# Protecting Water Supply Watersheds in North Carolina: The Rules and Their Impacts

**David H. Moreau**
**Jeri Gray**
**Kathy N. Watts**

North Carolina's Water Supply Watershed Classification and Protection Act of 1989 grew directly out of legislation contemplated in 1987 to provide protection for Raleigh's water supply, Falls of the Neuse Reservoir. The Falls' watershed lies in the jurisdictions of six counties and two major municipalities, Durham and Raleigh. Long-standing concern about the potential for pollution of Falls; failure of long-running negotiations among and within the jurisdictions to produce satisfactory local ordinances to protect the Falls watershed; and, finally, development of Treyburn in the headwaters of the reservoir in Durham County motivated Avery Upchurch, Mayor of Raleigh, to request the legislative delegation from Wake County to introduce legislation in the General Assembly to protect the Falls watershed. In April 1987, Aaron E. Fussell, a member of the Wake county legislative delegation, submitted a draft "Watershed Protection Act." It would have required all local governments in the watersheds of nutrient-sensitive reservoirs used for public water supply to enact watershed protection plans. Because Jordan Reservoir was not then used for public water supply, the only nutrient-sensitive public water supply reservoir in the state was Falls of the Neuse.

Because of heated opposition from the Durham County legislative delegation, the "Watershed Protection Act" was replaced by a bill to establish a commission to study the need for a statewide watershed protection program. That bill passed, and during 1988 the Legislative Watershed Protection Study Committee held hearings and drafted the bill that became House Bill 156, the Water Supply Watershed Classification and Protection Act. The act established a mandatory program of local watershed protection consistent with statewide minimum performance standards to be set by the Environmental Management Commission (EMC). The act directed the EMC to adopt watershed classifications and to assign an appropriate classification to each water supply watershed in the state.

Ratified June 23, 1989, House Bill 156 also created the Water Supply Watershed Protection Advisory Council to assist the EMC in developing statewide minimum standards. The makeup of the council was spelled out in the act to include representatives of a broad range of interests, specifically: (1) secretaries of four cabinet-level departments of state government; (2) ten representatives of municipal and county governments, their regional organizations, health departments, and soil and water conservation districts; (3) experts on land use planning and water resources; and (4) representatives of environmental groups. During early 1990, the council held five public hearings and a work session, drafted a set of classifications and standards, and forwarded them to the EMC in April 1990.

The EMC voted in May to put the proposed classifications and standards before the public (see Table 1). Eight lightly attended public hearings and a series of educational meetings were held across the state in the summer of 1990. Most participants expressed support for the standards. In December 1990, EMC adopted the standards as modified following the public hearings.

In May 1991, representatives of Treyburn, a large housing development in Durham County, asked the EMC to invalidate certain parts of the standards because they were not adopted in accordance with administrative procedure. While the EMC refused to invalidate any portion of its standards, they did agree to send

*David Moreau is a professor of City and Regional Planning at UNC-Chapel Hill and Director of the Water Resources Research Institute (WRRI) of the UNC system. Jeri Gray is a technology transfer specialist at WRRI. Kathy Watts is a research associate at WRRI. She received a masters in Regional Planning from UNC-Chapel Hill in 1991.*

the entire set of classifications and standards back to public hearing (See Table 1). The watersheds and their proposed classifications (as identified at that time) are shown in Figure 1. In August 1991, eight public hearings were held on the standards adopted in December 1990. This second set of hearings was heavily attended, with environmentalists accusing developers of packing the hearings.

Following the second set of hearings, the classifications and standards were again modified. This third version of the standards was adopted by the EMC in February 1992 (See Table 1).[1]

## Classifications and Standards

As it has been implemented, the watershed protection act can be characterized as a non-degradation policy similar to those in the federal Clean Air Act and the Clean Water Act. The classifications adopted by EMC are based on existing levels of development in watersheds. Nothing in the regulations is designed to mitigate existing conditions. The regulations establish four classes of watersheds. The same water quality standards must be met in all classes, but performance-based standards vary with existing levels of development. Uninhabited Class WS-I watersheds will remain that way. Watersheds not subject to much urban development and without known discharges are classified WS-II. The regulations are intended to keep these watersheds primarily undeveloped. Standards for WS-III watersheds are designed to hold the line in moderately developed watersheds in which there are only domestic and non-process industrial discharges. WS-IV standards maintain existing conditions in heavily developed watersheds with no categorical restriction on discharges.

In addition to restrictions on wastewater discharges, standards are set to guard against pollution from various sources of polluted runoff (nonpoint source pollution) and from accidental spills of hazardous materials. Measures intended to control nonpoint source pollution include vegetative buffer areas along streams and reservoirs; restrictions on activities and hazardous material use; and development density and impervious surface area limitations. The density and surface restrictions are either without engineered stormwater control devices (low-density option); or with engineered devices (high-density option).

Each watershed includes two areas: a critical area, within which pollutants from uncontrolled runoff or spills pose an imminent threat to the water supply and where stricter nonpoint source controls are applied; and a noncritical area, where controls can be less stringent.

Treyburn's 1991 challenge to the standards centered on the definition of the critical area, which had been increased from one-half mile from reservoir normal pool elevation in the 1990 version to one mile in the 1991 version. The rules adopted in 1992 reduced the critical area back to one-half mile and significantly increased allowable densities and impervious surface areas in all classifications except the WS-II critical area.

| | Proposed 1990 | | Proposed 1991 | | 1992 (Adopted) | |
|---|---|---|---|---|---|---|
| | Dwelling Units Per Acre | Percent Built Upon | Dwelling Units Per Acre | Percent Built Upon | Dwelling Units Per Acre | Percent Built Upon |
| **WS-II Critical Area** | | | | | | |
| Without stormwater controls | 0.5 | 6% | 0.5 | 6% | 0.5 | 6% |
| With stormwater controls | No high-density option | | No high-density option | | | 6-24% |
| **WS-II Watershed** | | | | | | |
| Without stormwater controls | 0.5 | 6% | 0.5 | 6% | 1 | 12% |
| With stormwater controls | No high-density option | | No high-density option | | | 12-30 |
| **WS-III Critical Area** | | | | | | |
| Without stormwater controls | 0.5 | 6% | 0.5 | 6% | 1 | 12% |
| With stormwater controls | | 6-30% | | 6-30% | | 12-30% |
| **WS-III Watershed** | | | | | | |
| Without stormwater controls | 1 | 12 | 1 | 12 | 2 | 24 |
| With stormwater controls | | 12-30% | | 12-30% | | 24-50% |
| **WS-IV Critical Area** | | | | | | |
| Without stormwater controls | 1 | 12 | 1 | 12 | 2 | 24 |
| With stormwater controls | | 12-30% | | 12-30% | | 24-50% |
| **WS-IV Protected Area** | | | | | | |
| Without stormwater controls | 2 | 24 | 2 | 24 | 2 | 24 |
| With stormwater controls | | 24-70% | | 24-70% | | 24-70% |
| **WS-V** | | | | | Classification added as river segment, with no restrictions | |

*Table 1. Comparison of Proposed Watershed Density Regulations*

## Impact of Rules on Residential Development

Two main economic development questions arise from these regulations. First, do these regulations pose a significant constraint on the supply of land that is available for new development? Second, what impact would the 1991 version of the regulations have on the economic welfare of affected communities and how would the 1992 version differ?

*Land Availability*

Residential development is the largest class of land use in urban areas. The regulations will not significantly limit the supply of land for that purpose. Gross develop-

| Class | Area (Sq Mile) | Percent of Watersheds With Densities Less Than: 1 DU/10 Ac | 1 DU/4 Ac | 1 DU/2 Ac | Class as a Percent of Total Area |
|---|---|---|---|---|---|
| II-Critical | 167 | 75% | 96% | 98% | 1.5% |
| II | 1,791 | 95% | 99% | 99.9% | 15.8% |
| III-Critical | 153 | 55% | 82% | 95% | 1.3% |
| III | 2,333 | 82% | 92% | 99% | 20.5% |
| IV-Critical | 1,173 | 50% | 97% | 99% | 10.3% |
| IV | 5,748 | 68% | 93% | 96% | 50.6% |
| Total | 11,365 | 73% | 94% | 98% | 100.0% |

*Table 2. Percent of Total Area With Stated Densities (in Dwelling Units/Acre)*

ment densities were estimated using a geographic information system to capture 1990 U.S. census counts of housing within each of the 359 watersheds in Classes WS-II, III, and IV. (WS-I watersheds are virtually uninhabited.) Only 22 percent of the 52,700 square miles of North Carolina are affected by the rules, and only a very small fraction of the 11,400 square miles that are affected have been developed to urban densities. Only nine of the 359 watersheds in Classes WS-II, III, and IV had gross densities in 1990 as high as one unit per acre. Those watersheds covered only 30.4 square miles, less than three-tenths of one percent of land in classified watersheds and less than one-tenth of one percent of the state. As shown in Table 2, 98 percent of classified watersheds had densities lower than one housing unit for every two acres, and 94 percent had densities under one unit for every four acres. Even with generous allowances for publicly-owned land and other unbuildable areas, the supply of land available for residential development is hardly affected. Land within classified watersheds will hold many times the present population of the state under any of the versions of the rules.

*Prices*

The second of these two questions is more complicated, and only partial answers are possible. A review of the literature does not provide a definitive answer to the question of economic efficiency (see sidebar). At best it may suggest the direction of change in land and housing prices under alternative conditions of supply. One special area of concern about the watershed regulations has been the question of how they will affect the cost of

## Theoretical Approaches To Assessing Economic Impacts Of Regulations

Effects of regulations on the economic welfare of affected communities was the topic of a special issue of *Land Economics* in 1990. One of the principal assertions in the issue's lead article is that regulations confer both benefits and costs on the community and that those effects are capitalized in property values--benefits as increases, costs as decreases.[2] Empirical evidence about the magnitudes of these changes is limited, however, and the evidence that is available must be interpreted with care.

Most of the literature reviewed in that issue dealt with the question of zoning. Fischel noted that a large proportion of the literature erroneously viewed zoning as a single constraint. In practice zoning usually comes in a package of constraints. It is not entirely proper to use empirical results based on zoning to make inferences about the effects of density limits alone. One set of articles found little evidence to support the claim that zoning had any effect on property values, while another set of papers provided evidence of an effect. Fischel pointed out that empirical results in the first set came from cities that have had zoning for a long time; they were not necessarily applicable to cities where zoning has been adopted relatively recently.

Another factor shaping zoning's effects on property values is whether the city is "open" (no constraint on land supply) or "closed". Pollakowski and Wachter conclude that in an open city, land-use controls have no impact on the price of a standard unit of housing.[3] In a closed city, however, land use restrictions will lead to a positive effect on the price of developed land and a negative effect on undeveloped land. They used data from a housing market with stringent caps on new development to support these findings.

Fischel commented on one study which found that, after adjusting for other factors which may influence prices, vacant lands subject to floodplain regulations were less valuable than those without such regulations. He argued that while these effects are not welcomed by owners of vacant land, the cost to that group of landowners is not sufficient to assert that floodplain regulations are not economically efficient. To perform a test of efficiency, economic benefits from reduced flood damages and benefits to owners of developed land would have to be weighed against the costs to the owners of the vacant land.

undeveloped land and consequently, the price of housing. Much of the literature points toward either no effect or a downward pressure on prices of undeveloped land and an upward pressure on prices of existing development. Land prices are not the only factor affecting housing prices. The quantity of additional land required to satisfy density limits and the process by which those costs are incorporated into the housing market also influence housing costs.

*Land Requirements*

The impact of the rules on land requirements can be assessed by comparing the densities at which residential subdivisions have been developed in recent years with the densities specified in the rules. At least two indicators of impact are readily measurable: the percentage of developments that would not be affected by the rules; and the average percentage increase in land requirements to make recent development practices consistent with the rules.

These quantities can be estimated from an analysis of the land consumption frequency curve for recent developments. Impacts of the rules were examined in eight of the most affected counties (Catawba, Davidson, Durham, Gaston, Guilford, Moore, Person, and Rowan). No significant impacts on residential development were found in Durham and Guilford because local regulations in those counties are comparable to the state regulations. Person County was excluded because of the limited number of developments in its watersheds. In the remaining five counties, 65 subdivisions developed since 1985 within water supply watersheds were selected for further analysis.

Some developments in this sample were located in areas with no density limits; the most restrictive density limit for any of the watersheds in which these subdivisions were located was one housing unit per quarter-acre lot. No development in the sample had a higher density; 10 percent of the subdivisions consumed less than 0.43 acres per housing unit (a/hu), and 25 percent consumed less than 0.53 a/hu. The median consumption in these developments was 0.82 a/hu. Assuming that the sample is representative of development practices in unregulated watersheds, the curve can be used to estimate the percentage of developments that would satisfy the rules in those counties where state regulations are more restrictive than current local ordinances. Table 3 compares percentages of subdivisions that would satisfy the rules under the 1991 and 1992 (adopted) versions of the rules with and without stormwater regulations.

These results suggest that differences between the rules as proposed in 1991 and as adopted in 1992 were

| | 1991 Rules | | 1992 Rules | |
|---|---|---|---|---|
| | Without Stormwater Control | With Stormwater Control | Without Stormwater Control | With Stormwater Control |
| II-Critical | 9% | 9% | 9% | 81% |
| II | 9% | 9% | 37% | 89% |
| III-Critical | 9% | 89% | 37% | 89% |
| III | 37% | 99% | 81% | 99% |
| IV-Critical | 37% | 89% | 81% | 99% |
| IV-Protected | 81% | 100% | 81% | 100% |
| All | 54% | 83% | 72% | 98% |

Note: The ALL category percentage shown was calculated by weighting the percentages within each category by the relative sizes (land area) of the categories.

*Table 3. Percent of Subdivisions in Sample That Would Satisfy Rules*

| | 1991 Rules | | 1992 Rules | |
|---|---|---|---|---|
| | Without Stormwater Control | With Stormwater Control | Without Stormwater Control | With Stormwater Control |
| II-Critical | 183% | 18% | 183% | 8% |
| II | 183% | 18% | 52% | 3% |
| III-Critical | 183% | 3% | 52% | 3% |
| III | 52% | 0% | 8% | 0% |
| IV-Critical | 52% | 3% | 8% | 0% |
| IV-Protected | 8% | 0% | 8% | 0% |
| All | 54% | 32% | 18% | 1% |

Note: The ALL category percentage shown was calculated by weighting the percentages within each category by the relative sizes (land area) of the categories.

*Table 4. Average Percentage Increase in Land Requirements for Residential Development in Classified Watersheds*

significant. The land requirement impacts in WS-II, WS-III Critical, WS-III, and WS-IV Critical categories without stormwater controls were significantly modified by changes in the regulations. Changing the rules from those proposed in 1991 to those that were adopted in 1992 substantially increased the percentages of subdivisions that would not be affected, from 9 to 37 percent of WS-II developments, and from 37 to 81 percent of WS-III and WS-IV Critical developments. For all categories the percentage of exemptions increased from 54 to 72 without stormwater controls. With stormwater controls that percentage increased from 83 to 97.5.

A relative frequency curve of land consumption derived from the sample can be used to determine the average increase in land requirements for subdivisions under the new regulations. Percentage increases in land requirements necessary to satisfy the regulatory standard for each category of watershed can be calculated for all values of land consumption. Weighting those values by their relative frequency in the sample, an average for each category can be calculated (see Table 4).

These results indicate that the 1991 rule changes sharply reduced the average magnitude of impacts on developments. For example, average increases in land requirements would have been 183 percent in WS-II non-critical areas under the proposed 1991 rules. Further, the high density option with stormwater controls was not allowed in those areas. The 1992 changes reduced that impact to 52 percent without stormwater controls and 3.1 percent with stormwater controls. Reductions of impacts on WS-III and WS-IV Protected areas were also quite significant. Overall, the average increase in land requirements was reduced from 54 to 18 percent without stormwater controls, from 32 to 1 with stormwater controls.

If changes in the price of undeveloped land due to regulation are ignored, effects on housing costs can be approximated by changing raw land requirements while holding all other factors constant. Tax assessment data for the 65 watersheds in the sample indicate that the value of developed lots represents 10 to 20 percent of total housing value. Undeveloped land accounts for some lesser percentage, but those costs are so highly variable that reliable estimates are not available for the sample. Nonetheless, it is doubtful that raw land costs will exceed 50 percent of developed land costs except in those situations where only minimal improvements are made. Those cases with only minimal improvements (no water or sewer) tend to be located in rural areas where land costs are low. If raw land costs are as high as 50 percent of those of developed lots, then the cost of raw land would range between 5 and 10 percent of housing costs. Under those conditions, a 52 percent increase in land requirements under the 1991 rules (without stormwater control) would have meant a 2.5 to 5 percent increase in the cost of housing. The rules as adopted in 1992 would cause a rise of 0.5 to 0.9 percent. If stormwater controls are adopted, the cost of additional land will be reduced. However, these reduced land costs will be at least partially offset by the cost of the controls. Clustering makes on-site improvement costs the same with or without regulation. Some additional off-site costs for streets, water, and sewer can be expected in areas where additional land requirements are very high.

## Conclusions

The watershed protection rules proposed in 1991 would have provided a substantial degree of protection to public water supplies. One of the costs for that protection would have been a significant increase in land requirements for new developments in those watersheds located in counties that did not have comparable local ordinances. The most important impacts on both the size of affected areas and average impacts on individual developments would have been in the WS-II non-critical class of watersheds. However, modest changes to the rules or adoption of stormwater regulations could have substantially mitigated those impacts.

The drastic changes between the rules adopted in 1992 and the 1991 version considerably reduced both the level of protection and potential impacts on new development. Without stormwater controls, the amount of additional land required for new development was reduced from 54 percent to 18 percent.

Rough estimates of effects of these requirements on housing prices indicate only modest impacts under either version of the regulations. The rules as adopted will, on the average, cause a less than one-percent increase in housing prices.

Finally, most of the attention given to this issue has been on the cost side of the balance sheet. Very little attention has been paid to the benefits. Without that information, it is not possible to determine the economic impact of the regulations. For instance, prior studies suggest that existing development will benefit from changes in land values. The most important of the benefits to measure, however, is the direct benefit of providing sustained protection to public water supplies. If the quality of water or available storage in existing reservoirs is diminished to levels that make some existing sources unusable, the economic and environmental costs of replacement could be substantial. CP

## Notes

[1] Watershed classification information taken from: *WRRI News* No. 245, August 1987, No. 259, September/October 1989; No. 262, March/April 1990; No. 263, May/June 1990; No. 267, January/February 1991; No. 269, May/June 1991

[2] Fischel. 1990. "Four Maxims for Research on Land-Use Controls", *Land Economics*, Vol. 66, no. 3, pp.229-236.

[3] Pollakowski and Wachter. 1990. "The Effects of Land Constraints on Housing Prices", *Land Economics*, Vol. 66, no. 3, pp.315-324.