MACROECONOMIC ANALYSIS

IN

WATER QUALITY REGULATION

Submitted to:

Nitrogen/TDS Task Force
Santa Ana Watershed Project Authority

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1.0 INTRODUCTION

Economics is often called "the dismal science." This is because of the complexity associated with economic analysis. Such complexity leads to debates over costs and consequences that seem unresolvable.

The reason economics issues are so frequently indeterminate, lies in the very nature of economics: "relative valuation." Economics is less like chemistry or physics which conform to physical laws of reality and more like psychology which operates on perceptions of reality.

Economics is fundamentally the science of predicting human behavior in response to changes in needs, desires and resources. Since all people maintain unique value systems, it is all but impossible to develop rule-based systems that accurately predict market-based decisions.

Regulation is, by definition, an attempt to encourage or inhibit specific behaviors that market-driven systems are unable to control. Regulation is most effective in those situations where the economics incentives driving individual decisions run counter to the best interests of the entire society. Pollution control is one example where regulation is necessary to restore equilibrium between individual and societal interests.

Waste disposal, for individuals, is best accomplished at the least possible expense. After all, the waste is being disposed because it has no value. And, increasing the cost of disposal does not add value to the waste. Cost minimization would not be a problem if all wastes disposed by each individual could be isolated from effecting any other individual.

More often than not, the least expensive method of waste disposal is to relocate it away from the original source. That approach minimizes costs for the waste generator. In some cases, however, the true cost of disposal are merely transferred along with the waste to its new location. Therefore, what is an efficient solution for one waste generator is very inefficient for the whole society.

Ironically, a waste generator who operates in a manner to protect others from the effect of their disposal actions, incurs costs which make him/her less efficient or competitive in the market. Unless good stewardship can be translated into perceived product value, the inefficient generator will ultimately fail.

Public health and safety is the foremost rationale for increased government regulation. For example, car manufacturers knew for some time that airbags would save lives. But, few people were willing to pay the cost for increased protection when it was offered as an option. By making passive restraint systems mandatory, government eliminated the competitive disincentives that had previously stalled widespread adoption of the safety technology. And, once demand for airbags saturated the production system, economies of scale caused equipment prices to fall dramatically. It is unlikely that a market-based system could evolve the same outcome without government intervention.

The case for regulations to prevent pollution are built upon the same assumptions about the natural limits of free markets. All manufacturers desire to "do the right thing" but are prevented from acting for fear that their competitors will gain a competitive advantage through lower waste disposal costs. Therefore, regulations are needed to ensure that individuals do not seek competitive advantage by transferring their disposal costs to society at-large.

Where regulations are indisputably related to protecting public health and safety, including the greater natural environment, there is little argument over the economic necessity of government intervention. The more subjective the perceived risks and benefits, the greater the controversy over the necessity of using state authority to achieve such ends.

Economists are often called upon to compare the costs and benefits of proposed laws and regulations. Lawmakers and regulators are just as frequently frustrated by the apparent inability of the experts to agree on the net value of the proposed actions. The problem arises when one assumes that economic analysis provides an objective measure of merit. It does not.

The evaluation of economic impacts, both positive and negative, depends largely on the definition of terms in the equations used to model the system. Therefore, the objectivity of the valuation process depends on the objectivity of the definitions used. If the scope of an analysis is artificially limited by the definitions employed, the utility of the analysis will be similarly confined.

Limited definitions are routinely employed in economic analyses. Sometimes the limits are imposed by the lack of appropriate data. At other times, definitions are selected to support preconceived judgements about the net-value of proposed actions. More often than not, ill-fitting definitions are chosen simply because there is inadequate guidance describing appropriate selection criteria.

Federal and state legislatures are increasingly asking government regulators to conduct formal cost-benefit analyses to support proposed rules. Just as regulatory agencies must now show a level of economic rationalism for pending regulations; regulated entities are often required to rely on the dismal science to justify waivers or variances from generic rules. And, rarely is instruction given as to how such studies should be performed.

Even more rarely are economic decision-criteria formally codified. When are benefits "worth" the costs? How much is "too much to spend?" Without firm guidance, the final decisions will always remain inherently subjective regardless of how sophisticated the science of economics becomes. That's why they're called "value judgements."

2.0 REGULATORY REQUIREMENTS

2.1 Federal Regulations Relating Economics to Water Pollution Control

EPA has long maintained that the Clean Water Act does not empower them to consider economic cost-benefits when proposing federal regulations. The agency interprets their enabling legislation, and congressional intent, as specifically rejecting a regulatory paradigm based on economics:

EPA has consistently stated that traditional econometric analysis tends to undervalue the benefits of environmental protection. They note that while to costs of compliance are easily quantified, the benefits of action and the costs of inaction are very difficult to measure or appraise.

EPA only encourages formal economic analysis on three occasions: 1) when deleting or downgrading a designated beneficial use, 2) when making an anti-degradation demonstration and, 3) when calculating fines based on the costs avoided by non-compliance.

EPA's official position is that economic values are best considered at the time beneficial uses are designated for each waterbody. Once uses are established, water quality criteria must be adopted to protect those uses. If a state believes the cost of meeting the criteria is excessive, then they have the option to downgrade the use if controls more stringent than those required by the Clean Water Act "would result in substantial and widespread economic and social impact." [40 CFR 131.10(g)(6)]

In their Water Quality Standards Handbook (1994), EPA provides limited guidance for assessing when substantial and widespread economic and social impacts occur. One approach evaluates how costs of compliance will effect individual businesses using micro-economic principles. The other approach assesses the aggregate impact across an entire region using macro-economics. In both cases, EPA's guidance recommends adjustments based on the relative economic conditions in the region at the time new regulations are proposed.

As a rule-of-thumb, EPA recommends that the cost of compliance should not be considered excessive until it consumes more than 2% of disposable household income in the region. The threshold is meant to suggest more of a floor than a ceiling when evaluating economic impacts. And, designated uses may not be downgraded if they have "existed" in the waterbody at any time since 1975 regardless of the economic costs or consequences.

Where water quality is better than necessary to protect beneficial uses, federal regulation require that quality to be maintained unless the state makes the necessary anti-degradation demonstrations. Such demonstrations require proof that allowing lower water quality is "necessary to accommodate important economic or social development in the area in which the waters are located." [40 CFR 131.12(a)(2)]

In the Water Quality Standards Handbook, EPA interprets the phrase "necessary to accommodate important economic or social development" with the phrase "substantial and widespread economic and social impact." As such, they believe the guidance written to describe when beneficial uses may be downgraded is also appropriate for defining when water quality degradation may be permitted.

Despite recent congressional attempts to require federal agencies to conduct formal cost-benefit analysis, including the 1995 Unfunded Mandates Act, EPA recently reaffirmed their previous position on economic considerations in the Advanced Notice of Proposed Rulemaking (July 7, 1998).

Very few court cases have challenged the economic rationality of specific water quality criteria. This is because the economic issues become moot if the designated beneficial uses already exist in the waterbody. If permit limits are established as necessary to protect the designated uses, there is no regulatory discretion to allow flexibility.

Legal challenges, based on economic necessity, are more likely to be successful where water quality is already better than necessary to protect beneficial uses. Provided that beneficial uses remain fully protected, regulators have much greater discretion to allow lower water quality. Rarely, however, has this situation arisen or been adjudicated. And, more often than not, anti-degradation policies are a matter left to state enforcement.

2.2 California Regulations Relating Economics to Water Pollution Control

Unlike federal regulations, California law requires consideration of economic impacts at the time beneficial uses are designated <u>and</u> when water quality criteria are established to protect those uses. Section 13000 of the California Water Codes states:

> *"…activities and factors which may affect the quality of the waters of the state shall be regulated to attain the highest water quality which is reasonable, considering all demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible."*

Section 13241 of the California Water Code is even more explicit:

> *"It is recognized that it may be possible for the quality of water to be changed to some degree without unreasonably affecting beneficial uses. Factors to be considered by a Regional Board in establishing water quality objectives shall include, but not necessarily be limited to, all of the following: a) past, present, and probable future beneficial uses of the water, b) environmental characteristics of the hydrographic unit under consideration, including quality of water available thereto, c) water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area, d) economic considerations, e) the need for developing housing within the region, f) the need to develop and use recycled water."*

It is important to note that items (e) and (f) in Section 13241 were added, by later amendment, to the first five factors. When groundwater objectives were originally established in the Santa Ana River watershed (circa 1972-75), consideration for housing and reclamation was not explicitly required. The significance is explained in a letter from the State Water Resources Control Board's Chief Counsel (William R. Attwater) to the Executive Officer of the Regional Water Quality Control Board in the Santa Ana Region (Bill Dendy):

> *"In summary, then, encouragement of wastewater reclamation and adequate protection of groundwater quality are not mutually exclusive. The Legislature has mandated that the Board both protect water quality (Water Code Section 13001) and encourage reclamation and reuse (Water Code Sections 13510 and 13512). Although the State Board has previously given substantial guidance to Regional Boards with respect to water quality maintenance, guidance with regard to a proper approach to reclamation has been limited. The Policy and Action Plan for Water Reclamation in California represents an effort to provide the necessary as to how reclamation and reuse can be accomplished where appropriate within the framework of the responsibilities of the State and Regional Boards to protect the beneficial uses of the State's waters."*
>
> *"Since only recently has the State Board developed a specific Policy and Action Plan for Water in California to implement the statutory mandate of Water Code Sections 13500, et seq., during the basin planning process completed in 1975, the Regional Boards may not have considered the relative costs and benefits, economic and environmental and social, which might be associated with the use of reclaimed water in their basins. To the extent that these issues did not formerly receive consideration, it may be appropriate for the Regional Boards to re-examine the beneficial uses and water quality objectives identified in their basin plans on a case-by-case basis as reclamation projects are proposed. Further, the reclamation policy should be taken into account during the updating of the basin plans." [letter dated December 29, 1976]*

The Policy and Action Plan for Water Reclamation in California (State Board resolution no. 77-1) was adopted on January 6, 1977 nearly two years after the original Basin Plan for the Santa Ana River watershed. The memorandum cited above makes it clear that economic factors must be continuously reevaluated as regulations and community conditions change.

Although the Porter-Cologne Act specifically requires the State Water Resources Control Board and the Regional Water Quality Control Boards to consider economic factors, there is very little official guidance on the subject. In an Administrative Procedures Update issued in May of 1990, the State Board sought to define the meaning of "economic considerations" in Section 13241 of the California Water Code:

> *"Factors that should be considered when determining whether the discharge is necessary to accommodate social or economic development and is consistent with maximum public benefit, include: a) past, present, and probable beneficial uses of the water, b) economic and social costs, tangible and intangible, of the proposed discharge compared to benefits. The economic impacts to be considered are those incurred in order to maintain existing water quality. The financial impact analysis should focus on the ability of the facility to pay for the necessary treatment. The ability to pay depends on the facility's source of funds. In addition to demonstrating a financial impact on the publicly- or privately-owned facility, the analysis must show a significant adverse impact on the community. The long-term and short-term socioeconomic impacts of maintaining existing water quality must be considered. Examples of social and economic parameters that could be affected are employment, housing, community services, income, tax revenues, and land value. To accurately assess the impact of the proposed project, the projected baseline socioeconomic profile of the affected community without the project should be compared to the projected profile with the project…EPA's Water Quality Standards Handbook (Chapter 5) provides additional guidance in assessing financial and socioeconomic impacts" [Antidegradation Policy Implementation for NPDES Permitting, APU #90-004]*

The Administrative Update clarifies some of the specific factors that must be considered when evaluating economics. However, it does not provide any objective criteria by which to evaluate those factors. And, referencing EPA guidance provides little additional insight. "Although EPA has issued suggestions on what might be considered in determining economic or social impacts, the Agency has no predetermined level of activity that is defined as "important." [Questions & Answers on Antidegradation, Water Quality Standards Handbook, 1989]

At first glance, the lack of predetermined thresholds would appear to provide greater regulatory flexibility. In practice, however, very few projects are approved when it is likely that they will degrade water quality without impairing beneficial uses. Although economic evidence is submitted, it is difficult for Regional Boards to know when the burden-of-proof has been met. The controversy surrounding the Inland Surface Waters Plan (ISWP) is a good illustration.

Failure to formally evaluate relevant economic factors was the primary basis upon which California's Inland Surface Waters Plan was overturned by state courts in 1993. Failure to agree on a specific method for conducting such an analysis is the primary reason that the State Board has been unable to enact a replacement for the ISWP. Ultimately, EPA asserted jurisdiction over water-borne toxins in California. Federal regulations do not require consideration of economic factors when setting water quality objectives.

If, in the end, California is unable to develop a reasonable system for evaluating economic factors, then the fact that the law requires such a review is rendered moot. The real-world implication is that federal and state regulators will not officially approve projects likely to lower water quality regardless of whether beneficial uses remain unaffected. This is not the result of any inherent opposition to such projects but, rather, derives from the lack of specific review criteria and essential expertise by which to evaluate the economic impact of approving or disapproving the project.

3.0 FUNDAMENTALS OF MACROECONOMIC ANALYSIS

3.1 Purpose and Uses of Macroeconomic Analysis

Although EPA's Water Quality Standards Handbook contains considerable information on how to evaluate a company's or agency's ability to bear the cost of increased regulation, the micro-economic guidance is intended for use when setting limits in the discharge permit. The recommended procedures to evaluate micro-economics are impractical when assessing the impact of new water quality objectives or waste-load allocations throughout an entire watershed. The cost of evaluating the individual impacts on every person and/or business in the region would likely exceed the proposed treatment costs. In such cases, EPA recommends that macroeconomic analysis be used instead.

Macroeconomics is the study of how money flows in an economy. It examines, and attempts to model, how and why economic decisions change in response to important factors such as inflation, taxation, unemployment rates, savings & investment, and consumption. Where regulations may impose new costs, or provide new benefits, those effects may also be integrated into the econometric model.

Economic decisions are primarily psychological. It is notoriously difficult to accurately and reliably measure attitudes. However, attitudes are manifest in consumer and business behavior. And, there is an overwhelming amount of objective data available to quantify how money moves through the economy.

We may not know the precise level of apprehension that individual consumers must experience before they begin curtailing discretionary expenditures but, we can correlate rising unemployment rates to falling sales tax rates. We can link rising tax rates to falling savings rates. And, we can deduce something about cause and effect from the patterns observed.

When a corporation announces its intention to build a new manufacturing facility in a town, econometric models can reliably predict how the wages and salaries paid will influence retail sales in the area. Likewise, it is possible to make accurate predictions concerning the probable increase in local tax revenues. When a corporation announces its intention to close a factory, similar econometric models can calculate the negative impacts just as easily.

Many cities and states use economic models to make important decisions on whether to offer tax incentives for companies to locate in their jurisdiction. Invariably, such analyses must weigh the costs and benefits. Such calculations are enormously complex.

When a new company comes to town, they place new demands on the local infrastructure (roads, schools). Increased tax revenues may offset the increased costs, direct tax incentives reduce the expected value of the offset. The economic calculations made by the econometric models depend on critical assumptions about how new revenue streams will recirculate through the economy. Such models also tend to assume that "everything else remains the same." Anyone who has seen what happens when Wal-Mart builds a store knows that everything else does not remain the same.

Big public policy questions tend to generate big econometric models (with even bigger underlying assumptions). Consider the question of whether the minimum wage should be raised. Proponents claim that, like other public health and safety regulations, competitive pressures prevent free markets from paying adequate wages to the bottom 10-15% of the workforce. Therefore, government intervention is necessary.

Opponents of the minimum wage have their own econometric models to show that low wages are related to lower productivity and less value-added. They claim that raising the minimum wage will only increase unemployment as employers seek to restore the balance between revenues and expenses in order to preserve profit.

Every time Congress seriously considers raising the minimum wage, out come the same old arguments along with a few new economic studies to support each viewpoint. Even when an issue is essentially purely economic, as it is with the minimum wage question, economic science is unable to agree on what's the right answer. The complexities of the underlying behavior and the inherent subjectivity of humans defining the analysis and interpreting the data will always limit the utility of econometrics for making value judgements.

As public policy questions become more complex, the limitations of econometrics are even more evident. When a new company seeks to relocate, it is not difficult for a city to calculate what level of tax incentives produce a net gain given the increased infrastructure requirements. But, it is nearly impossible to calculate the net economic benefits of investments in pollution control technologies. Often intangible, the benefits of environmental regulation frequently defy precise quantification.

3.2 Valuation in Macroeconomic Analysis

Assuming that one could predict with absolute accuracy all of the positive and negative effects associated with a proposed regulation, the problem of deciding whether to implement the regulation would not become noticeably easier to resolve. How does one weigh the value of a 20% increase in fish abundance with a 0.2% increase in unemployment?

In the earlier example of a city considering whether to offer tax incentives for a new factory, the municipality could reduce the question to a common denominator of net income. Environmental regulations cannot be evaluated using a common denominator. Relative value (getting your money's worth) is an abstract and subjective concept.

Because all regulation starts with the presumption that the free market has undervalued some activity (if not they would be doing it), regulators tend to assume that econometric models will not produce a meaningful basis for making appropriate decisions. Thus it is that regulations may require economic factors to be considered but cannot describe how to use the analysis to make or revise policy. In most cases, the economic data (often conflicting) is simply laid before the decision-makers and they draw their own conclusions based on their own internal value judgements or those of the people they represent.

The inability to evaluate the economic propriety of environmental regulations based on a common denominator politicizes such decisions. Arguing that "compliance costs too much," causes those who oppose new regulations to appear anti-environmental. When there is no objective standard for "how much is too much," all regulatory decisions would appear to pass the test of economic reasonability.

The fallacy of such reasoning is the assumption of unlimited resources in a non-competitive environment. The Administrative Procedures Update (cited above) illustrates the point by listing other "community services" among the economic factors to be considered. In the real world, government assessments (whether by tax or regulation) are limited to percentage of total wealth generating capacity. Regulators must compete with tax collectors and other regulators for their share of that capacity. Money spent on water pollution control is not then available for other government services such as schools, police, or parks.

The political process negotiates the priority of competing regulatory interests. Politics provides the essential process-check for defining how much is too much. It is a barter-based system rather than a rules-based system; and the relative value of competing priorities can change in response to changing conditions and perceptions.

3.3 Efficiency vs. Equity in Macroeconomic Analysis

If, macroeconomic analysis is poorly suited for making decisions about whether we got our money's worth, it is well-suited for choosing the best implementation strategy once the important value judgements have already been made.

If it has already been decided that society cannot tolerate higher salt concentrations in drinking water, then macroeconomic analysis can suggest the most efficient means to achieve that end. For example, it may be that it is cheaper to remove salts from water supply when it is pumped from the ground by production wells then it is to prevent the salts from reaching the aquifers in the first place.

Bear in mind that the question of what constitutes the least expensive remedy is categorically different from the question of who should bear the cost. Most debates about macroeconomic efficiency are really arguments about who will pay. Macroeconomic analysis cannot answer the question of whether new pollution regulations pose an "unfair" burden on upstream residents compared to downstream residents. And, if the issues of responsibility and remedy cannot be separated, then macroeconomic analysis offers no hope of resolving the dispute.

In addition, because politics is inherently jurisdictional, there is a tendency to limit the economic impacts analysis to the jurisdiction one represents. Hence, it is easy to conclude that increased regulations will reduce discretionary income of rate-payers in one jurisdiction while failing to note that the discretionary incomes for ratepayers downstream will actually increase. Economically, this may be a zero-sum exchange; politically, it never is.

Even assuming that the increased cost-of-compliance reduced discretionary income for rate-payers as a whole, the water utility agency used the money to purchase goods and services. The money remained in the economy, it just recirculated via a different path of consumption. If resident A pays higher utility rates and must forego the family trip to Disneyland, resident B (who happens to sell pollution control technology) enjoys an increase in discretionary income. As a result, she goes to Disneyland instead.

The recirculation effect works both ways. Suppose a downstream resident must pay $600 for a new water heater that died a premature death due to higher salt concentrations. Her discretionary income declines. But, the appliance salesman sees his discretionary income rise as a result. Whether the water heater fails, or not, does not decide the net discretionary income in the region, it does influence exactly who has it.

Money spent on pollution control (RO), or pollution avoidance (bottled water), or lack of pollution control (new water heater) is still money spent and respent in the economy. From a regional, or statewide perspective, the path the money takes is largely irrelevant to the overall health of that economy.

Determining the net economic effects of a particular regulatory action (or inaction) depends more on the boundaries of the macroeconomic analysis than on the details of the model. What's deemed bad for consumers downstream may be good for certain businesses downstream. What's seen as economically burdensome upstream may be totally offset by the costs avoided downstream. Even when money leaves the State of California, as may happen to pay municipal bond-holders in other states, the net effect on the national economy is zero-sum. All of this merely confirms that macroeconomics can describe how money flows in the economy, it cannot decide whether that flow is fair or not.

3.4 Waste in Macroeconomic Analysis

It may be tempting, after reading the preceding section, to argue that some expenditures "waste" resources. For example, why should discretionary income be diverted to pay for replacing water heaters if the higher rate of appliance failures could have been avoided through lesser expenditures in pollution control? Or, conversely, it may be cheaper to let the water heaters fail, then it would be to extend their life by desalting wastewater dischargers upstream.

Part of the problem lies in the fact that costs and benefits are jurisdictionally separated. The holistic regional perspective exists only as a theoretical abstraction. Ratepayers upstream do not directly benefit from the cost-avoidance achieved downstream.

Arguing a claim of "economic waste" often carries an underlying assumption about equity. Are all homeowners entitled to have their water heaters last an equally long time regardless of where they choose to live? If not, then what minimal life expectancy are they entitled to expect?

Arguing about "economic waste" also carries underlying assumptions about valuation. For example, if behavior is a surrogate indicator for value, then what conclusions can be drawn when those most adversely affected by pollution elect to endure the degradation rather than pay the costs required to attain higher quality?

Fundamentally, “waste” implies a disequilibrium between cost and benefit. Ideally, every trade between cost and benefit provides a perfect balance. When energy is converted into motion, the transformation is rarely 100% efficient. Losses due to friction are said to be “wasted” because the heat generated has no utility and, hence, no value.

Waste occurs when something distorts the pricing system on a basis other than value given and received. If those who discharged the pollution are required to pay more to improve quality than those who ultimately benefit would be willing to pay for the same improvement, is the difference a “waste?”

If an act of disposal transfers responsibility for remediation in a manner which increases the ultimate expense of clean-up, the marginal difference in cost should be considered a “waste.” And, if the cost of mandatory pollution control technologies exceeds the amount beneficiaries would have expended to receive the same benefit, then that is also a “waste.”

Being able to define, and even quantify, economic waste does not suggest a strategy for regulatory implementation. And, as discussed earlier, one person’s waste is another person’s windfall. The resulting exchange continues to drive the economic engine but the transference fails to produce optimum satisfaction. All of this produces an interesting philosophical discussion about the metaphysics of happiness, but is hardly the basis for more efficient or equitable regulation.

4.0 MACROECONOMICS IN WATER QUALITY REGULATION

4.1 A General Critique of Methods

Macroeconomic studies related to water quality issues often share many of the same general deficiencies. Most often the economic analyses are inaccurately specified. For example, if the relevant regulatory question is whether to impose mandatory treatment obligations, then the economic analysis must evaluate the costs and benefits of the system as it will exist after such requirements are imposed.

Too often, the economic analyst assumes, incorrectly, that there is no adaptive behavior on the part of those affected by the regulation. While it is reasonable to assume that regulated agencies will "comply" with new laws, it is risky to predict how they will comply. If municipalities are prohibited from discharging higher salt concentrations, then they may comply by changing their point of discharge.

Alternatively, municipalities may comply by reducing the salt concentrations in their wastewater. However, in doing so, it may become a "waste" to discard the highly treated product. The discharger may then elect to recycle rather than discharge the wastewater. Water supplies would increase upstream and decrease downstream. In either case, any calculations about the cost-benefits to downstream users must include the possibility that they may not be the beneficiaries of improved water quality. Therefore, econometric analyses comparing upstream treatment costs to downstream treatment costs or tolerance costs may be unduly simplistic.

Another problem with most econometric studies related to water quality is that they fail to account for the non-linear relationship between costs and benefits. For example, when it comes to taste, consumers may be willing to pay more to improve water quality from 600 mg/L to 400 mg/L than they would to go from 800 mg/L to 600 mg/L. The difference can be explained by the fact that consumer acceptance is more a threshold phenomena. If water quality improvements aren't perceived, they aren't valued. If they're not valued, expenditures to provide the improvement are considered a "waste."

Non-linearity can also be observed in less subjective adverse effects. For example, some studies suggest that the greatest reduction in appliance lifetimes occurs in the first 500 mg/L of increasing salt concentrations. Thereafter, higher salt concentrations have a disproportionately smaller effect in retarding appliance life. Most studies seeking to quantify the cost-benefits of salt reductions wrongly assume that a given improvement in salt concentration will produce the same marginal increase in appliance life regardless of the initial and final concentrations.

Because most econometric studies tend to artificially narrow the focus of effects, the costs and benefits incurred outside the "area of interest" are often ignored. So, for example, if a discharger is precluded from recycling water to meet internal demands, they may be forced to import water from elsewhere. While this strategy may assure compliance with the local basin plan, the impacts of relocating water from elsewhere is usually not included in the econometric analysis. This is inconsistent with California's antidegradation policy which requires benefits to be evaluated on a statewide basis.

4.2 Local Case Studies Using Macroeconomic Analyses

There have been several large-scale econometric studies of water quality issues conducted in the Santa Ana River watershed. All of the studies committed many of the errors in specification and logic described above.

In 1990-91, the Santa Ana Watershed Project Authority (SAWPA) commissioned a macroeconomic study of proposed regulations to reduce dissolved solids and nitrogen in local groundwaters. The study was not tasked to determine whether reducing the concentration of pollutants provided a net economic benefit to the residents of the watershed but, rather, to determine which alternatives were most economically efficient.

Estimates of economic costs were based on faulty assumptions of proportionate linear impacts to increasing salt concentrations. Estimates of economic benefits failed to consider adaptive behavior, to minimize or recoup increased treatment costs, by those forced to comply with stricter regulations. And, none of the econometric models made any adjustment for the replacement value of the water carrying the pollutants. No effort was made to validate whether estimated consumer penalty costs correlated with perceived consumer benefits as measured by adoption of cost-avoidance strategies. And, finally, assessment of econometric impacts was confined to the Santa Ana River watershed. The economic and environmental consequences to Northern California, of transferring additional water supplies to Southern California, were not considered.

As noted earlier, the purpose of the first Nitrogen/TDS study (circa 1991) was to identify the most economically efficient approach to assure that groundwater quality met basin plan objectives. That study was never intended to provide an economic rationale for validating or revising the water quality objectives themselves. Many of the omissions of the previous study were not material to the questions raised at the time. But, the macroeconomic approach used in the earlier SAWPA study would not work to determine what constitutes "maximum benefit to the people of California."

In 1992, Risk Sciences submitted an extensive macroeconomic analysis as part of the on-going Use-Attainability Analysis (UAA). That study attempted to find a common denominator for evaluating proposed environmental regulations by examining the second and third-order effects of higher utility rates and lower discretionary income.

While the study was successful in overcoming the perception that small changes in discretionary income had no significant effect on ratepayers, it also proceeded from a false assumption. The UAA economic study failed to adequately account for the recirculation effects described in Section 3.3 above. Nor did it correctly acknowledge that losses within the watershed would be offset by gains in discretionary income elsewhere in the state or nation.

Finally, the UAA econometric study did not consider the many ways in which dischargers might recoup their investment in R.O. by marketing or recycling the product water. The methods described in Volume 5 of the UAA Final Report further demonstrate the futility of trying to use econometric modeling to make policy decisions laden with value judgements.

Recently, Metropolitan Water District completed their own Salinity Management Study. That project used many of the same assumptions that SAWPA relied on in 1990-91:

> *"The salinity model is designed to assess the average annual regional benefits or impacts based on demographic data, water deliveries, TDS concentration, and costs for a typical household, agricultural, industrial and commercial water use. It uses mathematical functions which define the relationship between TDS and items in each affected category, such as the useful life of appliances, specific crop yields, and costs to industrial and commercial customers." [1998, pg. 2-20]*

Many of the mathematical functions were derived from previous studies on the relationship between TDS and consumer penalty costs. The validity of those studies was not independently validated. The relationship was, once again, assumed to be linear and proportionate throughout the range of TDS concentrations observed.

As with SAWPA's first N/TDS study, the MWD study is intended to identify the most cost-efficient method of complying with current water quality objectives in the Basin Plan. It was never intended for the purpose of evaluating the relative value of meeting or not meeting the Basin Plan objectives. And, since the MWD study was designed to help that agency choose among its own salt management strategies, it did not address the question of how other agencies would elect to comply if required to do so by regulatory fiat.

5.0 CONCLUSIONS

Traditional macroeconomic analysis is ill-suited to the task of defining "maximum benefit." The method is severely limited by:

- Inability to quantify all costs and benefits related to a project or regulation.
- Failure to consider costs and benefits beyond the "area of concern."
- Inappropriate assumptions about the distribution of costs or benefits.
- Inability to define a common denominator by which to compare costs/benefits.
- Failure to acknowledge income recirculation and zero-sum effects.
- Inappropriate assumptions about static vs. dynamic behavioral responses.
- Inability to integrate value judgements and social priorities.
- Failure to establish a prior decision criteria or acceptance thresholds.
- Inappropriate assumptions about alternative compliance strategies.
- Inability to evaluate costs and benefits holistically (w/o jurisdictional borders).

No where are the limitations of macroeconomic analysis more evident than in the State Board's attempt to revise and readopt the Inland Surface Waters Plan. The inability of various experts to agree on a standard procedure for estimating and evaluating economic impacts is testimony to the inherent complexity and subjectivity of the issues.

After considerable review, we can find no example where macroeconomic analysis was successfully used to change beneficial use classifications or applicable water quality objectives. That is not to say that economic factors have no influence over regulatory policy. On the contrary, many decisions reflect the obvious concern state and regional regulators have to be "reasonable." But, rarely are economic considerations cited as the formal basis for revising official standards.

It is likely that a priori economic review criteria can not or will not be developed. It may be technically and politically impossible to reduce the valuation process to a rule-based system while maintaining adequate dynamic response to reflect changing conditions or priorities. A different approach for assessing "maximum benefit" is required.

“MAXIMUM BENEFIT” WHITE PAPER

APPENDICIES

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Appendix 1:

Administrative Procedures Update, 1990

Appendix 2:

Rancho Caballero Decision, 1973

(SWRCB Order No. 73-4)

Appendix 3:

Testimony of Richard Bueermann, Exec. Dir., Santa Ana Regional Board In Rancho Caballero Hearing

1972

Appendix 4:

Speech by Ronald B. Robie, Vice-Chairman State Water Resources Control Board

Regarding Rancho Caballero Decisoin

1973

Appendix 5:

Draft Antidegradation Policy for Lahontan Regional Board

1996

Appendix 6:

California Reclamation Policy

(St. Bd Resolution 77-1)

1977

Appendix 7:

Excerpts from Interim Basin Plan For Santa Ana Region

1971

Appendix 8:

Draft Memorandum from St. Bd to Reg. Bd. Regarding 68-16, 73-4 & 77-1

Dec., 1976

Appendix 9:

Memorandum from St. Bd. Exec. Officer To Regional Board Exec. Officers Regarding Rancho Caballero and Reclamation

April, 1978

Appendix 10:

Memorandum for St. Bd. Asst. Counsel
To St. Bd. Chief Counsel
Regarding Calif. Antidegradation Policy

May, 1994

Appendix 11:

Memorandum from St. Bd. Counsel To Cal/EPA Regarding Application of Antidegradation To Landscape and Agricultural Irrigation

April, 1997

Appendix 12:

Memorandum from St. Bd. Counsel
To Santa Ana Regional Board
Regarding Application of 68-16 to Groundwater

March, 1987

Appendix 13:

Memorandum from St. Bd. Counsel To Division of Clean Water Programs Regarding Application of 68-16 to Remediation Projects

February, 1994

Appendix 14:

Excerpts for Code of Federal Regulations

EPA's Antidegradation Policy
(40 CFR 131.12)

Appendix 15:

Excerpts from California Water Code And Code of Federal Regulations