoted to water supply planning in general and the establishment of minimum flows and water levels in particular.

3. There is wide variation in the degree to which the four states (or local governments or interstate river basin commissions) attempt to incorporate potential climate change into their water supply planning. Climate change would have significant impacts on water supplies and demand in general, affecting particular areas in a state more than others. Drought scenarios need to be included in water supply planning.

For example, in Florida, the SWFWMD did include a climate change scenario in its Regional Water Supply Plan for the Tampa Bay area. The Plan projected a "1 in 10" drought pattern for each year from the year 2000 to the year 2020, and found that water supply needs would be twice that of the projections using the "normal" precipitation year. However, the plan omitted any discussion of the fiscal, economic and environmental implications of that drought forecast, and did not provide any scenario forecasting for less-extreme drought conditions. Consideration of such consequences would allow for a wider range of planning alternatives to be considered at the state, regional and local level.

While Maryland currently does not conduct state level water planning, consideration was given to climate change in the 2020 supply/demand forecasts prepared by the Interstate Commission on the Potomac River Basin (ICPRB). Although the ICPRB model of a "1 in 10" drought scenario appeared nearly to deplete Potomac reservoir levels by the year 2020, the commission did not include the result in the forecast because of what it regarded as inclusive results. The latest *New Jersey Water Supply Plan* (1996) did not include climate change scenarios because of inadequate information. Of all the local water supply plans reviewed in this case study, one case stands out for incorporating alternative population growth and climate scenarios: the 1996 *Regional Water Supply Plan* prepared for Portland, OR by the Regional Water Suppliers Consortium.

4. In all four states, there currently is a poor level of coordination between water supply planning and growth management planning. The cases show that having a statewide water plan -- or a water crisis – are neither necessary nor sufficient conditions for good local water supply planning and for coordination of that planning with growth management planning. It is true that political boundaries do not align with watershed and aquifer boundaries; that major rivers can flow through several states; and that land use planning in the U.S. is seen as a local responsibility and is usually done on a much smaller scale than water supply planning. However, the Regional Consortium in Portland, and a few county water and sewer plans in Maryland, demonstrate that good water supply plans can be generated at a regional or local level

The case-study state in which land use planning and water supply planning could be most closely coordinated – Maryland – has a low level of water supply / growth management coordination and, of the four states, has the *least* amount of water supply planning. County governments are responsible for land use planning (including designation of Priority Places for new development) and for preparing 10-year water and sewer plans. However, the study finds that the water and sewer program planning requirements for county governments has *not* been well coordinated with the Priority Funding Area component of Maryland's Smart Growth, thus far. The Maryland case demonstrates that

having identical boundaries for water supply planning and land use planning is not a sufficient condition for coordinated water and land use planning. Other factors have prevented Maryland from having a more comprehensive water supply planning program, and from integrating such planning with its Smart Growth program - - such as relative complacency regarding water supplies and insufficient resources to support extensive local water supply planning.

5. One major reason for the poor level of coordination between water supply planning and growth management planning - - at least in Florida and New Jersey - - is that local government priorities often lead to local land use decisions that are inconsistent with water source limitations, even when knowledge of water scarcity is available. The Florida examples in this paper demonstrate that coordination between water supply planning and local land use planning exists on paper, but not in reality. Water supply problems are well known. But, as key informants for this study all indicated, growth is Florida's state industry, and it is difficult for local jurisdictions to accept the concept of limits. (Zovanyi ([999)] argues that growth management in the U.S. generally has not incorporated the concept of carrying capacity.) The situation is similar in Oregon, where a state water resources department staff member observes: "It is difficult for any community to really view water as a finite resource and to look at alternatives to what they are doing now." Oregon hopes to affect more water conservation by requiring water suppliers to establish conservation goals in their required water management and conservation plans, and by basing future water permitting decisions, in part, on suppliers' performance in achieving those goals.

In New Jersey, fragmentation of local land use planning responsibility to 566 municipalities, and those local jurisdictions' unusually heavy reliance on property taxes (98 percent of own-source revenues and 75 percent of total), frequently results in development patterns that are inconsistent with the State Development and Redevelopment Plan, and that often threaten water sources. While the Governor sponsored a smart growth summit in late October 2002 to rethink the state's growth management program, he has offered no proposals since then to challenge township home rule state-wide and to alter the tax structure. The governor has, however, expanded state regulation of land use in buffer areas around category 1 surface waters. In Florida and New Jersey, local development imperatives constrain efforts at water supply / growth management coordination.

6. Another factor contributing to problems in coordinating water supply planning and growth management is that state agencies are sometimes unwilling or unable to enforce existing regulations or to deny new water permits even when water supply limitations are known (due to political pressure from developers, municipalities and other stakeholders). Maryland state agencies have been lax in enforcing content and update requirements for water and sewer plans submitted by local governments. Much of this may be due to the recognition that insufficient funding has hampered some of the local plan preparation. In Oregon, the state official responsible for reviewing local water management and conservation plans acknowledges that 'we don't have the political will to cut off new water". Having a good system for water supply planning and for coordination of that

planning with local growth management, will only produce sound results when there is sufficient funding for competent plan preparation and adequate state-level enforcement of permitting / planning requirements.

7. Inadequate coordination between state water supply planning on one hand, and utility company commitments to service new development on the other, is complicit in the growth-accommodating orientation of state growth management programs. A vivid example of this is the Hillsborough County, FL comprehensive plan (quoted earlier), in which (in one paragraph), the county discusses how it ensures that adequate water supply exists before it issues certificates of occupancy, but then adds that the Tampa Bay Water utility company "must provide water supply to meet Hillsborough County needs." In New Jersey, Department of Environmental Protection (DEP) Secretary Bradley Campbell laments that the state's process for areal analysis of water supply to support new development is so backlogged that water utilities often commit to supplying water for new homes and businesses, years before DEP can even assure that the water will be available for them (Nussbaum 2002).

VII.B. Implications of the Case Studies for Maryland

The case studies provided herein have several lessons for Maryland as officials in that state undergo their review of water supply planning and management. Maryland is fortunate in that land use control less fragmented than in northeastern states such as New Jersey.

- The Maryland Department of Environment (MDE) needs better information on the state's water resources. Additional funding is needed to support more extensive stream gauging, strategic test-well drilling, and the enhancement of hydrological models that can boost our understanding of complex ground water systems. Such resources will help generate reliable information on minimum flows and water levels in various parts of the state, and on the surface water / groundwater interaction in particular areas. For example, information could be generated on the recharge rate and area of a specific unconfined aquifer. Such improved data will enhance the county water and sewer plans.

- While the state does not need a statewide water supply plan akin to those of Florida and New Jersey (profiled herein), MDE should be the lead agency that ensures that studies are done, on major water sources currently not covered by river commission planning, which are of broader scope and longer planning horizon than 10 years – since the planning and deployment of supply alternatives could take several years. The Interstate Commission on the Potomac River Basin conducts such long-term studies for the Potomac River, but similar studies need to be conducted for other water sources. In conjunction with the Governor's Water Resource Management Advisory Committee, MDE can develop a strategy for generating needed studies and for ensuring consistency among the forecasting techniques used. The Advisory Committee can recommend sources of funding for such studies. Consistency in data bases, forecasting scenarios and projection

techniques used by river commissions and by counties in their water and sewer plans, will improve overall water supply *and* growth management planning.

- The water supply-related components of county water and sewer plans need to be strengthened, and tied more closely to planning for Priority Funding Areas. The plans should include projections of water supply and demand under alternative growth and climate change scenarios, so that a high growth, long-term drought scenario is included in the forecasting - - with implications for water supply alternatives and their financial costs and environmental impacts. The water and sewer plans should disaggregate the forecasts so that they show the water supply demand projections for distinct hydrological regions in the county. The plans and the forecasts should also discuss the consistency of water supply planning and growth management planning (i.e. Smart Growth and Priority Funding Areas) in the county. The Maryland Department of Planning should not accept any plan unless it includes such commentary. (It should be noted that neither the Anne Arundel County nor the Frederick County water and sewer plans forecasted the types of water supply emergencies that each area would face shortly after plan publication (in southern Anne Arundel County and the city of Frederick, respectively). Upgrading the planning requirements could help prevent such disparities between plans and actual conditions.)

- Another required element of the water and sewer plans should be a water conservation strategy with specific objectives for reductions in per capita water consumption (similar to Oregon's requirement for water management and conservation plans). MDE would review the objectives before approving the plan. Updates of the plan would then compare actual reductions in per capita use to the objective. A county not meeting its objectives would need to explain the reasons for the underperformance and outline steps for improvement. MDE could withhold approval of the updated plan if the department was not satisfied with the local plan, and provide technical assistance if needed.

- Where appropriate, county water and sewer plans should discuss the findings and recommendations of the tributary strategies being prepared under the Chesapeake Bay program, and their relevance to the water and sewer plan.

- This improved, local planning, along with attaining water conservation goals will require increased state funding for local water and sewer plan preparation, and for publicizing water conservation objectives and strategies to local residents. According to COMAR 26.03.01.02(F), "the planning part of the Sanitary Facilities Fund established under Environmental Article, §9-218 of the Annotated Code of Maryland, shall be available to the Department to finance planning . . . including the preparation, amendments and revisions of county [water and sewer] plans."

- The county water and sewer plans need to be informed by the long-term water supply and demand forecasts for rivers and aquifers that cross county and state

boundaries (discussed above). MDE needs to review each county's updated water and sewer plans for consistency / compatibility with other counties that share the same river or aquifer as a water source.

- MDE should use improved data on minimum water levels in making and enforcing water permit decisions, so that water withdrawals are limited to the particular aquifer's sustainable yield. As noted by Robert Summers (2003), Director of MDE's Water Management Administration, there is a need for MDE staff to enforce permits by using administrative penalties when necessary, which will require the hiring of additional compliance staff.

VII.C. Concluding Comments

State and local governments intent on conforming land use plans, policies and regulations with sustainable use of surface waters and groundwater, need accurate information on the quality and quantity of those water sources. As an exercise of the police power, growth management regulations must be consistent with 5th and 14th Amendment guarantees of due process. This means, in part, that development restrictions may not be arbitrary and capricious. Land use regulations derived from concerns over water quantity and quality can avoid due process complaints if they are based on solid, scientific evidence. The Florida case illustrated how expert-panel peer review is a high-profile aspect of the setting of minimum surface water flows and of minimum water levels in aquifers. Water agency spokespersons in all four states underscore the need for more sophisticated models. As more information is available, an important role for planners will be to help communicate hydrological knowledge to elected officials and the public.

The Maryland case, in particular, indicates the Maryland Department of Environment's need for better information on the state's water resources. Additional financial resources are needed to support more extensive stream gauging, strategic test-well drilling, and the enhancement of hydrological modeling. The Florida case illustrated how expert-panel peer review is a high-profile aspect of the setting of minimum surface water flows and of minimum water levels in aquifers. Water agency spokespersons in all four states underscore the need for more sophisticated models. As more information is available, an important role for planners will be to help communicate hydrological knowledge to elected officials and the public.

The need for additional water-supply related data to inform public deliberation has been given particular attention recently in Florida and New Jersey. Through the April 2002 legislation described herein, the Florida Legislature is mandating that water management districts develop information on hydrological conditions of major surface and groundwater sources, and to provide suggestions for good conservation practices. The information is to be provided at regular intervals to every Florida legislator and to local print and broadcast media. In New Jersey, Gosier (2002) reports that the Department of Environmental Protection officials are contemplating the retention of certain water restrictions after the current drought ends, hoping to maintain awareness of the need for water conservation.

Establishing closer links between water supply planning and growth management planning not only will require greater knowledge and public information about minimum flows and levels than is available at present. In addition, more research is needed on the impacts of alternative development patterns on those flows and levels. Although hydrologists acknowledge that impervious surfaces redirect stormwater runoff to streams rather than to groundwater, case-by case analyses are needed to determine how much of that runoff is removed from local water sources. In addition, more research needs to be conducted on the degree to which so-called "smart" development patterns (including urban infill, higher density development) produces better water quantity/quality outcomes than other development patterns for a given area. Experimentation to improve pervious pavement, "green roofs" and other innovations can provide more environmentally-friendly options for smart growth.

If their growth trends continue and drought conditions become more frequent, states like Oregon, Florida and New Jersey will soon have difficult policy choices to make. Sufficient water will not be available where most of these states' growth is occurring. It remains to be seen how high a price customers will be willing to pay to for desalinization, new pipelines, and other heroic solutions to their water supply problems; or what water users will tolerate in terms of water-use restrictions; or what trade-offs customers will allow between water for agriculture, versus development, versus wildlife; or how water will be rationed between current and future users. These are choices that are already being made by some states in the arid West. The next era of growth management in many other parts of the country may very well be shaped by these water-based dilemmas.

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