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This study has combined results of engineering, biological and economic investigations as a preliminary step in evaluating the economic consequences of effluent disposal alternatives. Management and governing institutions are investigated to determine institutional forms for future resource administration.

Direct and indirect measures of external effects were obtained from a 16 sector interindustry model of the Yaquina Bay, Oregon study area. The pricing scheme of a nondiscriminating monopolist was also introduced.

Measures of externalities were then introduced into a compensation framework to isolate principally affected sectors. Use maximizing options were considered in the general framework of "second best" theories, with primary emphasis on the sectors involved and the institutional mechanism to be used rather than the designation of a solution. Specific water rights and pollution laws, and forms of

local and state government are discussed with respect to their past, present and future roles in management.

The alternative of the total loss of the fishery will result in the greatest change in gross output (.3%). Eighty-four percent of the income effect (a 2% change) was distributed among the five sectors affected directly by these changes. Therefore, although differences in income levels for each of the disposal alternatives can be measured, they are not highly significant. Nevertheless, these differences may be sufficient to stimulate and justify adjustment in resource use.

For certain alternatives the positive net of cost savings (pulp mill) minus incomes lost (sports fishery) is sufficient to provide for compensatory payments and possible increased purchases of endogenously supplied inputs.

Valuation of direct benefits to the sports fishery for various disposal alternatives by means of a maximizing nondiscriminating monopolist will be counterbalanced by the secondary effects of the decreased angler days associated with the maximizing price and quantity. Both benefit types must be used to maximize their values as policy guides.

Figures net of cost savings and income losses may be used in the compensation framework of welfare theory. If this idealistic viewpoint is not appropriate, the numerical values do reveal sectors affected by use alterations, the magnitude of their involvement and

the degree to which this is the result of either a direct or an indirect interaction.

These results would become policy variables in a statutory framework permitting variable water qualities in a dynamic management framework involving a state supervisory and coordinating agency and some local resource unit. The State Water Resources Board was chosen primarily because of its prior existence, accumulated experience, and appropriate goals.

In light of certain criteria such as cooperative needs, size economies, functional jurisdiction, legal and administrative ability and accessibility and participation, the state level unit (the Board) would be appropriate for the provision and supervision of statistical materials, the coordination of state resource planning, supervision and enforcement of local resource decisions and cooperation with other agencies. The local unit (district or county) would initiate designation of a resource area, request information, perform local decision-making and administrative details and exercise some counterbalancing controls over the activities of the state level unit.

Study results should be evaluated in light of (1) exclusion of water quality effects other than on the sports fishery within the bay, (2) exclusion of opportunity costs associated with ownership uncertainty, (3) inadequate measures of flexibility needs and (4) an appreciation of the costs of making changes in use patterns.

Results suggest the need for (1) some form of a dynamic, multilevel input-output model, (2) knowledge of the pulp mill's investment patterns, (3) measurement of ownership uncertainties, (4) inclusion of activities complementary to the sports fishery, (5) more precise measures of flexibility needs, and (6) further evaluation of local government forms.

Welfare and Institutional Economics as Tools in the Analysis of an Area Water Resource Management Problem

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I. INTRODUCTION

Traditional investigations of the efficiency of resource use have concentrated on the analytical techniques most commonly designated as production economics. Virtually an entire era has been devoted to this work. The percent of this work devoted to production analysis of the many alternative uses of water has also been extensive though not playing a central role in the entire body of empirical work in production economics. The following study is designed to investigate two areas of decision-making in resource allocation, the assimilation of data and the development of empirical techniques, and the incorporation of these measures into a framework of welfare and institutional economics.

The alternative uses of water resources inevitably involve the identification and measurement of variables associated with many scientific disciplines. To obtain a true measure of the economic value of the effects of each alternative use in each of these disciplines, functional relationships between biological, physical and economic variables must be established. These results in terms of economic values must then be inserted into an economic model of the resource area to obtain the total effect of all direct and

indirect endogenous interactions. As an aid in decision-making, sub-sectors within the study area may also be identified, according to the degree of influence experienced for a given resource use alternative.

In addition, the economics of market solutions to water resource allocation problems is complicated by the existence of common resource ownership. Without this problem of commonality individual problems might be solved and solutions indicated which could very well be achieved in the market place provided that the missing or needed information has been supplied. With common ownership however, the provision of additional information, or the introduction of new techniques, is stymied by the fact that individuals are not free to allocate a resource over which they have command, because in fact this command, or ownership, is in common often with many other owners. As there is little likelihood of creating some new form of individual ownership, solutions in the market place are pre-empted by the need for some decision-making organ which will include all common owners.

The attempt to assess alternative forms of decision-making is designated as a venture into institutional economics by this author. The scope shall include the assessment of past, present, and possible future resource management alternatives. In addition to this direct need for an institutional investigation, it is necessary to

examine the legal institution that has arisen in lieu of market transactions as the guideline for the allocation of water resources. This guideline is the present substitute for economic criteria and a possible barrier to the introduction of greater use of economic criteria in the future.

Thus, this shall be a two-step analysis. First, possible forms of resource allocation will be determined which meet some measure of increased efficiency. Then the steps necessary to achieve any proposed re-allocation will be examined in light of the existing institutions. This may lead to suggested modifications in such areas as water law and local government as applied to the administration of water resource allocation.

The Problem

The most efficient use of water resources is a key element in maximizing the economic growth in the state of Oregon. It is only as water has evolved from a relatively free good to its present condition of scarcity that popular concern about efficiency has focused attention upon the alternative uses of water as a factor of production. The use of efficiency measures as choice criteria for water use may be modified in light of institutional considerations resulting from the common ownership of water as defined in the history of water law, as well as additional considerations of pollution law, the

existing forms of local government available to administer the management of water, and the limits to future changes in either water law or local government forms.

The particular problem to be considered in this dissertation involves the estuary of Yaquina Bay, Newport, Oregon. As is typical of many (perhaps all) water use areas in the state, patterns of production use have evolved which are now being subjected to challenge in light of current needs and existing legal rights. Opposing groups exert pressures encouraging different uses and combinations of uses. Groups not directly concerned with the allocation of this water (those in other areas of the state) offer opinions based on some moral or subjective evaluation which may or may not represent the indirect economic effects to which these groups are subjected. The problem therefore is to determine, as closely as is possible with the tools and data presently available, the economic alternatives available should the pertinent decision makers wish to attempt to achieve an economic optimum.[1] In addition, the problem

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[1]It would be appropriate to emphasize two points at this juncture. First, due to conceptual and technical limitations the attempt to achieve the "best" solution normally associated with optimum efficiency criterion will in fact result in the designation of "better" solutions.

Second, this investigation was not initiated for the sole purpose of determining a solution to the specific problem used as an example in this study. Rather, as this problem represents the general form of many conflicts in the management of water resources, it is the intended goal of this study to provide solutions of an equally generalized nature.

may be further expanded, and this is the unique contribution of this study, to include an examination of the problems encountered in assessing the feasible range of corrective steps which might be taken in achieving a more efficient solution, in light of all direct and indirect effects.

The Objectives

With respect to the above description of the problem at hand the following are the objectives for the research described on ensuing pages.

(1) To complete an input-output matrix of dimensions 16×16 which will be used to describe the total and separate sector economic activity of the study area. Additional solutions will be generated, each associated with a different level of pollution, and each indicating the effects on the separate sectors of the area economy. These new solutions will be obtained through the use of engineering, biological and economic data relating effluent concentrations, biomass reductions, and a recreational demand curve.

(2) Examine this array of solutions with the aim of identifying those sectors primarily affected by differing pollution levels and the extent of the relationship with those sectors reacting to water quality changes to some lesser degree.

(3) Indicate those sectors which would undergo the most significant changes in economic activity when proceeding from one solution in the array to succeeding solutions.

(4) Propose alternative forms of compensation schemes as possible means of achieving one or all of the solutions considered, using available welfare criteria as a theoretical basis for compensation.

(5) Identify the most important institutional barriers and/or aids in making the changes suggested by welfare criteria and show how they must either be modified (as barriers) or utilized (as aids).

The Study Area

The area of study centers on Yaquina Bay, formed at the confluence of the Yaquina river at Newport, Oregon (pop. 5, 743) and includes a land area of approximately 220 square miles populated by slightly less than 15, 000 people located primarily in and around the cities of Newport and Toledo in Lincoln county (See figure 1).

The economic geography of the area is associated primarily with lumber and paper products industries, sports fisheries, tourism and recreation. More specifically, upon entering the harbor the first sight would be the marinas and dock-side activity associated with sports and recreation and immediately thereafter dock

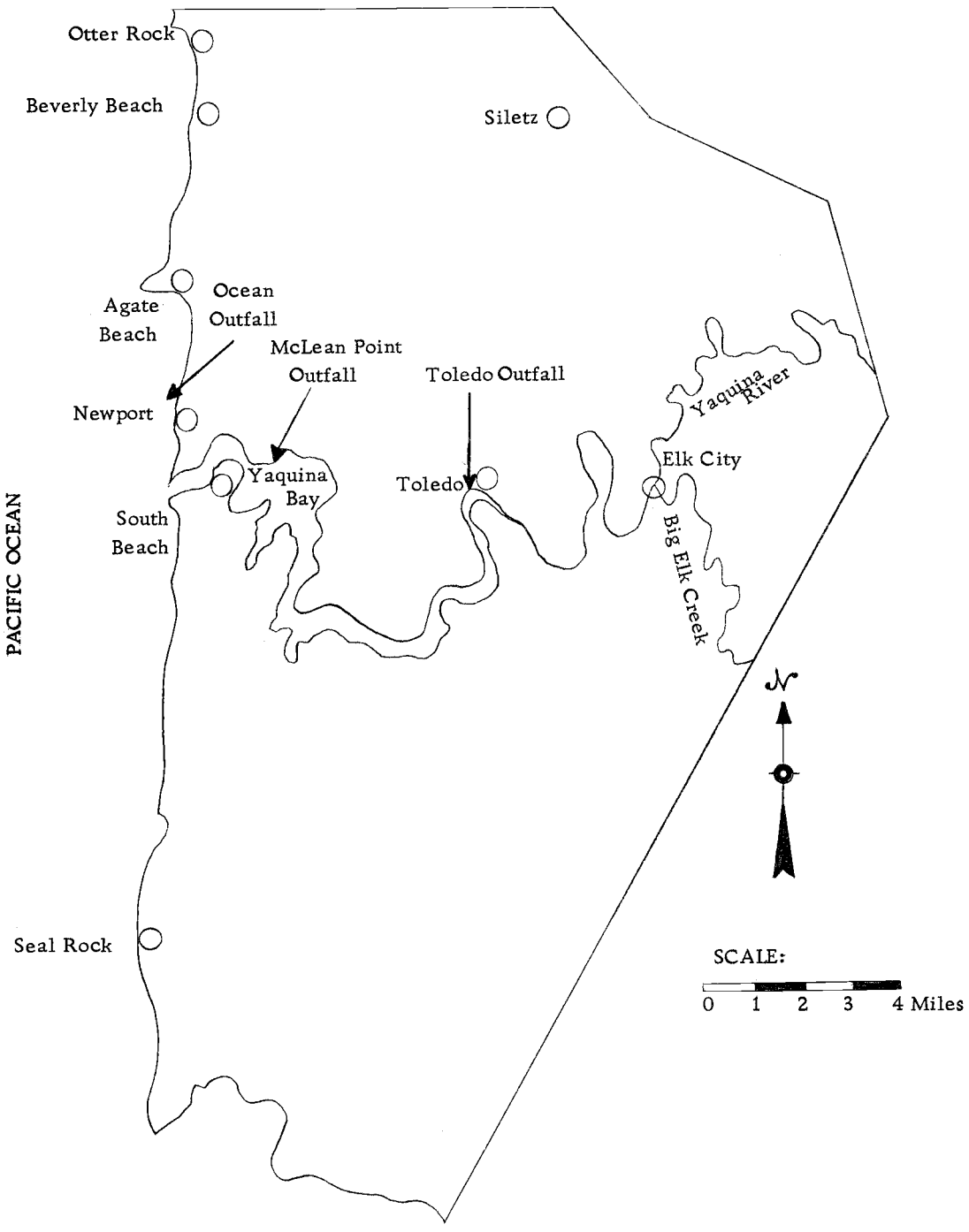
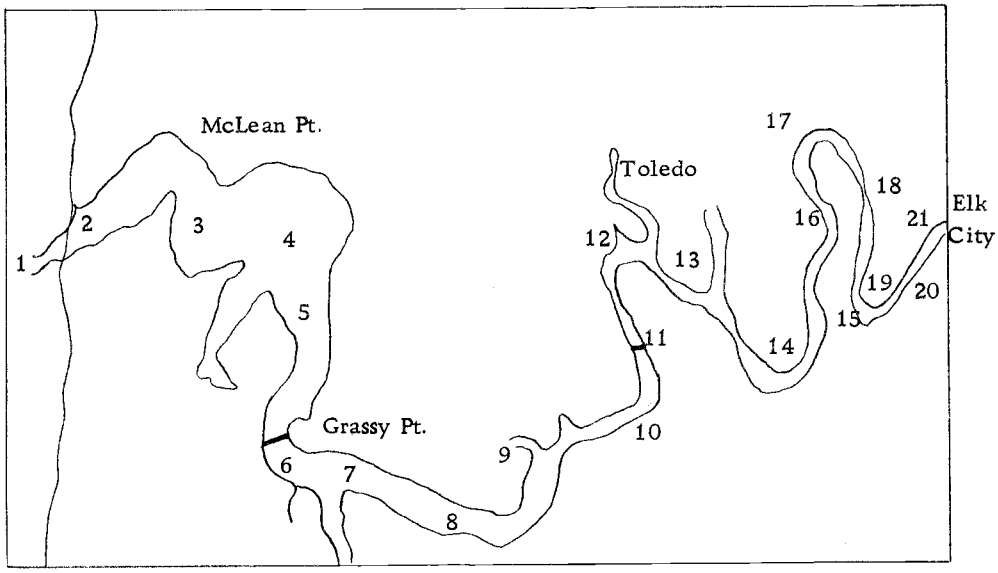


Figure 1. Yaquina Bay area, Lincoln County, Oregon.

facilities for ocean-going lumber transport vessels (figure 2). At appropriate times of the year these areas of the bay, as well as the area between the jetties, will be populated with various sports fishing craft. In addition, both banks of the bay expose productive hard-shell clam beds at low tide. Once beyond the confines of Newport proper, about three miles up the bay and proceeding for six to eight miles, are scattered marinas and some soft-shell clam beds. It would not be unusual to encounter tugs moving barges of finished lumber downstream to docking areas. Just before entering the Toledo area at what is essentially the head of the navigable portion of the estuary (except for small fishing craft) one would encounter heavy floating log traffic and begin to appreciate the magnitude of the pulp and lumber complex that dominates this city of 3,163 population. Beyond Toledo spreads about 15 miles of the Yaquina river and its main tributary, the Big Elk, each stream dwindling to a low-flow diameter of about 15-25 feet and an average depth of four feet at the head of the tide.

In addition to this estuarine geography there are numerous motels and small areas of ocean beach activity north and south on coastal highway 101 from Newport and included in the study area. As a matter of pure economics it is the lumber, pulp and other wood products industries and the liquid and air waste products that result which are in competition with the fisheries and recreation



Zone	Mile Boundaries
I	0- 2
II	2- 6
III	6-11
IV	11-21

Figure 2 Yaquina Bay, Oregon.

and tourism industries as these latter industries depend very much upon clean air and water.

This geographic area has the following favorable characteristics as a study area. First, the area defined represents a reasonably separated labor market related almost totally to the economic activity of either Newport, Toledo or the smaller incorporated and unincorporated towns in the study area. Second, the line of conflict is clearly drawn. It is a case of lumber mills and a pulp-paper factory vs. recreational activities. The problem would be more complicated if there were several polluters distributed along the stream, each disposing of a different type of effluent, as opposed to the actual situation of one basic type of effluent being disposed at one location on the estuary. Third, in a reduced form this conflict is typical of several other instances of conflict in the state of Oregon and in the Nation. Fourth and finally, the area is relatively close to the main campus of Oregon State University and does have facilities for the work of marine biologists associated with the project.

The Procedure

The procedure to be followed is interdisciplinary and as this study is the final study in a series associated with the project virtually all other work associated with the study is or will soon be completed. This involves the Departments of Agricultural

Economics, Fisheries and Wildlife, and Civil Engineering at Oregon State University. The latter two departments do research which is complete in itself as well as providing valuable information for research in the Department of Agricultural Economics. This latter department does not provide data to the other departments, but rather incorporates data from each with its own work to produce final work in the economics of water quality management.

The task faced by the engineers included three facets. First, there was the problem of conceiving the alternatives which might be available for the disposal of effluent in the estuary. Second, it was necessary to measure the cost of each of these alternatives and finally, they needed to obtain the physical measurement of the effects of each of these alternatives on biological water quality variables which were to be used in the investigations of the biologists (39). The alternatives studied were: (1) Pumping all waste five miles into the ocean, (2) Pumping to McLean Point, slightly above Newport, and disposing by dilution at that point, (3) Complete treatment by activated sludge or some comparative method at the plant site. All methods must include treatment for odor and foam control. The alternatives of barging wastes to the ocean and withholding ponds with timed releases of water were considered at an early stage and subsequently dismissed. The barging alternative is essentially the same method as piping. The greater cost, the size and

offensiveness of ground water seepage, as well as odor associated with withholding ponds made this alternative infeasible. This portion of the research has been completed and pertinent data made available to both the biologists and the economists on the project.

Using previous knowledge of the general pattern of estuarine use, biologists participated in the formation of a sampling procedure designed to determine the distribution of use between different species of fish, different locations on the estuary and different times of the day, week, month and year for this particular estuary. The reference point was confined to sports fishermen. Given this disaggregated data it would be possible to determine the effect of effluent disposal on each species, isolating the species pertinent to the sports fishery, by coordinating data on variable stream flow, effluent dilution patterns under each possible method of disposal, the seasonable movements of each species of fish, and the patterns of sports fishing pressure.[2] Data was confined primarily to estimates of fish kill levels. Further information on the effects of effluent on reproduction, growth, flavor and migration patterns would have to be somewhat hypothetical, as these were based on the fish kill levels and secondary information available to the biologists.

Two economic studies associated with the project have been completed. In one of these the demand for fishing was determined

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[2]This latter information was gathered by means of a year long sample survey of sports fishing activity in the study area.

(87). This was accomplished in conjunction with the previously mentioned sample. In addition to general activity patterns of fishermen, data was collected on the total time spent fishing on each trip and at each location. Data were collected on the success of each fisherman, and measures were also obtained of the expenditures made by each individual within the study area. Subsequently indications were obtained of the income level of each individual and the distance traveled to reach the area. With this data it was possible to obtain a functional relationship relating the demand for fishing to fishing success.

In addition to this study a linear programming model has been developed which can be used to compare the various alternatives facing the one large pulp mill as it determines its method of disposing of the effluent generated at its Toledo location (35). By using this model it was possible to determine the most likely method to be used and therefore the resultant pollution levels in the various areas of the Bay. By integrating this information with the previously mentioned engineering and biological data it will be possible to adjust both the success levels for fishing in the bay and the demand for this economic activity. These results were stratified by zone in the bay and by salmon, bottom fish and clam digging activity.

This study shall continue from this point with the inclusion of one additional body of data. This data is the result of a sample

survey of 200 business and households in the Newport-Toledo-Siletz and coastal area. This data pertains to the expenses and revenues of these firms and when expanded to the total number of firms in the study area it represents the bulk of the data included in the input-output model used to delineate the economic activity in the area (Table 1).

The initial input-output matrix will be adjusted by using the information provided by engineering and biological studies to form an array of input-output solutions for the area's economy, each for a different level of pollution. Given these levels of pollution, the next step will be to indicate the changes in the demand for fishing activity which are implicitly a function of these pollution levels.

For each input-output solution there will be different total and different sectoral levels of income generated. The steps made necessary by a management decision to move from the present positions will be detailed. This will involve the following steps and each shall be considered in turn.

First, those sectors (individuals) directly affected by a change from one solution to another will be delineated. This process will be a prelude to the use of compensation schemes as derived from welfare theory as the method of maximizing the net social product as well as the compensated income of all concerned.

Second, it shall be necessary to examine the institutions

Table 1. Interindustry sectors.

Intermediate demand	Final demand
1. Pulp, paper and all other lumber	1. Nonlocal households
2. All other manufacturing	2. Exports and imports
3. Hotel, motel, trailer park	3. Investment and depreciation
4. Cafes and taverns	4. Government
5. Marinas and marine supplies	5. Inventory changes
6. Fisheries	
7. Service stations, auto parts, sales and repair	
8. Communication, transportation, including shipping	
9. Professional services	
10. Banks and loan agencies	
11. Construction	
12. Other product-oriented wholesale and retail	
13. Other service-oriented wholesale and retail	
14. Agriculture	
15. Government	
16. Households	

manifesting an influence on the process of reaching the final stages of a given solution. These institutions may aid the process of change or they may inhibit the process of change. In the latter case it may very well be necessary to propose changes in the nature of the institutions to permit the attainment of a desired solution. Peculiar to a question of water resource allocation are the institutions of water law (rights and pollution) and the structure of state and local government as they participate in water resource management.

Finally, the type of water resource management unit available for each solution in the proposed array will be considered and subsequently, in the light of this investigation, the type of management unit which would be best suited to reaching any or all of the proposed solutions will be suggested.

Hypotheses

As a guide to the implementation of the above-mentioned procedure it is appropriate to conceive of this study as a test of certain hypotheses. The following are to be examined in the remainder of this text.

(1) A range of pollution levels exists which will make a significant difference in the income levels generated in those sectors associated with sports fishing, tourism, and recreation.

(2) A range of pollution levels exists which would lead to

alterations in the production levels of the Georgia-Pacific pulp mill located in the city of Toledo on Yaquina Bay.

(3) The different production levels of the pulp mill will result in significant changes in the income levels generated in those sectors associated with pulp, paper, and lumber production.

(4) As an alternative to present legislation and legal dictation of certain distribution, compensation schemes exist which will lead to whatever solution may be chosen by the appropriate decision making body.

(5) An appropriate organization does not exist which has the necessary powers and authority to implement the desires of those individuals principally affected by the allocation and/or reallocation of water among uses on Yaquina Bay, and it is not possible to design an appropriate unit within the framework of water rights and pollution laws and government organization.

(6) Nevertheless certain water rights, pollution and local government laws and statutes exist as aids to improved water resource management practices.

II. ANALYTICAL CONTEXT: SURVEY OF LITERATURE

The historical separation of the two groups of theorists that I shall refer to as micro, production orientated economists and descriptive, institutional economists is nowhere more apparent than in the approaches to the study of natural resources. This separation is striking in these cases due to the prominence of various mechanisms of an institutional nature which exist as substitutes or complements to the market's process - the core of micro-economic analysis.

In the study of the water resource, although much remains to be done, there has been a significant body of work designed to determine production coefficients and value products for water in alternative uses. Also, some descriptive analysis of some general, rather all-pervasive institutional characteristics of water resource management has been presented. However, there is a need for more guides to decision making in a specific framework of market principles in combination with particular institutional limitations.

It is at this point that this study begins. It will be familiar in that the relations in the market-place will be examined to determine the pattern of resource use and those affected. In addition some descriptive characterization of the institutional aspects of the problem are inevitable. From this point on however, the procedure

will be unique, and the key to this singularity will be the attempt to relate institutional economics and welfare economics; or more specifically the externalities in existence and the economic and institutional procedures necessary to compensate for the externalities present while striving toward the goal of a maximum net social value product[3] as distinct from a maximum net private value product.

The literature to be summarized immediately below provides the background for this analysis. The welfare theory is that associated with the issues of externalities, compensation, and second best theories. Only that body of theory relevant to the establishment of an environment conducive to achieving "better" solutions is included. Those arguments leading to eventual paralysis in the attempts to achieve maximum of "best" social welfare solutions are considered far too binding for the decision making, policy problems at hand. These optimum criteria would also be incompatible with the non-optimizing input-output techniques used in this study.

The institutional "variables" are those incorporated in the water rights and pollution law and local government statutes. These

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[3] Net Social Value Product is the monetary gain or loss to society (the limits to the society in this case being the study area) resulting from a shift in an input (water) from one use to another. Net private value product is the monetary gain or loss to an individual resulting from a change in the use of an input (water).

shall be examined in light of the specific study area at hand, although some generality must be retained in the hope of providing a resource management framework which will be useful for other areas within the state.

Welfare Theory

Externalities

In the context of this study externalities may be defined in the following manner.[4] Assume we have the function --

$$Q^a = Q^a(X_1, X_2, \text{-----}X_m, Y_1)$$

where

Q^a = the product of A, the sports fishery

$X_1, X_2, \text{-----}X_m$ = activities under the control of the sports fishery sector

Y_1 = effluent activity under B's control, the pulp mill's effluent

It is crucial to appreciate the fact that "activity" in this case is defined as any distinguishable human action that can be measured. A significant element of the ensuing examination will be the

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[4] This discussion parallels that found in (21).

measurement of the pollution externality in terms of specific sector social value product changes with and without certain pollution levels. Another important distinction concerns marginal externality, which is defined as--

$$Q^a_{Y_1} = \frac{\partial Q^a}{\partial Y_1} \neq 0$$

$Q^a_{Y_1} > 0$ implies a marginal external economy

$Q^a_{Y_1} < 0$ implies a marginal external diseconomy

Of additional value, in terms of measurement of externalities, is the existence of infra-marginal economies, which exist in the case of

$$Q^a_{Y_1} = 0$$

but where

$Q^a_{Y_1} + \int_0^{Y_1} Q^a_{Y_1} \, d_{Y_1} > 0$ implies an infra-marginal external economy

$Q^a_{Y_1} + \int_0^{Y_1} Q^a_{Y_1} \, d_{Y_1} < 0$ implies an infra-marginal external diseconomy

This is to say that, while incremental changes in Y_1, the effluent produced and disposed by B, have no effect on A's (value) product, the total effect of all Y_1 does in fact have an effect on Q^a, the output

of the sport fishery. This particular concept does help to emphasize an additional unique aspect of this study. Until recently the measure of the externality between effluent disposal and fisheries or other recreational use of a common water has been confined to the infra-marginal effects, or at least to rather large incremental changes. Due to studies immediately preceding this one the incremental relationship between effluent disposal and productivity of the sports fishery has been more accurately specified (39, 79, 93).

The reason for this desire to specify the nature of the externality in question is an attempt to discern those externalities which are relevant, those that may be isolated and measured. Another criterion of relevance is whether the individual(s) initiating the externality is empowered to make decisions and take action, e.g., Y_1, which is under the control of B.

Further, a potentially relevant externality exists when the activity performed generates the desire of the affected party (A) to modify behavior of the party B, the party initiating the externality.

Nevertheless, the existence of this marginal, potentially relevant externality at Yaquina Bay does not automatically imply the ability to act upon the desire to modify this externality. As will be pointed out subsequently, institutional arrangements have been devised to implement this desire, these arrangements being the next best alternative to a solution generated in a free market. Now, in

returning to possible economic solutions, some consideration must also be given to these substitute institutional arrangements for the alleviation or modification of the externality.

A further refinement, and one which is consistent with Welfare economics, is the designation of a Pareto-relevant externality, e.g., the activity in question may be modified so that the externally affected party A (fisheries), can be made better off without the acting party B (polluter) being made worse off. Such actions would be the logical consequence of declaring an activity as being potentially relevant. Nevertheless, marginal, potentially relevant externalities may continue to exist in a condition of Paretian equilibrium, as only Paretian relevant externalities may be truly internalized or compensated in a free market, aside from the possibility of merger (28). Thus, to solve the problem of pollution externalities on Yaquina Bay, the solution must improve the situation of the sports fishery and recreation sectors without decreasing the position of the pulp mill if this is to be considered a movement toward a Paretian equilibrium. Divorced from pure economics however, this does not mean that a solution contrary to these Paretian criterion might not still be desirable to the decision-makers involved and attainable under certain conditions.

Additional terminology to be used in this study involves the variously defined dichotomy between technical and pecuniary externalities. The core of this debate concerns the degree to which

interactions incorporated in the price mechanism may be properly associated with an identifiable externality. Bator explicitly defines an externality as a direct interaction outside the price mechanism (10, p. 358). This would be technical by definition. Mishan, however, assigns all interdependencies related through the market as well as those which do not pass through the market to the category of technological external economies. He simply attributes all factors directly or indirectly related to some technological relationship as being technological externalities (67). Though undeniably true in one sense, this definition is hardly of any value. He purports to be amplifying Scitovsky's attempt (87) to eliminate the necessity for the separate designation of pecuniary externalities. While this is an improvement on Meade's initial attempt to associate pecuniary externalities with some mysterious "atmosphere," (60) the analytics of this study dictate the necessity of differentiating between the technical relationship of the physical interaction and the market relationship reverberating through the price mechanism. All too often dismissing pecuniary relationships as a simple function of traditional market behavior ignores important elements of the evaluation problem in resource management.

In this study a pulp mill may pollute a body of water by disposing of generated kraft effluent. From the viewpoint of the sports fishermen using these waters the deteriorating water quality is a

technical relationship beyond their control. However, in terms of the values involved in maximizing the local social product, the market corrections associated with fisherman reaction to the polluted water, as reflected in associated economic sectors such as marinas, tackle shops, cafes, etc., may very well be of importance. To distinguish these interactions from the many other occurrences of the local pricing mechanism, these extensions of the original technical externality shall be hereafter referred to as pecuniary externalities.

Compensation

As an alternative to attempts to internalize externalities leading to sub-optimal use of certain fixed resources in production, the principle of compensation has progressed very little from its initial conception. The original statements were concerned primarily with the pros and cons of interpersonal comparisons.

Harrod proposed that for the purposes of useful theorizing economists should make an attempt to separate their theory into two parts; the theory of value and distribution, and the rule that productive resources should be distributed so as to yield equal marginal social net product (41, p. 387). The latter portion should involve scientific calculation while the former may involve introspection; but this is not necessarily bad and should not be avoided, especially where the choice seems to be obvious. He opposes those who state--

"---that a given interference will lead to certain consequences X, Y, Z, ...and then remain silent, leaving his (the economist's) client to decide whether X, Y, Z is a state of affairs which he wishes to bring about (41, p. 390). The problem of interpersonal comparisons is not a part of that portion of economics concerning scientific precision (production vs. distribution and value). We should not hesitate to make interpersonal comparisons when it would be foolhardy to ignore the obvious. "This implies that we cannot in fact decide whether two pence have more utility to a millionaire or to a beggar. Yet we may have a shrewd suspicion" (41, p. 395). Robbins differs from Harrod in that he insists that some attempt be made to "---better realize the exact connection between the normative and the positive, and that their (economist's) practice as political philosophers might be made thereby more self-conscious" (82, p. 640). Certain necessary normative evaluations must always be specified as coming from outside the realm of economics.

What followed immediately was an adaptation of the Harrod position to a specific criterion which could be used as a guideline for compensation.

> In all cases, therefore, where a certain policy leads to an increase in physical productivity, and thus of aggregate real income, the economist's case for the policy is quite unaffected by the question of comparability of individual satisfactions; since in all cases it is possible to make everybody better off than before, or at any rate to make some people better off without making

> anybody worse off. ----it is sufficient for him (the economist) to show that if all those who suffer as a result are fully compensated for their loss, the rest of the community will still be better off than before. (52, p. 550).

Here Kaldor is concerned only with the questions of efficiency of production. He shares the belief with Robbins that questions of distribution must come from outside economics. The decision on whether or not to actually perform the implied compensation was a political one and the economist was only one of many who could voice an opinion.

Hicks grasped the concept of discussing the welfare aspects of maximizing efficiency divorced from considerations of value and distribution. He adds the acknowledgment that there are several "optimum" solutions, one for each possible distribution of social wealth (74, p. 701, 708). Hicks supplies suggestions for improving the working of compensation itself. First, compensation for a product no longer produced involves compensating the consumer for lost opportunities to consume this product and compensating the producer for differences in income earned from the new versus the old product. Second, the source of compensation funds will be different in a competitive as opposed to an imperfect environment. Third, we should be sure that a recommendation will result in the inputs being put to a more productive use. These questions of efficiency must be separated from questions of distribution if they are

to have a fair chance of being evaluated (44, p. 712).

This leads to the Kaldor-Hicks criterion--a criterion based solely on measures of economic efficiency as raison d'être for compensation. However, in 1941 Scitovsky revealed the inherent possibility of solutions showing a position to be simultaneously superior and inferior to another position.

The most comprehensible discussion of the implications of the Scitovsky criterion are given by Mishan (64). This reversal test examined compensated solutions to determine if they are uniquely superior. Consider the case of two individuals, A and B, and the distribution of goods x and y. Different combinations and the preference ranking for A and B are presented below.

A		B		Rank
x	y	x	y	
2	8	18	12	iv
5	5	15	15	iii
8	12	12	8	ii
10	10	10	10	i

The preference rankings for B are as given. For A, 8X, 12y is preferred to 10x, 10y and 2x, 8y is preferred to 5x, 5y. In comparing welfare distribution (iii) with (i) it is possible to show by compensation that (iii) is preferable to (i). First, (iii) is attained in the following manner.

A	
10x	10y
-5	-5
5x	5y

B	
10x	10y
5	5
15x	15y

To demonstrate superiority of this change, B may compensate A in the following manner:

A	
5x	5y
3	7
8x	12y

B	
15x	15y
-3	-7
12x	8y

As 8x, 12y is preferred to 10x, 10y by A and 12x, 8y is preferred to 10x, 10y by B, (iii) is preferred to (i).

But, as shown below, (iv), which is preferred to (iii), can be obtained from (i).

A	
10x	106
-8	-2
2x	8y

B	
10x	10y
8	2
18x	12y

Therefore, (i) is superior to (iii), which is contradictory to the above conclusion that (iii) is preferred to (i).

Hence, basing our comparison on the (i)-distribution of welfare between A and B, (iii) can be shown to be superior to (i). While, basing our comparison on the (iii) distribution of welfare, (i) can be shown to be superior to (iii) (64, p. 314). As 4 is superior to 3 this implies that 1 is superior to 3, a contradiction to the Kaldor-Hicks criterion.

Scitovsky has proposed his criterion as a supplement in determining an indisputable compensation scheme. His reversal test is

theoretically correct, but as Mishan points out, in an actual test to determine a solution absolutely without contradiction it would be necessary to consider an infinite number of possible interactions. Therefore absolute adherence to the reversal test is essentially beyond reach. Therefore, it is necessary to restrict comparisons to those alternatives which fall on the contract curve.

With very little debate these men have agreed to (at least) attempt to divorce questions of value and distribution from those of efficiency. Even if we accept their initial attempts as being somewhat successful, these attempts have natural limits. Despite all attempts, valuations, distribution and efficiency must always remain interdependent. These authors did not fully appreciate the true extent of interpersonal comparisons.

A criterion which has led to considerable controversy is the proposal of I. M. D. Little (57, p. 227). It is his belief that value judgments and emotive language are unavoidable in welfare economics and therefore it is necessary (and possible) to include these in the theory, indeed as an explicit part of any proposed welfare criterion. In particular he is concerned that the type of compensation suggested by the Kaldor-Hicks criterion would most normally be rejected if the value judgments contained therein were made explicit. Three essential points should be mentioned. First, he implies that some income inequality would be a good thing; second, he includes the

Scitovsky reversal criterion, and third, he believes in the possibility, interpersonal comparisons and cardinal measures of utility notwithstanding, of making relative comparisons between different welfare distributions. Thus, not only is he comparing two positions in the light of the Kaldor-Hicks and Scitovsky criterion, but he is also asking the question: "Which of these two has the 'best' distribution of goods, income, etc.?" Therefore, the first two elements of this composite criterion may not be satisfied, but a change may still be made based upon a ranking of the welfare distribution in each case. As this case becomes a decision based solely on a value judgment, and is therefore repugnant to even the most liberal minded, Little is forced to consider alternatives under the arbitrary assumption that purely distributional changes are not possible. Without this assumption there is a certain no-man's-land of indecision with respect to a choice between bundles of goods where the natural tendency is to move to an ideal distribution of this given bundle.

Despite these potential sources of error in decision-making, Little's criterion is an attempt at solving a specific weakness in all welfare criteria, the attainment of sufficient conditions. The Kaldor-Hicks and the Scitovsky criterion provide a means to be assured that the necessary conditions for welfare maximization may be met. But, as has been pointed out, even with the fulfillment of both of these criterion this would not be <u>sufficient</u> to guarantee that

the change being considered would increase efficiency and improve distribution. As an extreme case the example of the beggar and the millionaire should be sufficient to show that an evaluation of the changing welfare distribution involving these two men will certainly be sufficient to dispel any remaining fears of contradictions between the ranking of two alternative solutions according to the Kaldor-Hicks and Scitovzky criterion.

Additional literature amplifies these issues, as well as considering the problems of administering a compensation framework and the necessity of including the costs of this administration in any determination of the advisability of a compensation scheme. A pertinent issue is the debate concerning bribes and charges, their similarities and differences. The possibility of different output levels under each is suggested (53), and should be examined in an empirical framework. This issue of who should charge who is resolved in this study by examining the institutional pattern of resource management to determine the source of responsibility in lieu of a compensation plan.[5]

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[5] In the example of the upstream polluter and the downstream user the issue of whether the polluter should pay the user to allow pollution or whether the user should pay the polluter to defray pollution may be resolved by consulting existing laws to determine which of these alternatives may be permissible i. e., pollution in combination with compensatory payments.

Discussions on Land Tenure

Discussions of the problems of commonality and the absence of true property ownership, and the resultant absence of resource control sufficient to lead to the optimum allocation of resources according to the classic price mechanism, bear some resemblance to a traditional problem discussed in the literature on farm tenure systems. In both cases the entrepreneur-operator is hampered in his decision-making practices by the lack of complete control over a key input in his production process. In the case of the farm operator this input is land and associated semi-durable inputs and in the case of both the pulp and paper manufacturer and the sports fishery firm it is water. This similarity in the problem suggest that there may be some complementarity in the suggested solutions to these problems. A brief examination of this possibility follows.

Leasing arrangements represent a venerable institution in farm management. As institutions, they have been subjected to only gradual change in agricultural history, in contrast to the rapid technological changes, especially of recent years. Examples can be found where a given arrangement has remained substantially unchanged through generations, while technological changes have led to considerable alteration in the distribution of the relative share of land, labor and capital in the input mix. To be able to adapt to these

technical changes the tenant should be able to make the same managerial decisions available to the owner-operator. It has been observed that this is not the case and the result is a greater prevalence of sub-optimal, lower income farmers among the tenant farmer group.[6] The answer can be found in both the tenants inability and hesitancy to involve increasing inputs of the capital and semi-durable inputs in the factor combinations used. (See Figure 3.)

In the general case applicable to all forms of leasing arrangements, it has been hypothesized that insecurity resulting from the lease has been a prime cause of misallocation (85). Without the guaranteed protection of semi-durable and durable investments that would exist from ownership or long-term leases the tenant is hesitant to make these necessary investments and tends to allocate inputs in a sub-optimal manner. Long term leases are not forthcoming, however, due to their tendency to leave the landlord vulnerable to sub-optimal practices by the tenant, with the landlord not being free to exercise the option of seeking another tenant with higher entrepreneurial qualifications.

The solution of longer leases being therefore somewhat unattainable, the next possible solution to be suggested is a form of compensation. The working mechanism would involve the

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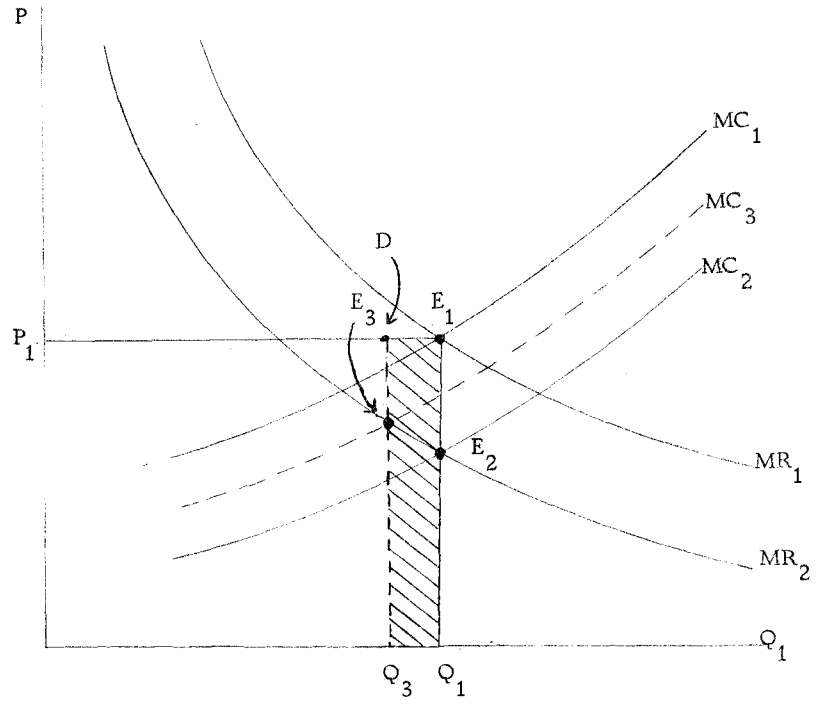
[6]The general background for this discussion is (42, 85, 86).



MR_1 = marginal revenue associated with the existing production function for owner-operators.

MR_2 = marginal revenue used as decision guide for the tenant with cash-share lease.

MC_1 = marginal cost to the owner-operator.

MC_2 = marginal cost to the tenant. The difference between MC_1 and MC_2 being that portion of the cost accruing to the landlord.

E_1 = equilibrium solution for the owner-operator.

E_2 = equilibrium solution for the tenant. E_1 and E_2 will result in the same output, Q_1 when the leasing arrangement is ideally designed so that the marginal costs assumed by the landlord are exactly equal to his incremental return for each level of production and the leasing arrangement is such that the uncertainty to the tenant is identical to that of the owner-operator and he will therefore follow the same decision-making pattern.

MC_3 = marginal cost to the tenant subjected to additional uncertainties due to the nature of the leasing arrangement.

E_3 = the new equilibrium for this tenant.

Q_3 = the new output at E_3.

$Q_3Q_1E_1D$ = the net value product lost due to the increased uncertainty.

Figure 3. Production levels with the added uncertainties of tenure arrangements.

establishment of an improvement compensation fund (86, p. 465) to be used to compensate tenants for the remaining discounted value of improvements they have made which contributed toward the production process, in the event that their lease should not be renewed before the termination of the productive life of these improvements. In this manner the tenant is supposed to combine resources in a more productive manner, leading to a greater social product, and a distribution of this output more in line with market demand.

These suggestions have not been adopted to any noticeable extent, assumably because of some of the unmentioned problems associated with the administration of this proposed scheme, in addition to one theoretical problem. The concept of the compensation fund itself is undeveloped. It is necessary to generate answers to the questions: Where will the compensation funds come from? Who will administer the fund? Who will determine the array of rather sophisticated values to be used in the operation of the fund? And finally, will the value of the compensatory payments necessarily increase net social output if they are exactly equal to the value of the remaining productivity of the resource investments made by the tenants?

To treat these issues in reverse order, it appears that the arguments presented by Schickele (85, 86) though pathbreaking at the time of their writing, would now benefit considerably from the further developments in welfare theory.

The compensation scheme proposed by Schnickele is incomplete in several aspects. First, the mere existence of unexpired resources at the termination of a lease is not sufficient to justify compensation in the name of increased net social product. As in every proposed compensation arrangement, some attempt must be made to determine if the increased production resulting from the assurance of compensation is greater than the compensatory payments made. Only in this manner can there actually be an increase in social product as compared to the results derived from a non-compensatory environment. In addition, in at least certain types of rental arrangements the landlord will also benefit from the increased productivity. It would be valid to consider some form of compensation mechanism in which he also plays a part commensurate with the benefits he derives from the increased productivity. In fact, there might also be some mechanism to compensate the landlord for losses he has incurred in an abortive attempt to increase productivity through increased investment in capital inputs to complement the tenant's contributions. All these factors would have to be considered to make this compensation proposal theoretically more acceptable.

The original motivation behind these investigations of the lower level productivity issues was to increase food production during W. W. II. The County War Boards were suggested as a possible administrative body at that time (86, p. 456). Which group would be appropriate

at this moment is not relevant, although it would certainly need information similar to the intended results of this study.

The similarities between this study and the above tenure problem areas follows: First, the uncertainties of the tenant with respect to capital investments and the uncertainties of the water resource user with respect to the enforcement of pollution and rights laws are somewhat similar. One may at least hypothesize that in the latter case continued review of previous interpretations of water rights and pollution laws creates an atmosphere of uncertainty which may modify resource allocation in some sub-optimal fashion. This is in addition to the actual dictates of these interpretations. The problem for both the tenant and the water resource user is one of the absence of the decision-making power that comes through ownership.

It would be important to indicate that this uncertainty is not confined to the firms directly associated with the sports fishery, but also to the pulp mill in the study area, as resource management decisions of an unfavorable nature could be imposed upon each sector of the economy, and also magnified through related sectors.

Second, as the concept of compensation has already been introduced into the water resource management problem, it is appropriate to consider further modifications. In addition to the earlier discussion of the potentital benefits that could arise from readjusting decisions accompanied by compensation, it is now

necessary is also consider further compensation based on the desire to improve productivity after a decision has been initiated. This could be attained by reducing uncertainties associated with the anticipation of further changes and compensating for investment losses in the event of continued short run changes in resource decisions.

Although the feasibility of this inclusion will be discussed at further length on succeeding pages, it would seem appropriate to make one observation here. Decision-making in any production process must always involve certain degrees of uncertainty, especially in an atmosphere of imperfect markets. Even resource owners are faced with the possibility that capital investments may prove out-dated and need revision before the particular capital item has run its normal physically productive life. With this in mind it seems possible that attempts to measure and compensate for uncertainty associated with imperfections might also include some uncertainty normally encountered in all forms of ownership. While this might be commendable in that it could possibly increase the social product; it would be inaccurate to include these two forms of uncertainty under the single label of uncertainty due to unique ownership problems. This study will be confined to the unique problems of water resource management and not the general problem of uncertainty.

Second Best Theories

Aside from the problem of interpersonal comparisons in the structuring of a compensation framework, an additional problem in the management of resources arises in that the attainment of an optimum solution is contingent upon the existence of perfect input and product markets, the Paretian assumptions. The institutions to be considered in this study constitute violations of these assumptions, and therefore any optimum must be achieved in light of these violations. The limited literature on this subject has been concerned primarily with second best theories.

The theory of second best arose out of the difficulty of either discovering situations where all the assumptions of Paretian optimality could be met and/or where it was unpallitable to assume away these imprefections. The next logical steps were either to attempt to formulate a maximizing framework which would work when there were many exceptions to the Paretian conditions or to seek out situations where there were only a few violations of these conditions. There are only two comprehensive treatments of these problems; a mathematical treatment by Lipsey and Lancaster (58) and a non-mathematical discussion by Mishan (66).

Two statements usually associated with second best theory may be found in Lipsey and Lancaster (58, p. 11-12).

> The general theorem for the second best optimum states that if there is introduced into a general equilibrium system a constraint which prevents the attainment of one of the Paretian conditions, then an optimum situation can be achieved only by departing from all the other Paretian conditions.
>
> There is no a priori way to judge as between various situations in which some of the Paretian optimum conditions are fulfilled while others are not. Specifically, it is not true that a situation in which more, but not all, of the optimum conditions are fulfilled is necessarily, or is even likely to be, superior to a situation in which fewer are fulfilled.

Therefore, the removal of any one constraint may affect welfare or efficiency either by raising it, by lowering it, or by leaving it unchanged; and nothing can be said about the direction or the magnitude of the secondary departures from the optimum conditions. Mathematically, the theory of the second best involves adding at least one additional constraint to those associated with the Paretian optimum. This additional constraint prevents the attainment of at least one of the Paretian optimum conditions.

The preceding statement should indicate the futility of "piecemeal economic planning" at least in the sense of trying to achieve a truly optimum solution. An example is the case for trade unions. If there is one country which is definitely not following free trade and other countries have the choice of following free trade or forming a customs union, the choice of following the principles of free trade will not necessarily maximize world trade given the

additional constraint of the one country. Trade would possibly be maximized by forming a customs union which operated in consideration of this constraint.

Given these problems, Lipsey and Lancaster have formulated a mathematical model, which is intended to verify the existence of the solution to a generalized second best optimum. Their success is limited in that first order conditions become increasingly complicated as a greater number of constraints are added (an infinite number for a general solution) and as these these take the form of second order derivatives it is virtually impossible to interpret them. As this model is unable to develop truly general conditions for the determination of a second best optimum it deals what appears to be a severe blow to those hoping that some second best form of optimizing can replace what seems to be the shattered status of first best solutions.

There was little challenge to this analysis of second best solutions for some five years until Mishan, in the process of trying to regain some of the lost stature of all welfare theories, re-analyzed this concept in a non-mathematical, pragmatic light. To him second best theories merely involved a few additional constraints on the mathematical manipulation. He feels that such convincing proofs of the usefulness of second-best theories are only for those convinced of the uselessness of first-best theories. He does not feel

particularly inhibited in either case.

> Thus, in so far as the individual is correctly apprised of all constraints, budget and otherwise, he must be deemed to attain a correct maximum solution - whether first- or second-best - in virtue of the maximizing assumption. Even though it exceeds our mathematical ability to derive the specific conditions necessary for this maximum, they are implicitly realized: for whatever the individual's choice is, it has to be accepted as the best solution in the circumstances facing him. (66, p. 209).

Mishan expresses the belief that it is useful to view the individual who, no matter how many constraints may be imposed, will reach a solution that he considers optimum, although mathematically it is virtually impossible to determine the nature of this optimum. We can choose to be guided by the mathematical impossibility of determining the nature of the second-best optimum and ignore the solution reached by this individual, or we can observe the solutions actually reached by this individual and designate this as the optimum under the constraints. As an example he considers the labor market. As it is not feasible to allow each worker to work the number of hours that he desires we introduce the constraint that each worker must work the same number of hours at a given job. If this is the only constraint then the individual reallocates his resources subject to the usual marginal conditions and a second best optimum is reached, which will in this case be better than the first best optimum allowing for variable hours. One should not avoid acknowledging such a

direct solution merely because the mathematical determinants of such a solution cannot be found.

In addition, there is also the case where in the process of top level planning a choice must be made between maximizing all sectors possible or abandoning this approach because all sectors are not subject to Paretian optimality and therefore following a course of general optimization would be false logic. Mishan points out that there may be many cases where those sectors (where we cannot equate marginal products) will be only a small portion of the market and therefore the optimizing solution in the controllable sectors will not lead to a significantly different solution by ignoring these sectors subject to additional constraints. If this is not the case then one must certainly proceed with additional caution.

> For one thing, it would seem very reasonable to believe that (i) the smaller are the constrained sectors relative to the remaining ones, and (ii) the larger are the initial discrepancies in price-marginal cost ratios of the free sectors as compared with the constrained sectors, the surer we are to improve matters by optimizing in the free sectors alone than by standing by and sadly sucking our thumbs under the sign of the second best (66, p. 214).

This is what he refers to as a third best solution. In addition

> If second-best theory has a positive contribution to make it is that of serving notice that, in the presence of constraints, slap-dash optimizing, wherever one can, may not improve matters: one has, in that case, to proceed cautiously - which is rather different to not proceeding at all (66, p. 216).

He is essentially interested in coming as close as possible to an

ideal welfare position which is neither completely attainable nor practicable.

There is very little in second-best theory of the sort proposed by Lipsey and Lancaster which will contribute to increased technical precision in this study of the economics of water quality. However, in the general framework proposed by Mishan, alternative selections in a constrained environment may be assessed in terms of relative optimum characteristics. Just as Mishan observes that solutions are in fact generated in actual constrained economic environments, it is also possible to ascertain the solution attained in this study area in the presence of certain institutional constraints. In addition, it should be possible to determine adjustments in these constrained solutions upon modification of any or all of these constraints, while continually heeding his admonition not to forget that these solutions are always second best. In addition, this study will not proceed beyond the specification of these alternative solutions to a ranking of these second best solutions. Rather, this study will terminate with an indication of institutional adjustments needed for the attainment of each alternative, the methods for the continued generation of pertinent information, and some suggestions of possible forms for a decision-making organ.

Legal Considerations

Water Rights

In the Yaquina Bay Estuary the ownership of a distinct portion of this water is denied to individuals because water cannot be portioned out to individuals in any absolute sense. Those who use the water of the estuary, as well as those who benefit from the environment created around its outfall, have certain rights which exist as a lower limit to their use of the water. Beyond this, individual rights are merged into a common right to use the water. As a result of this rather unique form of "ownership" the "normal" process of resource allocation is inhibited. External effects become the rule rather than the exception and investment decisions lead to less than optimum resource allocation.

The minimum rights existing in the absence of ownership take the form of legal rights. These rights must also substitute for ownership in the economic decision-making process. Being subject to the interpretation of the courts these legal property rights are at best secure only in the short run. Incorporating the long run uncertainty leads to a prohibitive outlook towards these investments in water related economic activities.

As the administration of common water resources has been

largely legal, there has arisen an imposing body of water law indicating the manner in which all forms of water allocation decisions have been reached. It is somewhat paradoxical that whereas in the above instance we considered the problem of uncertainty and changeability of the forms of ownership as these characteristics affected resource decisions, we now are faced with the opposite problem, the rigidity of resource allocation and the barriers to change erected by the legal institution.

Therefore, to consider the possibility of changing, or suggesting changes in the use of the water resource in the Yaquina estuary, some consideration must be given either to changes in ownership rights which might diminish the necessity of legal administration and/or to changes in the established law which will allow for greater flexibility in decision-making. In addition to considering these questions, the degree to which these problems may be solved in a decentralized as opposed to a centralized environment must also be measured.

This discussion may be introduced by Professor Trelease's credo.

> -----water law should provide for maximum benefits from the use of the resource, and this end should be reached by means of granting private property rights in water, secure enough to encourage development and flexible enough for economic forces to change them to better uses, and subject to public regulation only when private economic action does not protect the public interest (91, p. 2).

Water rights of surface waters are categorized by two basic types, riparian and appropriative. Under the riparian doctrine the owner of land bordering a stream obtains ownership rights to the land and rights to the use of the stream, which should continue to flow through or adjacent to this land undiminished in quantity and quality, except that each upper and lower riparian may devote this resource to some reasonable use, though not to diminish another's reasonable use. Water may be diverted from the original riparian location if it is returned and available in undiminished form to lower riparians. The measure of damages is subject to the interpretation of a particular case.[7]

Under the doctrine of prior appropriation water was considered as public property but, in the same sense as western lands were considered property, this water became the sole property of the first individual to make beneficial use of the water. Priority was thus a function of time, the first person appropriating a given source for a lasting beneficial purpose being the one with the superior right. Appropriative rights cannot exist without actual diversion from the stream. Determination of beneficial use has evolved from the original belief that this depended on the merits of a particular case to the present tendency to rank certain uses. In most cases the transfer

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[7]For references to the development of this definition see: 3, 5, 7, 21, 23, 48, 50, 56, 109.

of rights involves the transfer of land appurtenant to the water. Failure to use water in the prescribed manner may lead to the loss of the right.

The enactment of a state water code in 1909 in Oregon marks a demarcation point between distinct periods in Oregon water right history. Of the above-described characteristics of Riparian doctrine the following were developed prior to this date: (a) the idea of continuous flow subject to use first for domestic purposes and then for irrigation (95, 17, 109); (b) rights obtained through ownership of adjacent land (23, 48); (c) rights do not take the form of ownership of water (50).

In the eastern United States riparian doctrine established a firm foothold in basic common law form. Despite the overwhelming changes in the population density of eastern regions and the rapidly increasing demand for water in a multitude of uses, the basic elements of this riparian doctrine have remained. The qualification of riparian doctrine which states that domestic uses shall have first priority, combined with the fact that eastern regions of the United States have very little irrigation of agricultural land (80) leave a situation where riparian rights are satisfactory and essentially unchallenged. Further west, land owners desiring water (which is scarce) for irrigation purposes have challenged the ordering of the riparian system and subsequently found that some form of the

appropriative system was better suited to allocating water to their needs. The distribution of riparian and appropriative dominance and the various combinations in between take on the same form as a rain map (51, p. 586); the more abundant the natural supply of water the greater the emphasis on the allocation of water by means of the riparian system of water rights. This is also true to some degree in the State of Oregon.

Though the doctrine of prior appropriation is the "official" means of assigning water rights, actual adjudication to assert the nature of these rights has occurred only in those areas where the water resource is scarce relative to use. This includes most sections of eastern Oregon and portions of the central Willamette valley. Little of the coastal waters and few streams of the coastal range have been assigned specific rights as part of the adjudication procedure. As increasing pressure for water use leads to a diminished role for the assignation of rights according to the riparian doctrine of the eastern United States so also will increasing pressures lead to greater actual use of prior appropriatin in areas of Oregon. This conclusion is subject to dispute however (51, p. 615-616).

A turning point in the conceptual change occurred, as noted by Hutchins,

> when----after asserting the firm establishment of the riparian doctrine in the state, the Federal court went on to observe that the modern tendency is to make

> beneficial use of water the test of a water right, and that, unless a riparian owner benefits substantially from the water, he should not be allowed to prevent use by others. After the water code of 1909 was enacted, the trend of the decisions stressing appropriative rights took a sharp turn upward (46, p. 196-197).

An act of Congress (1866)(102), its amendment (103), The Desert Land Act (1877)(104), the Oregon decisions of Hough v. Porter (1908)(78) and subsequent decisions began the process of replacing or providing for the replacement of riparian rights as the guide. In varying degrees public lands were either to be accompanied by appropriative rights if prior to a riparian claim or if local custom or law dictated the appropriative method. An important early distinction is that the

> ...appropriative right excludes the idea of equality between appropriators, and contemplates a right to the use of a definite, certain, and fixed quanity of water; but the riparian right is correlated with the similar right of every other owner of land riparian to the same stream, and in the nature of things contemplates the right to use a variable quantity of water (46, p. 198-199).

In this sense the character of riparian rights as tenancy in common tends to preclude achievement of beneficial and/or reasonable use. Appropriative rights, as tenancy in severalty, allows individuals to pursue beneficial uses to the exclusion of use by others to some degree, the degree left to judicial interpretation.

This interpretation resulted in the conclusion that the use of

water held as a riparian right in such manner as is prescribed for an appropriative right is sufficient to convert the right to an appropriative right (14). This allowed for the evolution from riparian to appropriative concepts over time as the demands for the resource changed.

It has been evident from the above discussion that two important interpretations of riparian and eventually appropriative rights have been present; "natural flow" theory and "reasonable use" theory (38). It would be accurate to note that

> In general, it would seem that such right (to pollute in this case) expands or contracts, as a matter of judicial practice, in response to the geographical and economic environment, the identity of the parties before the court, and the interests of groups represented by them (82, p. 632).

Pressures of an unspecified sort (for the moment) have led to legal modification to suit the situation. The variability of the interpretation of these pressures and their effects led to the belief that much of this subjective quality could be avoided by putting the measures heretofore used into statutory form. Thus, it is necessary to examine these statutes and evaluate their role in the administration of water rights.

The original statute was the Oregon water code of 1909. It designated riparian rights that had been put to beneficial uses as vested-subject to considerations of elapsed time and the genuine

value of the use. It did not grant riparian rights to those who did not have riparian right prior to 1909. Adjudication was to follow the appropriative pattern. Prior to the modern interpretation and revision, court interpretation played a key role in the administration of this statute. With respect to legislation and concern about violation of due process of law--

> Vested rights of settlers to the reasonable use of such water flowing over their lands as they have appropriated or used for a beneficial purpose, said the court, cannot be taken away by legislative enactment or judicial decree, but like all other property they are subject to reasonable regulation (46, p. 206).

Subsequent to this interpretation, administration of the code led to the gradual elimination of the concept of right to a continuous flow of water in favor of beneficial use and the concomitant concept of prior appropriation. The U. S. Court of Appeals supported this decision of the State Supreme Court saying that

> ...riparian rights were substantial property rights which might not be arbitrarily destroyed, but, like other property, they were subject to the police power of the state, and within reasonable limits, they might be modified by legislation passed in the interest of the general welfare.--The end sought to be achieved by such legislation, the court said, might properly include the economic welfare of the community, which was one of the chief ends of the 1909 legislation; and the modification of riparian rights affected by that statute, as construed by the Oregon Supreme Court, ----could be reasonably regarded as essential to the accomplishment of that end (46, p. 109-210).

That this attitude toward the relationship between riparian and

appropriative rights was consistent with the Federal Desert Land Act of 1877 also gave strength to the Oregon Water Code. The process of adjudication, or the allocation of rights according to use on the surface water of the state, contributed to the evolving concepts of appropriation. The goal was to create right of the form of tenants in severalty, which was in the courts' opinion the only way to guarantee rights to "specific" quantities of water.

The following are condensations of pertinent water laws now in force in Oregon.[8]

537.110/ All water within the state belongs to the public.

537.120/ All waters in the state may be appropriated subject to existing rights.

537.130/ A permit from the State Engineer is necessary to appropriate water for beneficial use(s).

537.140/ Each application shall designate source, use, and associated construction.

537.160/ Subject to the degree of beneficial use and conflict with existing rights the State Engineer shall grant a permit.

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[8]Numbers refer to Oregon Revised Statutes (ORS). Expanded statements of these and subsequent statutory references may be found in Appendix I.

537.170/ If the State Engineer considers a proposed use in conflict with public interest he shall submit same to the State Water Resources Board, which may reject or revise the application using guides such as conserving highest use, maximizing economic development, loss of state control, quantity available, and existing rights.

537.250/ An individual water right shall continue so long as the water is applied to a beneficial use.

540.030/ If scarce, water shall be allocated in the order of municipal, agricultural, and finally, industrial uses.

540.140/ The State Engineer shall make regulations governing the distribution of water subject to individual rights and state laws.

540.720/ No person shall use or waste water entitled to another.

The issues which presently remain to be resolved involve the continually changing definition of "beneficial use" as a decision variable and the conflicting roles of state and federal agencies in the administration of water rights in the state of Oregon. This latter point may be summarized briefly.

The federal government gains jurisdiction whenever the issue

concerns interstate or navigable waters.[9] Interstate waters include estuaries to the head of tidewater. Navigable waters are undefined in any absolute sense, but apparently this term is more inclusive than originally anticipated. The result is such that there is apparently greater opportunity for federal participation in the administration of state water resources than had been originally realized (68). The provisions that federal authority shall act only when state laws do not provide for state action plays a greater role in this environment.

Pollution Law

Much of what has been said above about rights has been concerned implicitly with pollution. Early development of western water resources included few instances of water pollution which actually resulted in infringement of rights. In Oregon, cases instituted by private litigants (17) began the evolution of decisions which specified certain beneficial uses receiving preferential consideration. This early patchwork approach gradually developed into an inclusive prescription of beneficial uses. As pressures for water use increased and pollution increased in an environment of a mounting demand for

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[9] This is in addition to Federal land, a significant portion of total land in many states. This has potential for increasing future importance with respect to water rights and pollution enforcement matters.

water, administration of pollution problems followed the typical riparian-appropriative-statutory sequence.

In this environment certain guidelines for the compensation of damages incurred by pollution were developed. The main issue is whether the damage is permanent or temporary. Specifically:

> It is the general rule that where an upper riparian owner has caused the pollution of the water course to the injury of the lower riparian owner, and evidence shows that the injury is permanent and irreparable, the measure of damages is the difference in the market value of the property before and after the creation of the nuisance (3).
>
> The right to pollute a stream and the liability in damages, or the duty to make compensation for pollution, are, however, beyond the measure of compensation in condemnation proceedings (5).
>
> In a large number of cases it has been held that where the pollution of a stream results in a permanent or irreparable injury, the injured landowner can recover for the depreciation in the value or market value of the property caused by the pollution. However, in other cases it has been held that where damage caused by pollution can be remedied or repaired at a cost lower than the difference in the value of the market value, the cost become the measure of damages.
>
> Where the pollution of a stream resulted in temporary, abateable, or non-permanent injury, it has been held in a large number of cases that the injured landowner can recover the depreciation in the rental or usable value of the property caused by the pollution.
>
> In a number of cases it has been held that the plaintiff can recover at least nominal damages for the pollution of a stream.
>
> The question of punitive or exemplary damages turns on whether or not malice, fraud, oppression, or gross negligence has been shown.
>
> In a number of cases it has been held or recognized that in determining the damages recoverable for the pollution of a stream, the destruction or deprivation of the use and enjoyment of the property may be taken into

account.

> It has been held or recognized in a number of cases that noxious odors may be an element of damage for the pollution of a stream.
>
> Although there are a few cases to the contrary, in most instances it has been held or recognized that discomfort, annoyance, and inconvenience constitute elements of damages for the pollution of a stream. It has been held or recognized in several cases that the injury or destruction of a fishing privilege may be taken into consideration in determining the damages for the pollution of a stream (6).
>
> The pollution of a stream by a private individual or corporation has been frequently enjoined where a material and irreparable injury will result from its further continuance, or the right to unpolluted water has been substantially interfered with or threatened, the courts generally taking the view that in such cases a nuisance exists, or will exist unless an injunction be granted (4).

The intriguing part of this argument is pointed out in the following statement:

> For, while the state may under its police power and by reasonable methods regulate and restrain certain uses of a stream in the interest of the general welfare, yet it may not, under the federal and most state constitutions, go so far as to deprive the landowner of the enjoyment of his rights of private property without just compensation (82, p. 634).

This problem may be solved by acting in the public interest by means of the power of eminent domain. This has traditionally been a tool only of public agencies, but some precedent has been set for private individuals to use the condemnation proceedings of eminent domain to seek a change in the ordering established under the appropriative rights system. He seeks to condemn a use of higher priority in favor of a use that he proposes. Thus, an individual suffering from

pollution may choose to attempt to gain a use priority by the condemnation procedure. All this would be necessary only if statutory prescription and/or enforcement was inadequate to handle the situation (37). This procedure would serve to make appropriative rights more flexible in the short run.

Early statutes supplementing rights decisions were concerned solely with domestic and farm purposes and fish life (75). It was not until 1938 that anything other than these few statutes on specific subjects existed. At this time an initiative measure was passed which created the State Sanitary Authority within the State Board of Health. Statutes pertinent to the operation of this authority and to this study are given below in digested form.

449.075/ Includes definitions of "water" (all bodies within territorial boundaries) "industrial waste" (any commercial by-product lowering quality of receiving water below standards), and "standard" (measure established in relation to use).

449.077/ States that in the interest of public welfare, safety, peace and morale of the people, it is declared to be the public policy of the state of Oregon to: (a) maintain reasonable standards of purity, and (b) foster and encourage cooperation. This chapter shall be liberally construed for these purposes.

449.080/ Designates powers to encourage cooperation, formulate, revise, study and enforce pollution load requirements and

miscellaneous other minor functions.

449.086/ Considers the extent to which floating or suspended solids, organisms and biochemical oxygen demands may be allowed in water and their relevance to health and to stability of water composition over time.

449.095/ Declares that the use of water as an effluent carrier is not acceptable and is classified as a public nuisance.

449.100/ Indicates that power is relegated to the State Sanitary Authority to use legal measures to prevent pollution when an emergency requires immediate action to protect public health.

509.460/ Proclaims that it is unlawful for any individual or local, state or federal agency to deposit injurious matter into state waters.

The following summary of the Federal Pollution Control Act is that presented by Murray Stein (82).

1. Reaffirmed the policy of the Congress to recognize, preserve, and protect the primary responsibilities and rights of the states in preventing and controlling water pollution.
2. Empowered the Secretary of Health, Education, and Welfare to initiate enforcement proceedings if, on the basis of reports, surveys, or studies, he had reason to believe that pollution of interstate water, endangering health or welfare in a state other than that in which the discharge originated, was occurring.
3. Authorized increased technical assistance to States and broadened and intensified research by using the research potential of universities and other institutions outside of government.
4. Authorized collection and dissemination of basic data

on water quality relating to water pollution prevention and control.

5. Directed the Surgeon General to continue to encourage interstate compacts and uniform State laws;
6. Authorized grants to States and interstate agencies for water pollution control activities.
7. Authorized Federal grants for the construction of municipal treatment works.

This law was further amended, particularly in its enforcement provisions, in 1961. It remains the policy of Congress to affirm the primary responsibilities and rights of the States in preventing and controlling water pollution. Consequently, the Federal functions in this area are designed to be carried out in full cooperation with State and interstate agencies, and enforcement functions in particular are limited by State sovereignty over waters that are not strictly interstate. Under the act as amended in 1961, the Secretary of Health, Education, and Welfare can initiate Federal enforcement proceedings against pollution when:

1. The pollution is on an interstate body of water, its effects are felt in a state other than that in which the discharges originate, and the effects are damaging to health or welfare; or
2. The pollution involves interstate or navigable waters, damage to health or welfare is occurring, and the Secretary is requested by the Governor or official water pollution control agency of any State affected to take enforcement action.

Since the enactment of the original act (1956) only 56 enforcement actions have been taken with two of these reaching the courts in preliminary rather than contestant form. These laws have not been tested and therefore we do not have a guide as to the limits of interpretation. There are great unused powers in these statutes which are only being resorted to under the recent growing public pressure.

Areas of conflict between the Federal and State exist primarily due to the use of the phrase "navigable water" in No. 2 above of the

1961 amendments. As indicated earlier, due to the precedent set in the Pelton Dam Case and others, the volume of waters included under this classification is much greater than originally anticipated. It is conceivable therefore that Federal Statutes forbidding pollution of a given level on a stream could come in conflict with its designation within the Oregon statute as beneficial use, so constituted by either the Sanitary Authority or the Water Resources Board. Though this situation has not occurred as yet two factors make it an important consideration. First, as pointed out by the former and present heads of the State Sanitary Authority,[10] state funds specifically allocated to enforcement are meager. The resultant inactivity on the part of the state enforcement agencies may encourage Federal participation. When this is coupled with the apparent abundance of resources available to the U. S. Attorney General, the likelihood increases. Second, in this study the proposal is to generate a solution that will be consistent with the existing legal environment. This would be simplified if Federal influence could be discounted.

The solution to this problem lies in the time horizon. Ideally, the proposals intended will facilitate the allocation of resources on the Yaquina Bay estuary and generally similar resource areas. To the degree that this is the case then the state may be better able to

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[10] Mr. Curtis Everts and Mr. Kenneth Spies, respectively.

take the initiative in solving its own resource problems. In this case the likelihood of Federal participation is diminished.

Pollution laws act as a constraint on resource allocation in much the same manner as water rights laws as they concern pollution. The difference lies in the manner of administration and enforcement of these laws. Also, in the gradual process of interpreting these laws, the pollution statutes are in a later stage of development. They act primarily as ex ante constraints in that they must be consulted by a water user before he establishes his pattern of water use and waste disposal.[11] Once he has established a use pattern there is also an ex post constraint in that his previous pattern of use may act as a guideline to proper future use rather than a complete interpretation of the flexibility of the existing statutes. This is a function of time in that these pollution statutes are new in comparison to rights laws and they have not been tested sufficiently in the courts to fully shape their meaning in resource use.

Thus, the use of the water resource in Yaquina Bay was initially developed subject to some consideration of an original interpretation of the laws concerning pollution as they appeared in both the common law and the statutory form. If one wished to presently

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[11] This "constraint" also has positive elements, in that the individual knows that others are subject to the same environment.

consider changing the pattern of the water use on this estuary there would be no concrete set of legal guides to follow in changing this pattern other than the present existing pattern. In a sense this might be characterized by stating that the law with respect to water use and the degree of pollution with respect to these certain uses has not been "pushed" far enough to determine the degree of flexibility within the scope of these statutes. Phrases such as "beneficial use" and "maximum economic growth" retain only partial meaning from antiquated common law interpretation. One cannot truly determine what these phrases mean in the light of current statutes and present pressures for resource use.

Concern about water law is appropriate here for two reasons. The question of water rights and the forms of ownership are relevant when considering the potential for a market solution to the problems of water allocation. These same rights laws and subsequent pollution statutes dictate the boundaries for any reallocation of the resource, irrespective of whether this occurs in the public or the private market. In calculating an "optimal" solution of resource uses in this estuary we must acknowledge that questions of feasibility may be resolved primarily on the basis of these legal guidelines.

Government Operation and Organization

As will be noted in a subsequent discussion, certain forms of

government organization are prime candidates for the positions as manager of water resources. If this is so, a question as to the suitability of these units arises. This question takes two forms, the first with respect to the legal limits of these units, and the second with respect to the efficiency aspects of performing certain functions. In this section the first of these two questions will be discussed.

There are provisions for two types of county government in Oregon, the county court or commission form and the county manager form. The latter alternative has never been adopted. Under the former, a maximum of seven officers in the proposed format of this form may be elected and additional officers, as specified by the constitution, are to be appointed. Only a few positions have been eliminated since the original constitutional designation of the form county government was to take.

Within this framework counties are units of limited governing powers, designated as public corporations except that they do not have the power to enact legislation for the general public health, safety and welfare. All authority is derived from the original constitution of the state and additional amendments or statutes dealing with some specific functions, the latest of these being the provision for planning and zoning commissions.

Counties receive revenues from: property taxes; the federal

government for forest reserve rentals, mineral leases and miscellaneous grants; state highway and liquor rentals; and they also have authority to levy fees for certain licenses and services. Bonding powers are limited by debt limits and therefore much financing is done by special levies and through special elections to raise or waive these limitations. It would be appropriate at this point to note that much of what takes place within a county may not include additional activities taking place within certain cities within these counties. This issue is mainly one of the duplication and separation of powers. Certain legislation enacted to aid in the cooperation between counties and cities and among counties has not been used to any great extent. Planning activities have been hampered by the lack of power to carry out the elements of the plans. Cooperation with special districts is virtually non-existent.

In 1958 a county home rule amendment was passed which allows county voters to "adopt, amend, revise or repeal a county charter" (Oregon Constitution, Article VI, Section 10). Under this provision counties are allowed to exercise powers which are not disallowed by state law, so long as this exercise of powers is a matter of county concern. This means that county government may be free to establish (theoretically) a more modern framework for the administration of its tasks, unencumbered by the framework of the past. Adoption by a greater number of counties in Oregon has been hindered by the

fact that this particular amendment has been laid out in excessive detail, somewhat defeating the conceptual purpose of home rule.

Although each type of special district in Oregon has some unique characteristics, "all are organized in a manner similar to cities, following the basic steps of petition, hearing and election" (73, p. 72). The proceedings to begin a district may be initiated by a city or county governing body or by the county court acting upon a popular petition. Most have three to five members serving without compensation, with only a few requiring skilled, well-paid members. There is little authority for these districts to perform more than one duty, and each new activity therefore requires a new district if the district form of management is desired. The fiscal authority of these districts is independent within the limits prescribed by statutes.

At the state level, one unit which would be appropriate as a water management unit is the State Water Resources Board. As this group is specifically concerned with water resources its legal guidelines are more extensive than those of the counties and special districts. A digested statement of these guidelines is as follows:

536.220/ Expresses general welfare of population as motive for maximizing economic growth associated with water, to be achieved through integrated plans and programs under the supervision of a single agency. The legislative assembly encourages an integrated development plan, with enforcement, to secure maximum beneficial

use while always considering multiple use.

536.300/ The board shall consider the supply, conservation and augmentation of state water resources and subsequently formulate a plan to achieve the needs revealed by these studies.

536.310/ When formulating these plans the board shall consider: existing rights, so long as toward a beneficial use, maximum economic development for the state as a whole, discouraging exploitative single purpose use, maintaining minimum stream flow and discouraging pollution, while considering human needs first.

536.320/ The Board shall not interfere with other agencies, alter existing rights, or act contrary to ORS 536.310.

536.330/ This act is supplementary to existing statutes.

536.340/ Subject to existing rights and priorities the Board may classify and reclassify waters as an aid in formulating balanced development programs. In this process the Board shall give consideration to natural characteristics of the source, adjacent topography, economics of the source and affected areas, seasonal factors and consumptive versus non-consumptive use.

536.430/ The Board shall devise plans so as to encourage maximum beneficial use and control.

These laws provide the guidelines for the operation and activities of the State Water Resources Board. Additional relevant activities at the state level involve the State Engineer and the

State Sanitary Authority, the former with respect to the granting and enforcement of water rights laws and the latter with respect to the measurement and enforcement of pollution criteria established in law.

This concludes the comments on the legal aspects of this study. The remaining section of this chapter will dwell further on the necessity for this legal framework in resource management, as well as an evaluation of past, present and possible future operational traits of county and district government.

Management Alternatives

Commonality and the Private Sector

The initial environment in Oregon as in the other western states, was one where water was a comparatively free good.[12] The legal and the economic structure for the allocation of this resource were undeveloped. As the resource was allocated on a first come, first serve basis and much of the western territories were as yet

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[12] In the strictest sense this is a misuse of the term "free good." It is used here to dramatize the differences between past and present attitudes toward water as an input. In actuality the formative years of water law were coincident with individual marginal evaluation of water as an input, though social concern may have been nil.

unexplored, economics was not highly developed as a science of scarcity. Legal rights were in the same stage of development. With little or no competition for any one body of water or parts thereof there was no need to establish rights and therefore the riparian doctrine of first in time first in right was adequate for the homesteading atmosphere.[13]

Competition first took the two forms of physical and economic competition (97). Water, as it began to lose its free good quality, became an economic input with alternative uses. It attained a value through the pricing process by attaching itself as a plus factor of varying magnitudes to the value of the adjacent land. In the production of goods and services the use of water gradually became associated with a definite input cost and therefore entered the input calculations as one of the many possible marginal value products that could be compared. The conception of water as a free good still remains as a factor in resource allocation.

Coincident with this activity a method of assigning the ownership of a free good was developed. Despite the fact that water was essentially free it was evident that some system was needed which

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[13] In early stages riparian and appropriative procedures were similar in that by first location or by first appropriation the result was often the same--agricultural or mining uses. Later interpretations laid greater stress on the necessity of appropriation in the literal sense--to establish the corresponding water rights.

would prevent one individual from roaming at will from one source of water to another without due regard for the interests of those already present and using part or all of a given water supply. As this individual would not be willing to purchase the water (free good), if in fact he could, the alternative was a means of protection which was wholly physical in nature. With little regard for the relative values of various long run uses of a given water supply individuals were granted rights on a first come first serve basis. The exact quantities, location, and the nature of the use were developed at a later date.

On Yaquina Bay economic competition for the use of the water resource is non-existent except for the verbal arguments concerning losses which will be incurred if use of the resource jeopardizes certain business sectors. The exact nature of this loss has never been specified. As a substitute for this economic argument water is being allocated by the existing rules of physical competition, the water rights and the water pollution law prevalent at this time.

The consistency between physical and economic competition takes the following forms. When a water resource is truly free both physical and economic competition will be essentially absent. As a good (input) becomes scarce its allocation is subject initially to attempts at economic allocation. If market allocation either fails or is inhibited, then the alternative is physical-legal allocation.

Although most recent legal and legislative specifications call for some considerations of a quasi-economic nature, economic guides to allocation play a secondary role. In addition, this pattern of competition (or the lack of it) and allocation has until now exhibited the trait of irreversibility.

This observation is backward-looking however, as this study is designed to suggest economic measures which will be convincing enough to aid in overcoming these irreversibilities, --in addition to suggesting the steps that might be followed in initiating these changes and the ultimate procedure to be followed.

The reasons why many problems of water resource allocation could not be handled in the market place reduce to the question of ownership. Allocation requires exchange of ownership and resulting compensation, that compensation to be used to measure the worth of the resource in a particular production process. If ownership cannot be established the allocative process begins to break down.

If two individuals "own" rights to a body of water, a third individual may be at a loss as to who to deal with if he wished to purchase part or all of the resource. This may be surmounted if the two "owners" can agree on a policy. However, as the number of common owners increases and the variety of uses multiplies, the likelihood of establishing a workable bargaining mechanism diminishes.

On Yaquina estuary the allocation of the water resource is primarily a function of legal constraints and historical coincidence. The irreversible legal structure inhibits allocation on the basis of productivity. Only within each of the separate business areas is there some re-arrangement in that one may purchase a marina or expand a marina if the investment is warranted and the funds are available. Nevertheless, the investment would be made with the confidence derived from the secure knowledge that the laws of water rights and water use will protect the investment.

There are many alternative approaches to water resource management. As pointed out by Crutchfield, with respect to the fishery resource, many inefficiencies result from the mechanism designed to allocate the resources involved in fisheries harvest. One means of improvement is to change the allocative mechanism itself (27). Scott argues for the case of sole ownership as opposed to some degree of competition as the ideal alternative to the present situation (88). There is the possibility of situations where the social marginal product will be maximized by this sole ownership principle, but it is more readily applicable when considering many firms within a single industry as opposed to several multi-firm industries. This study may establish some convincing evidence for sole ownership. This is not the purpose, however. The motive is to establish a framework of resource allocation which will reach the "best"

solution under varying circumstances over time. If the solution of sole ownership is the result, so be it! The problem is not one of the possibility of uncontrolled, unmanaged exploitation versus socially optimum government policy (36).

Many of the economic relationships involved in common ownership are categorized as externalities. Water rights, though they do not give an individual greater direct control over various external decision factors, do tend to limit these externalities to a certain range, thus making their effect more predictable. This in turn enhances the decision-making process, as certainty is a key element in making changes for better resource use as opposed to the stagnancy induced by severe uncertainty. In the context of a previous example, an entrepreneur considering an investment in a marina is aware that certain external effects have the potential to lead his investment to either success or failure. He is aware that his rights to the use of the water will not be usurped. Activities complementary to his business are protected in a similar manner. Similar calculations will be made by the other common users on the estuary, each under the influence of some external effects, and each realizing that these effects are confined within certain bounds. Our present area of concern is with the pros and cons of hypothesized changes in some of these institutional (legal) limits, the hypothesis being that there may be possibilities of increasing the social product

either by allowing certain externalities to have a greater (range of) effect or by changing the limits imposed on certain externalities. If this eventuality seems unattainable, some attempt should nevertheless be made to fully develop the framework of the existing scheme of externalities in order to appreciate their effects on the present use of the water resources of the estuary.

Thus, problems are encountered in trying to develop a legal system which will approximate an economic structure. Property ownership is necessary to guarantee security in investments and to enable water use to change through the transfer of this input from one productive role to another productive role as the market dictates. To attempt to attain this ownership water rights have developed. A particular rights concept may be ideal for a given situation with respect to its degree of short run rigidity and long run flexibility, but no rights concept will be adequate for all uses of the water resource. There is presently no legal form of water right equivalent to the deed of ownership to a parcel of land and the function that this deed plays in the economic allocation of the land resource.

With respect to Newport two observations can be made. First, the present nature of water rights and pollution law as a reflection of the fundamental problems of a common property resource is such that there is little hope for a market solution to the task of allocating the water resource between competing uses. This conclusion would

not be unique to Newport, but could be generalized to a majority of cases. Second, given that much of the judicial procedure has been by-passed and solutions to rights problems are under the jurisdiction of statutory provisions, the opportunity for judicial modification of existing use patterns in light of present economic information has been superseded. Whether the rigidity of this decision making environment is good or bad depends upon the solution suggested by the ensuing analysis and its consistency with the present statutory framework.

It is possible that as a result of the manipulation planned with the input-output matrix which describes the economic interactions of the Yaquina Bay area the nature of the common relationship between water uses and the concomitant externalities will be measured. Given this information it does seem reasonable that examination of these relationships will reveal some clues as to the nature of the present ownership pattern of commonly held water resources. This information may enable better evaluation of the worth of a given water "right" and therefore help to facilitate allocation. This procedure could be considered as both an alternative or a supplement to an examination of the implications of compensation as envisaged in welfare theory. In a sense, compensatory payments are adjustments in the purchase price of a resource, either to equilibrate underpayment for benefits not originally paid for or overpayment for benefits

not received or detracted from others who share the resource. If compensatory payments can actually be measured, then it is also possible to conceive of the eventual ability to discount this compensation over time and include this value into a purchase price associated with a transfer of ownership, this transfer inevitably involving changes in the pattern of resource use. In this environment there would appear to be greater opportunity for a solution involving a greater role for economics, thus minimizing the issues revolving around the imperfections in the legal and quasi-legal solutions to imperfections in ownership. Perhaps then the issues can be simplfied (though still far from elementary) to a debate of centralized vs. de-centralized decision making, considering the merits of each alternative in light of the more traditional issues, such as economies of scale and size.

Forms of Government Organization

To consider and evaluate the alternative forms of government available for the management of water resources, some criteria must be available. The following have been suggested. The first two are economic in nature, with the remaining being either political, administrative or social (101).

(1) The governmental jurisdiction responsible for providing any service should be large enough to enable the benefits from that service

to be felt primarily within the jurisdiction.[14]

(2) The unit of government should be large enough to permit realization of the economies of scale.

(3) The unit of government should have the legal and administrative ability to perform services assigned to it.

(4) The unit of government carrying on a function should have a geographic area of jurisdiction adequate for effective performance.

(5) Every unit of government should be responsible for a sufficient number of functions so that its governing processes involve a resolution of conflicting interests, with significant responsibility for balancing government needs and resources.

(6) The performance of functions by a unit of government should remain controllable by and accessible to its residents.

(7) Functions should be assigned to that level of government which maximizes the conditions and opportunities for active citizen participation while still permitting adequate performance.

Some further guidelines are supplied by Paul Ylvisaker (110).

> MAXIM ONE: The areal division of powers should be concerned basically with what is meant by the phrase "the power to govern." The assignment of powers to

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[14] Though no mention is made in this citation of a desire to have the costs spread over this same jurisdiction, unless one wishes to become embroiled in questions of income redistribution this is also necessary.

> component areas should in each case be a general one, covering the whole range of governmental functions, rather than a partial one related only to particular functions.
>
> MAXIM TWO: The optimum number of levels among which to share the power to govern would seem to be three.
>
> MAXIM THREE: The component areas should be constituted of a sufficient diversity of interests to ensure effective debate within each component and transcending communities of interest among the several components.
>
> MAXIM FOUR: Four processes affecting intergovernmental relations should be provided for: one, a process of last resort to settle intergovernmental disputes and questions of jurisdiction; two, a process (or processes) of intergovernmental cooperation; three, a process by which the several governments may act separately and independently, as well as in cooperation; and four, a process of organic change which can neither be dictated nor stopped by a minority of components.

Further, and in a more general sense, it is pointed out that "the physical nature of the inputs to and the outputs from the production process and the technology available set limits on the organizational structure for administration" (15, p. 216). With water resources, as these inputs are variable over time, the management process must be continuous and be characterized by flexibility both with respect to administrative policy and the actual form of the administrating organization (15, p. 223). These units must be explicitly conscious of the necessity of considering the social values involved in the production of non-marketable, common goods. Alternative methods should be available to satisfy the different groups holding these

social values. Some virtue may be attached to separating planning units from operating units (33).

In addition to these criteria, certain peculiarities of Oregon County and Special District government have been discussed and are currently under consideration.

The problems of county government have been summarized in a report by the Willamette University Institute of State Affairs (8). Though they specify the following with respect to the relations between counties and their provision of urban services, their comments apply generally.

(1) The present structure of county government (required by law) contributes overwhelmingly to the administrative incapacity and inefficiency of the counties.

(2) The poorly coordinated creation and operation of special districts has resulted in inefficient and stop-gap solutions to urban problems.

(3) Lack of adequate fiscal capacity or authority.

(4) The impossibility of meaningful administrative planning in 'headless' county government.

(5) Lack of real career service for county employees.

Should it be appropriate and desirable for county government to undertake the management of the water resource in the Yaquina Bay or any other area, part of the procedure for optimizing the

results would involve improving the county's abilities to meet the problems generated. This entails some degree of county re-organization, as implied above. This would take two general forms, re-organization under legislative control or some variation of county home rule.

Legislative alteration may take several courses, ranging from complete reform with alternative plans to be followed, to some partial reform of some specific elements of county government. The latter case might be concerned with administrative organization, civil service opportunities, or financial activities.

Some of the alternatives available include the county manager form, the county executive form or some detailed alternative. The states of Virginia, New York, North Carolina, Maryland and Ohio are the only examples of instances where these options have been undertaken, with only a small number of counties in each case.

County home rule has conceptual appeal because any of the above forms of government may be adopted within this framework if desired, or other alternatives may be chosen; the idea being that the local constituency is free to choose between any known alternative. However, only 30 counties have adopted some form of home rule (25, p. 112), a modest increase from 14 in 1958 (8, p. 14). Twenty-three of these are part of standard metropolitan

areas.[15] For various reasons, most of them concerning the method by which the proposed charter is to be approved, there is little likelihood that there will be a significant increase in the rate of home rule adoption.

Several proposals have been considered in Oregon. In 1929 a home rule measure reached the State Senate, and in 1944 an amendment was passed granting counties the right to adopt the county manager form of government. Attempts to adopt this form were defeated in Lane and Clackamas counties. The present home rule amendment was adopted in 1958 after a series of public meetings and studies. Specific sections of this amendment call for:

(1) Repealing the existing amendment to adopt the county manager forms of government. This would be unnecessary under home rule and would unduly confuse the issue.

(2) Basic enabling legislation granting the voters the right to adopt a county charter; and directing the legislature to establish the initiative and referendum procedure to be followed in establishing the new charter.

(3) The authority to adopt charters providing local legislative powers. By leaving this open-end each county could choose

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[15] Fifty thousand or more in central cities, as defined by the Bureau of Census.

that particular plan best suited to its special problems.

(4) The assurance (insistance) that activities be financed by those associated with the benefited property. This was to present a situation where a county charter provided for a service which was essentially urban but was financed by a general tax supported by a majority of rural property holders.

(5) The provisions for the officers, functions and other administrative particulars as desired by the constituents concerned. This was a specific substitute for constitutional provisions which heretofore specified all these elements in detail, and for each and every county.

(6) Certain required functions must still be performed by these charter counties, just as general law counties, as a legislative arm of the state government.

(7) The judicial branch of county government was exempted from this format.

(8) Initiative and referendum procedures were still to be reserved for the voters of these counties.

In a discussion of this subject (16), Bromage, though arguing for home rule, points out that few general statements can be made without some comparison to the state of affairs which must be the alternative to some form of home rule. Nevertheless, home rule can be a step toward eliminating the large number of needless

elective officials; it may permit the removal of historical legislative shackles; it encourages local experimentation with forms of local government, which is totally lacking; it will make county government a possibility in urban areas. Both Porter and Bromage point out the failings of the home rule principle. First, since local areas cannot be granted a complete free rein on local government, some line must be drawn. If local areas are given a very broad based grant of home rule, much of the burden falls upon the courts. The continuing litigation resulting would in itself tend to incapacitate home rule governments. Second, home rule can only simplify county government if it is given as a substitute for previous methods. If encouraged as an addition it will only be another element in the intricate legislative entanglement of county administration. Ideally there should be no legislation concerning the form of county government. However, "The very implications of the phrase 'home rule' spell variation, confusion, independence of action--everything indeed which the student of administration has been working to get away from" (16, p. 319).

From this discussion it can be seen that there is no direct solution to the problem of improving the ability of county level government to perform its function, which may include water resource management. The only generally acceptable statement would be that some rejuvenation or re-organization of county government is needed.

Specifically, this might take the form of limited home rule or varying degrees of legislative reorganization.

The problems of special districts may be simply stated. They have multiplied increasingly due to a financial and operative framework which dictates the necessity of forming a new district each time a new function is to be performed or additional financing is needed for a function heretofore performed by some other governmental unit. Seldom does one claim that the district in question is ideal in general, but only in light of the existing alternatives. The following have been suggested specifically as causes of this proliferation (11). They should be examined as variables in the choice of a management unit.

(1) Unsuitability of other local units: area.

(2) Unsuitability of other local units: finances and functions.

(3) Unsuitability of other local units: Administration and Attitude.

(4) The desire for independence.

(5) Advocacy by existing governments.

(6) Expediency and area conditions.

(7) Unadorned self-interest.

These comments on certain forms of governmental organization, as well as previous sections of this chapter, will be used in present and expanded form as a basis for examination of the suggested hypotheses in combination with the indicated empirical data.

III. QUANTITATIVE ANALYSIS

Given the background of welfare theory, water rights and pollution law, the statutory limitations of local government organization, and an evaluation of some of these institutions, the sequence of analysis in this chapter will be as follows. First, using the data provided by the Department of Civil Engineering, Oregon State University, the alternative means of effluent disposal will be delineated along with their associated costs and diffusion coefficients. Second, using information provided by the Department of Fish and Game in combination with other biological sources and certain assumptions, the value of the fishery will be calculated for each pollution level and the output and income distribution associated with each of the disposal alternatives. This is essentially an extension of the results derived by Stevens (60). Third, this array of values will be used to generate interrelationships in the business activities of the study area. These results will be used to show the net social gains (losses) when comparing one means of effluent disposal with another. This information will in turn be used to indicate the participants and forms of compensation schemes which might be used to achieve each of the alternative solutions. Finally, these alternatives will be exposed to the above mentioned institutional environment to determine those alternatives facing the most formidable barriers to the changes contemplated.

Preliminary Analysis

Disposal Alternatives and Engineering Analysis

A report prepared by Harris evaluates alternative methods of disposing of wastes at the Kraft process pulp and paper mill located at Toledo, Oregon (39). While models do not exist which will predict such measures as pollution concentration, dissolved oxygen, and temperature with a high degree of statistical accuracy, results that exert a representative effect can be identified. Additional measures of "pollution", such as odor, sludge deposits, slime growths, scum and color are beyond the means of the Harris study.

Using the limited data available for August 1955 (low flow) and February 1956 (high flow), pollution concentrations were obtained as averages over a tidal cycle, using diffusion coefficients in a computerized solution for the model of a well-mixed estuary. Dissolved oxygen measures were obtained by a similar process. The alternative methods of effluent disposal originally considered were (39, p. 3):

1. Dilution by outfall at various points in the estuary.
2. Treatment by various methods followed by dilution in the estuary.
3. Storage during low river flows with disposal at high river flows.

4. Low flow augmentation.
5. Disposal by pipeline of all wastes to the ocean.
6. Disposal by barge of strong wastes to the ocean and disposal of weak wastes into the estuary.

For the purposes of this discussion this list was pared in the following manner: The methods may be summarized as either dilution, treatment, transportation, and storage. The dilution alternatives may be adequately represented by considering either dilution at Toledo at the head of the navigable portion of the estuary or dilution at McLean Point.[16] a mid-estuary point indicated in figure 1. The treatment process singled out was the process of activated sludge, the only possible technique which would meet the required standards of pollution treatment for this type of effluent. The alternative of storage of effluent at low flows had to be dismissed due to the problem of a high water table within a feasible geographic area. Storage would result in seepage into this already limited ground water supply. In addition, this storage of effluent would generate an odor which could also be a serious problem. Low flow augmentation involves the myriad of values associated with the construction of a storage facility, a facility which might very well be designed primarily for some other function, such as municipal water supply and

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[16]At Grassy Point cost is comparable to that of McLean Point, but pollution is greater at all affected sections (39, p. 11).

irrigation and recreation uses. These uses are all precluded, however, by the fact that no suitable site exists for the location of such a storage facility and for this reason this alternative is not considered available at the present. The final alternatives, piping and barging, are essentially similar methods, and it would be unrealistic to truly consider the barging alternative, the more costly alternative, as a real possibility, except remotely as a supplement in the distant future.

The crucial remaining alternatives are:

1. Treatment and subsequent disposal by dilution at Toledo, the treatment method to be activated sludge.
2. Disposal by dilution at Toledo.
3. Disposal by dilution at McLean Point.
4. Disposal by pipeline to an Ocean outfall, approximately $\frac{1}{4}$ mile offshore.

In varying degrees the work done by Harris (39) and further amplified by Gibbs (35) indicates the pollution levels and the costs associated with these alternatives. Critical data on two of these alternatives are presented in table 2.

Of the remaining two alternatives, disposal by pumping to the ocean outfall is the only method of guaranteeing low waste concentrations in the bay. At this point in the discussion little attention is focused on odor and scum externalities peculiar to this means of

Table 2. The UBOD, percent waste concentration, and DO data for a 600 ton Kraft process pulp and paper mill located at Toledo, Oregon[1/]

	Low River Flow (33cfs)				High River Flow (100cfs)			
	Dilution at Toledo							
Zones[2/]	I	II	III	IV	I	II	III	IV
UBOD[3/]	nil	nil	12.6	14.5	nil	0.2	11.0	12.4
Percent Waste	.5	1.0	13.7	15.8	nil	0.8	8.2	9.0
DO[3/]	4.0	5.5	1.8	0.1	*	*	*	*
	Dilution at McLean Point							
UBOD	1.6	1.8	0.4	nil	1.4	1.6	nil	nil
Percent Waste	1.8	2.0	0.6	0	1.6	1.8	0	0
DO	*	*	*	*	*	*	*	*

1/ Digested from (35, p. 9).

2/ See figure 2.

3/ Ultimate biochemical oxygen demand and dissolved oxygens.

* Data not available.

disposal. Treatment by activated sludge presents a paradox. Whereas this method removes a high percentage of organic (solid) waste components, there is no reason to assume that the concentration of toxic components of kraft effluent will be less than that resulting from disposal by dilution at Toledo.

The reasons why this issue is crucial are: First, information supplied by biologists cooperating on this project indicate that neither DO or UBOD will be crucial factors in the reduction of the biomass, within the limits of the concentrations pertinent to this case, and second, as will be shown later, the cost of this alternative compared to other disposal alternatives is so great as to reduce the likelihood of this method being chosen as the desired ideal form, especially in light of the above-discussed consideration with respect to toxic components.

The annual cost of these alternatives, including such measures as amortization, power, and operation and maintenance, was calculated as $6,000 for disposal by dilution at Toledo, $399,200 for treatment followed by dilution at Toledo, and $66,000 for disposal by dilution at McLean Point, and $139,000 for piping all effluent to the ocean outfall (table 3). These figures, as were the figures in table 2, are based upon an output of 600 tons of paper products per

Table 3. Alternatives (for disposal of wastes from a 600-ton per day Kraft pulp and paper mill located at Toledo, Oregon)[1/]

Alternative	Amortization[2/]	Annual costs (dollars)		Total
		Power	Operation and maintenance	
1. Disposal by dilution				
a. Toledo	3,000	1,000	2,000	6,000
b. Grassy Point and Yaquina	---	---	---	---
c. McLean Point	38,400	15,000	13,200	66,600
2. Treatment by activated sludge followed by dilution at Toledo	131,000	17,600	250,600	399,200
6. Pumping				
a. All wastes to Newport ocean fallout	63,600	24,000	19,800	107,400
b. Same as 6a plus odor and scum control	90,000	24,500	25,000	139,500
7. Barging strong wastes to ocean	14,200	---	227,000	241,200

1/ See Harris (39) and Gibbs (35).

2/ Amortization costs based on formula: $\frac{\text{initial cost} \times 1.03}{20}$

day, the output in 1963.[17]

The activated sludge treatment alternative may be dismissed at this point, as in addition to the above information it is also significantly greater in cost than any of the remaining alternatives and similar if not more desirable results may be obtained by the less costly method of piping to the ocean outfall. This provides additional incentive to introduce an alternative means of disposal not heretofore considered. The new alternative introduced at this point is a combination of piping 300 ton equivalent to the ocean outfall and disposing of 300 ton equivalent by dilution at Toledo. This alternative has appeal because it permits consideration of partial dilution techniques and the effects these limited concentrations may have on the indigenous biomass and the subsequent value of the sports fishery. In addition, it is valuable to be aware of the cost of such an alternative, as it is feasible that at some time in the future the existing piping complex may be operating at full capacity and a dilution alternative is one means of disposing of the additional effluent above the capacity of these pipes.

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[17] Present levels of output are estimated at 900 tons per day. The concentration and the cost figures may be projected linearly as an approximation of changes associated with this production increase.

Estimation of Biological Determinants

Before proceeding to a consideration of the costs and values associated with the remaining four alternatives it would now be appropriate to introduce the biological values which are critical to this investigation. As classified by Stevens, the sports fishery is subdivided into categories labelled Salmon, Bottom Fish, and Shellfish (clams). At present levels of water purity gross expenditures may be computed for each of these segments of the sports fishery by the methods developed by Stevens. To extend this work it will be necessary to determine the initial biological effect of different pollution levels in different zones of the estuary before new gross expenditures for the total sports fishery can be calculated.

As these values will be approximate, and of the nature of reasonable assumptions based on the present state of knowledge, their determination for each alternative will be best considered in turn.

For the first alternative, dilution at Toledo, it was assumed that there would be a reduction of 15 percent in the bottomfish population and a reduction of 75 percent in the Salmon population. Clams were unaffected by this disposal procedure.

The derivation of these estimates can be explained in the following manner. In the study of bottomfish a crucial step is the use

of a one tenth application factor to adjust TL_ms'[18] for loss of biomass through processes other than death within the time limit associated with the particular TL_m. At the present state of knowledge this adjustment is commonly used by scientists though without any apparent scientific basis. By the use of this factor in combination with more scientific techniques it has been determined that sample concentrations of KME (Kraft Mill Effluent) will have definite effects upon certain bottomfish species (74). A study designed to simulate the concentration of KME in Yaquina bay indicated that at a six percent concentration up to 83 percent white seaperch, a representative bottomfish, survived a 96 hour TL_m. The application factor, a measure of reproductive ability, size, quality deterioration, etc., would reduce the concentration having an equivalent result to six tenths of one percent. The tested concentration which first results in total elimination of this species is the 14 percent 96 hour TL_m (19, p. 37). Harris has shown by means of concentration curves that in the areas of zones one and two there will be concentrations up to four percent (39). These are the predominant habitats for bottomfish. As the percent reduction in areal distribution is measured

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[18] In lay terms TL_m (median tolerance limit) is the average death rate for repeated samples of species exposed to given concentrations for fixed periods of time.

between five and 15 percent by Parrish, including a measure of the application factor, a 15 percent reduction was assumed as an upper limit for disposal by dilution at Toledo.

There is no information on the effect of kraft mill effluent on the salmon fishery in Yaquina bay. However, information from other fisheries may serve as a guide to the likely reaction to certain concentrations. In one instance sockeye salmon could tolerate up to a 4.8 percent full bleach KME solution in salt water, though decreasing DO levels lowered this figure to 2.5 percent (1). In another instance mature chinook became critically sensitive at concentrations of 1.6 percent. Younger Coho and Chinook resisted a 3.6 percent concentration for 14 days (45). In addition, a 0.6 percent solution was sufficient to produce a reduction in the growth rate of chinook salmon. Chinook also exhibited a marked avoidance of concentrations between 1.3 and ten percent KME, while Coho exhibited less avoidance and steelhead little avoidance (45). Even more crucial was the fact that some young Coho would not avoid lethal concentrations.

As salmon pass through the estuary certain zones of higher KME concentrations appear as barriers. Although the exact effect of these concentrations are not known there is reason to believe that exposure for periods similar to those described above would be lethal. The speed of migration then becomes an important issue.

Mature salmon will move in a pattern reflecting the conflict between the spawning urge and any tendency toward avoidance, both modified by the existence of freshets. Young Salmon moving to the ocean experience similar reactions.

As these salmon may move at speeds anywhere between five and 30 miles per day, there is some probability that concentrations lethal in three to five days and spread over a 15 to 25 mile range could result in significant reduction in either the fall immigration or the spring emigration.

If in fact the disposal of a 600 ton equivalent load of KME will result in concentrations ranging from two to 16 percent between mile six and mile 20 of the estuary and UBOD from four to 14 ppm between mile nine and mile 16 then as an upper limit it appears reasonable to assume the reduction of the salmon population of 75 percent, the cumulative effect over a period of years being even greater (39, p. 6-7).

By using the same background information and reasoning it was assumed that disposal by dilution at McLean Point would result in a 30 percent reduction in bottomfish success, a 25 percent reduction in Salmon success and a 75 percent reduction in clam success. The latter result would be primarily due to a reduction in edible specimens. For disposal by dilution of 300 ton equivalent at Toledo, and 300 ton by piping to the ocean outfall, the values are reduced by

one half of 600 ton disposal at Toledo, or a $7\frac{1}{2}$ percent decrease in bottomfish success and a $37\frac{1}{2}$ percent decrease in Salmon success.

Initial Estimates at Economic Impact

These values may then be used in the framework established by Stevens (93) to determine the new gross expenditures associated with the separate and total fisheries at each of the new pollution levels. The results of these calculations are shown in table 4.

At this point it is possible to proceed to the next two steps in this analysis. First, it is possible to take these total expenditures for the sports fishery and make a direct comparison with the cost of the disposal method associated with each alternative. This will lead to a measure of the net social gain to the local economy if the present disposal method should be replaced by one of the remaining three alternatives. Second, associated derived values may be inserted into the input-output model of the local economy to determine the multiplicative effects of these different levels upon the other sectors in the economy. The first of these two steps will give some normative impetus to the attainment of these alternatives, and the second will provide coefficients of inter-relationship which will facilitate the design of compensation schemes which could be created to achieve any of these alternative resource allocation plans.

The exact starting point of a comparison of the levels of

Table 4. Gross expenditures generated by sports fisheries for different methods of effluent disposal.

Fishery	Type of Effluent Disposal[1/]			
	A[2/]	B	C	D
Bottomfish	$ 95, 926	82, 995	70, 511	87, 512
Clams	11, 891	11, 891	1, 713	11, 891
Salmon	44, 120	11, 215	33, 808	27, 182
Cutthroat-Steelhead	2, 613	2, 613	2, 613	2, 613
TOTAL	154, 550	108, 716	108, 645	128, 198

1/ A: At present conditions - which involves pumping essentially all waste $\frac{1}{4}$ mile out into the ocean (600T. mill).

B: Disposal by dilution at Toledo plant location with the postulated effect of: 15 percent decrease in bottomfish success, 75 percent decrease in salmon success (600T. mill).

C: Disposal by dilution at McLean Point with the postulated effect of: 30 percent decrease in bottomfish success, 25 percent decrease in salmon success, 75 percent decrease in clam success (600T. mill).

D: Disposal by dilution of 300T equivalent at Toledo with effect equal to one half that in 'B', eg., $7\frac{1}{2}$ percent decrease in bottomfish success, and $37\frac{1}{2}$ percent decrease in salmon success.

2/ From (93, p. 186-187).

incomes generated at each level of pollution in Yaquina Bay is somewhat arbitrary. For the purpose of the following discussion the present arrangement has been chosen.

All cases involve a 600 ton equivalent Kraft process paper mill and can be expanded to accommodate the actual increases in the productive capacity of the mill which have in fact occurred since the collection of the original data incorporated in this study. Alternative number four may be adapted to consider the disposal of effluent generated as a result of future growth beyond the capacity of the present pipe line system.

Proceeding on this basis the following simple formulae may be used as the first in a series of steps to derive the net gain (or loss) to the local economy as the result of some change in the methods of pollution abatement:

$$(P_o - P_i) - (F_o - F_i) = NG_i \qquad i = 1, 2, 3$$

where

F_0 = original annual gross local expenditures generated by the sports fishery

P_0 = original cost of abatement measures associated with F_0.

F_1 = gross expenditures generated by sports fishery for 600T. equivalent disposal at Toledo mill site.

P_1 = cost of abatement for 600 T. disposal at Toledo.

F_2 = gross expenditures generated by sports fishery for 600 T. disposal at McLean Point.

P_2 = cost of abatement for 600 T. disposal at McLean Point.

F_3 = gross expenditures generated by fisheries for 300 T. disposal at Toledo and 300 T. piped to ocean outfall.

P_3 = cost of abatement measures associated with F_3.

NG_i = a measure of gain to the area economy associated with the ith combination of costs and expenditures where i = 1, 2, 3

The results of these calculations (table 5), based on a combination of actual data accumulated on the cost side and assumptions originating from preliminary research on the expenditure side, indicate that among these alternatives, disposal by dilution at Toledo is the most advantageous.

Using this measure of net gain will suffice as a guide to decision-making only to a certain point. The preceding observations are incomplete in that they do not truly measure the economic value of the sports fishery in the study area. The tools for a more precise analysis do exist.

The first of these tools is input-output analysis. After establishing the dollar flows, direct coefficients, and the final demand

Table 5. A measure of gain (loss) associated with four effluent disposal alternatives on Yaquina Bay, Newport, Oregon.

Abatement measures	Gross expenditures generated by fishery (F_i)	Cost of abatement facilities (P_i)	(NG_i)
Pipe all effluent to ocean	154,000	139,000	
Disposal by dilution at Toledo	108,000	6,000	87,000
Disposal by dilution at McLean Point	108,000	66,000	27,000
Dilute 300T at Toledo and pipe remainder to ocean	129,000	100,500	13,500

for this model, it is then possible to ascertain the distributive effects of a change in the method of effluent disposal and adjust the original final demand accordingly. Multiplying the 16 × 16 inverse coefficients by the column vector for each final demand will generate the gross output in each sector for each disposal alternative. The incremental change in the household sector represents that portion of output which is internally generated income, and it may be allocated among the sectors to determine the income effect, by sector, for each succeeding disposal alternative.

Input-Output Results

Alteration in Final Demand and Gross Output

Given the direct and indirect coefficients and the initial final demand,[19] the changes in gross expenditures indicated in table 4 may be allocated according to the manner indicated in table 6. For example, the numbers in column c indicate the manner in which the gross expenditures generated by the sports fishery for the alternative of disposal of $\frac{1}{2}$ by dilution at Toledo and pumping $\frac{1}{2}$ to an ocean outfall will be distributed among the seven sectors to be affected

[19] These were generated by the input-output model as described in chapter one. The completion of this model and subsequent revisions for each disposal alternative were an integral part of this investigation.

Table 6. Distribution of gross expenditures generated by the sports fishery for five effluent disposal alternatives.

Sector	Expenditure Distributions[1]				
	%	Ocean	Toledo	McLean Point	Toledo and ocean	Total loss
(4) Lodging in hotels, motels, trailer parks, and state parks	15.5	$ 23,995	$ 16,879	$ 16,879	$ 20,059	0
(5) Prepared meals served in cafes, bars, and restaurants	16.4	25,346	17,829	17,829	21,188	0
(6) Expenditures at marinas: boat rental, cruises, bait, fishing equipment, gas and oil for boat, launching	30.8	47,601	33,484	33,484	39,792	0
(8) Gasoline, oil, and maintenance of autos	12.5	19,319	13,590	13,590	16,150	0
(9) Telephone and telegraph	0.4	618	435	435	517	0
(13) Retail product: groceries, photo equipment, clothing, sporting goods (except marina purchases)	22.3	34,465	24,244	24,244	28,813	0
(14) Entertainment: movies, golf, liquor, bowling, etc.	2.1	3,246	2,283	2,283	2,714	0
TOTAL		154,550	108,716	108,645	129,198	

1/ These numbers were obtained in the following manner. First, the original figures for ocean disposal may be obtained from Stevens (93). Other columns were obtained by allocating the results of table using the same distribution as column one. Superficial numerical discrepancies appear in columns two and three due to the fact that a common figure was used to determine these values rather than the actual figures at the foot of these columns. These adjustments in no way distort the actual magnitude of these numbers.

directly. For sector four $20,059 will be subtracted from $23,995, to give the change in gross expenditures for this sector. This value will then be subtracted from the corresponding sector in the final demand. Adjusting each of the seven sectors in this manner will give a new final demand (table 7) vector which may then be used to generate gross output levels for the study area. In symbolic form, the steps are as follows:

$$\left[C_{ij}\right] \quad \left[Y_i^o\right] = \left[X_i^o\right] \qquad \text{where } i = j = 1, \text{ ----16}$$

and

$$\left[C_{ij}\right] \quad \left[Y_i^{a,b}\right] = \left[X_i^{a,b}\right]$$

$$\left[C_{ij}\right] \quad \left[Y_i^c\right] = \left[X_i^c\right]$$

$$\left[C_{ij}\right] \quad \left[Y_i^d\right] = \left[X_i^d\right]$$

where

C = matrix of inverse coefficients

Y = column vector of final demand

X = column vector of gross output

o = original effluent disposal procedure.

a, b, c, d = alternative disposal procedures.

These results (table 8) may be further analyzed to determine the differences in gross output and the magnitude and distribution of the income effect. To determine these differences,

Table 7. Final demand for five effluent disposal alternatives.

Sector	Disposal Alternatives			
	Original (Y_i^o)	a&b ($Y_i^{a\&b}$)	c(Y_i^c)	d (Y_i^d)
1	46, 887, 030	46, 887, 030	46, 887, 030	46, 887, 030
2	159, 746	159, 746	159, 746	159, 746
3	642, 795	635, 679	638, 859	618, 880
4	858, 795	851, 027	854, 386	833, 198
5	573, 114	558, 997	565, 305	525, 513
6	3, 991, 180	3, 991, 180	3, 991, 180	3, 991, 180
7	1, 776, 169	1, 770, 440	1, 773, 000	1, 756, 850
8	192, 054	191, 871	191, 953	191, 436
9	261, 416	261, 416	261, 416	261, 416
10	166, 479	166, 479	166, 479	166, 479
11	2, 356, 337	2, 356, 337	2, 356, 337	2, 356, 337
12	1, 362, 890	1, 252, 669	1, 357, 238	1, 328, 425
13	691, 808	690, 845	691, 276	688, 562
14	141, 402	141, 402	141, 402	141, 402
15	2, 555, 742	2, 555, 742	2, 555, 742	2, 555, 742
16	5, 867, 887	5, 867, 887	5, 867, 887	5, 867, 887

Table 8. Gross output associated with five disposal alternatives.

Sector	Disposal Alternatives			
	Original (X_i^o)	a&b ($X_i^{a,b}$)	c (X_i^c)	d (X_i^d)
1	48, 609, 164	48, 608, 819	48, 608, 973	48, 608, 002
2	294, 165	293, 951	294, 046	293, 442
3	966, 459	959, 140	962, 413	941, 871
4	1, 984, 879	1, 976, 564	1, 980, 279	1, 956, 845
5	707, 942	693, 771	700, 103	660, 160
6	4, 649, 221	4, 648, 608	4, 648, 882	4, 647, 157
7	11, 552, 359	11, 539, 688	11, 545, 351	11, 509, 649
8	2, 981, 439	2, 978, 884	2, 980, 026	2, 972, 826
9	1, 196, 336	1, 195, 263	1, 195, 742	1, 192, 719
10	1, 657, 749	1, 656, 470	1, 657, 042	1, 653, 442
11	6, 406, 263	6, 404, 051	6, 405, 040	6, 398, 118
12	9, 989, 692	9, 970, 865	9, 979, 280	9, 926, 242
13	3, 705, 859	3, 700, 275	3, 702, 771	3, 687, 061
14	507, 372	506, 902	507, 112	505, 787
15	4, 051, 517	4, 050, 648	4, 051, 036	4, 048, 590
16	24, 808, 377	24, 790, 774	24, 798, 641	24, 749, 079
TOTAL	124, 068, 793	123, 974, 673	124, 016, 737	123, 750, 990

$$\left[X_i^o\right] - \left[X_i^{a,b}\right] = \left[L_i^{a,b}\right]$$

$$\left[X_i^o\right] - \left[X_i^c\right] = \left[L_i^c\right]$$

$$\left[X_i^o\right] - \left[X_i^d\right] = \left[L_i^d\right]$$

where

L = the vector of gross output differences for the disposal alternatives.

Given these differences (table 9), a measure of the income effect, the changes in wages and salaries, etc., associated with the different disposal alternatives, is $L_{16}^{a,b,c,d}$, the differences generated for the household sector. However, these values represent only the total income effect for each disposal alternative. To attain the goal of determining the effect of these alternatives on the incomes generated in each sector it is necessary to allocate the incremental changes in the household sector among the remaining sectors to determine the degree in which each is affected. However, before proceeding to this step it would be appropriate to summarize the important numerical results noted up to this point.

Table 6 indicates that only five of the 16 sectors are essentially involved in the comparisons of the direct effects of different disposal alternatives. Of these, sector 5 has the highest ratio of sports fishery expenditures to sector final demand, or about 8.3

Table 9. Incremental gains (losses) in gross output for five disposal alternatives.

Sector	Disposal Alternatives		
	a&b($L_i^{a,b}$)	c(L_i^c)	d(L_i^d)
1	345	191	1, 162
2	214	119	723
3	7, 319	4, 046	24, 588
4	8, 315	4, 600	28, 034
5	14, 171	7, 839	47, 782
6	613	339	2, 064
7	12, 671	7, 008	42, 710
8	2, 555	1, 413	8, 613
9	1, 073	594	3, 617
10	1, 279	707	4, 307
11	2, 212	1, 223	8, 145
12	18, 827	10, 412	63, 450
13	5, 584	3, 088	18, 798
14	470	266	1, 585
15	869	481	2, 929
16	17, 603	9, 736	59, 298
TOTAL	94, 120	52, 056	317, 803

percent. This measure is an indication of the fact that the sports fishery in itself is not of major importance to any of the sectors involved in the study. Complementary relationships which may magnify the effects of alternative effluent disposal methods will be acknowledged subsequently.

The contribution of an input-output model to this study is the delineation of the indirect effects of the decline of the sports fishery. By the previously described process the final demand vector, (table 7) which differs in only seven sectors, will generate gross output vectors, table 8, differing in all sectors when multiplied in proper manner by the inverse coefficients. Table 9 indicates the magnitude of the secondary effects. The total changes of $94,120, $52,056, and $317,803 for a and b, c and d respectively indicate an output multiplier of slightly more than two in relation to the changes on expenditures generated in the sports fishery of $46,834, $25,352 and $154,550 for a and b, c and d. Though effects are registered in all sectors, the greater dollar values are confined to those sectors affected directly, namely 3, 4, 5, 7, 8, 12, and 13. The single exception is the household sector, 16, which measures the cumulative income effect. This change in income is slightly less than 19 percent of the output change, which is to say that for every change in the sports fishery which results in a change in the total output of the study area of $100 there will be a $19 change in

associated income.

Allocation of Household Incomes

To determine the effect of this income change on each sector in the model it is necessary to allocate the income designated in the household sector, say the $17,603 for alternatives a and b, among the remaining 15 sectors. The procedure to be used to determine this allocation involves a departure from the 16 sector closed model used to this point.

In order to overcome the technical inability to calculate the allocation of household incomes in the closed model it is necessary to remove the household sector, open the model, and recalculate the reduced inverse coefficients. It is then possible to use these new coefficients in combination with the original direct coefficients from the household row of the 16 sector model to generate the distributed income effect of the disposal alternatives. The calculating procedure may be reduced by using the differences[20] between the final demand vectors associated with each of these alternatives. The exact procedure is as follows:

[20] This would be equivalent to distributing first the original final demand, then an adjusted final demand, and subtracting the two vectors.

$$(C_{ik})(A_{16j})(FDD_k) = I_i \qquad \text{where } i = 1 - 15$$

$$j = k = 3, 4, 5, 7, 8, 12, 13$$

and A_{16j} = direct coefficients from the household row of the closed model

C_{ik} = those columns in the reduced inverse matrix corresponding to the sectors subject to a direct change in final demand. (Other columns will not produce an effect and may thus be excluded.)

FDD_k = the differences in the final demand vectors for the disposal alternatives. These are determined as follows:

$$Y_i^o - Y_i^{a\&b} = FDD_i^{a\&b}$$

$$Y_i^o - Y_i^c = FDD_i^c$$

$$Y_i^o - Y_i^d = FDD_i^d$$

As an example of the determination of the distributed income effects consider the following calculation for pollution alternatives a and b and sector one.

$$I_i = (C_{1,3})(A_{16,3})(FDD_3^{a\&b}) + (C_{1,4})(A_{16,4})(FDD_4^{a\&b})$$

$$+ (C_{1,5})(A_{16,5})(FDD_5^{a\&b}) + (C_{1,7})(A_{16,7})(FDD_7^{a\&b})$$

$$+ (X_{1,8})(A_{16,8})(FDD_8^{a\&b}) + (C_{1,12})(A_{16,12})(FDD_{12}^{a\&b})$$

$$+ (C_{1,13})(A_{16,13})(FDD_{13}^{a\ b}) = 7 \text{ (table 10).}$$

As indicated in this table, the income values distributed represent 78.5 percent of the values generated in the household sector of the larger 16 sector closed model. The technical problem of allocating all income involves the development of appropriate multipliers, a project deemed beyond the scope of this investigation. As these multipliers would primarily effect the magnitude of the figures presented here and not their relative distribution these figures are sufficient to indicate those sectors subject to greatest cumulative direct and indirect income effects for each disposal alternative.

The data revealed in table 10 once again indicates that the bulk of the effect of changing the disposal alternatives is confined to those sectors affected directly by a decrease in final demand, with 84.6 percent of the decreases in income being registered in five sectors (3, 4, 5, 12, 13) an additional 9.1 percent is registered in the two remaining directly affected sectors (7, 8) with only 6.2 percent being registered in the remaining nine sectors subject to an indirect effect.

The significance of these distribution characteristics is two-fold. First, the hypothesis that significant indirect effects are being overlooked must be refuted by this data, as these indirect effects, as indicated by the monetary measure of the pecuniary externalities, certainly cannot be considered to be of major importance, though

Table 10. Distribution of income losses resulting from disposal alternatives.

Sector	change in gross output for a & b	distribution of income lost for a & b	change in gross output for c	distribution of income lost for c	change in gross output for d	distribution of income lost for d
1	345	7	191	3	1, 162	23
2	214	66	119	38	723	221
3	7, 319	2, 349	4, 046	1, 299	24, 588	7, 922
4	8, 315	2, 164	4, 600	1, 197	28, 034	7, 297
5	14, 171	3, 363	7, 839	1, 861	47, 782	11, 342
6	613	89	339	49	2, 064	301
7	12, 671	749	7, 008	416	42, 710	2, 530
8	2, 555	512	1, 413	282	8, 613	1, 727
9	1, 073	237	594	131	3, 617	796
10	2, 279	89	707	49	4, 307	300
11	2, 212	163	1, 223	91	8, 145	554
12	18, 827	1, 663	10, 412	920	63, 450	5, 609
13	5, 584	12, 146	3, 088	1, 188	18, 798	7, 241
14	470	21	260	11	1, 585	70
15	869	190	481	104	2, 927	643
16	17, 603		9, 736		59, 298	
Total	94, 120	13, 808	52, 056	7, 639	317, 803	46, 576

they can be detected and measured. Only those five sectors directly concerned with expenditures generated within the sports fishery receive allocations of income from the altered income value measured for the household sector. One might even hypothesize as to the importance of these direct effects.

Second, as will be considered in greater detail later, the concentrations of these income effects in the five directly affected sectors will simplify discussions of the structure of decision-making units contemplated for the management of the water resource in the study area.

Before considering these questions of distributional emphasis the total income effects resulting from the disposal alternatives must be considered in one additional light. As these income figures represent income decreases resulting if these disposal alternatives should be enacted relative to the present method of disposal, so also are there monopoly revenues which are not being acquired for the lack of a pricing process. The hypothetical enactment of this process, as described by Stevens (93) will provide an additional measure of the value of the fishery for each of the disposal alternatives.

Monopoly Revenues

To be able to obtain a measure of the maximum attainable monopoly profits for the sports fishery, a demand curve for this

activity must be available. Such a function has been estimated by Stevens (93) using the well known Clawson techniques. As this function includes a variable incorporating measures of water quality, expressed in terms of fishing success, it may be used in coordination with the disposal alternatives considered here.

The general form of the demand equation estimated by Stevens is as follows:

$$\ln Y = a + bX_1 + cX_3 + dX_3^2$$

where $\ln Y$ = natural log of quantity of angler days demanded

X_1 = cost (expenditures) per angler day

X_3 = mean of income group per angler

By calculating a success elasticity for each equation it is possible to multiply this figure by any hypothesized or real change in success to determine resulting changes in angler days. These altered figures may then be used in combination with original data on X_1 and X_3 to determine the least squares demand equations. Whereas Stevens delineates the effect of a uniform 50 percent change in success, the alterations hypothesized here are those previously delineated and since referred to as a and b, c, and d. With no need to estimate the latter, there are nine potential equations to be estimated; for Salmon, Bottomfish and Clams in each of the three disposal alternatives. The need to estimate the clams equations is removed as there is no change

for a, and c, and the high success elasticity for clamming completely eliminated this sports activity for alternative b. The remaining six equations are listed below as they were estimated for the indicated changes in success, as measured through the change in angler days. Raw data is presented in table 11.

(1) Bottomfish: Disposal by dilution at Toledo.

$$\ln Y = 8.22105 - .682689X_1 + .129773X_3 - .012949X_3^2$$

(2) Salmon: Disposal by dilution at Toledo.

$$\ln Y = 4.17373 - .702695X_1 + .545187X_3 - .022653X_3^2$$

(3) Bottomfish: Disposal by dilution at McLean Point.

$$\ln Y = 8.07076 - .680831X_1 + .128250X_3 - .013010X_3^2$$

(4) Salmon: Disposal by dilution at McLean Point.

$$\ln Y = 5.33115 - .695620X_1 + .526618X_3 - .021924X_3^2$$

(5) Bottomfish: Disposal of $\frac{1}{2}$ by dilution at Toledo and $\frac{1}{2}$ by pumping to an ocean outfall.

$$\ln Y = 9.27528 - .686565X_1 + .130662X_3 - .012767X_3^2$$

(6) Salmon: Disposal of $\frac{1}{2}$ by dilution at Toledo and $\frac{1}{2}$ by pumping to an ocean outfall.

$$\ln Y = 5.15556 - .693790X_1 + .525275X_3 - .021892X_3^2$$

The resultant logs may then be antilogged and converted to angler days per ten thousand population and then cumulated to determine

Table 11. Observations used in estimating demand equations for disposal alternatives.

Fishery	Income group[1]	Distance zone[1]	Angler days[2] a	Angler days[2] b	Angler days[2] c	X_1[3]	X_3[3]
Bottom Fish	0-2, 000	1	2, 783	2, 384	2, 961	1. 21	1. 000
	2-3, 999	1	4, 422	3, 789	4, 705	. 96	3. 000
	4-5, 999	1	3, 512	3, 009	3, 737	. 52	5. 000
	6-7, 999	1	2, 160	1, 851	2, 299	. 67	7. 000
	8-9, 999	1	2, 997	2, 516	3, 240	1. 16	9. 000
	10-----	1	1, 162	975	1, 257	. 10	12. 500
	0-, 2, 000	2-6	69	59	71	4. 98	11. 000
	2-3, 999	2-6	93	82	96	6. 02	3. 000
	4-5, 999	2-6	93	81	96	4. 86	5. 000
	6-7, 999	2-6	162	140	167	5. 65	7. 000
	8-9, 999	2-6	135	112	148	5. 36	9. 000
	10----	2-6	55	46	61	4. 47	16. 500
Salmon	0-4, 000	1	74	219	183	1. 09	1. 400
	4-5, 999	1	189	560	467	1. 02	5. 000
	6-7, 999	1	617	1, 826	1, 524	1. 14	7. 000
	8-9, 999	1	735	2, 176	1, 816	. 82	9. 000
	10-----	1	512	1, 487	1, 241	. 73	17. 812
	0-6, 000	2	58	171	142	3. 39	4. 5000
	5------	2	100	297	248	4. 18	11. 625
	0-4, 000	3-6	2	7	6	5. 71	2. 000
	4-5, 999	3-6	8	25	21	7. 23	5. 000
	6-7, 999	3-6	9	26	22	5. 63	7. 000
	8-9, 999	3-6	13	38	32	6. 53	9. 000
	10-----	3-6	16	47	39	5. 18	18. 750

1/ Classification originally used by Stevens.

2/ These change for each disposal alternative.

3/ These do not change for each alternative.

total angler days for a particular fishery and a particular disposal alternative.

However, each of these equations has been determined, with daily angler expenditures serving as the price variable in the estimation process. As the purpose of this discussion is to evaluate maximum potential monopoly revenues available to a non-discriminating monopolist, a range of prices will be introduced, using the relevant range established by Stevens.

To ascertain the potential attainable revenue, charges in increasing increments of 25 cents are added to the daily angler cost (expenditures). For each fishery and disposal alternative this will then lead to six new arrays of ln Y values for the price range. The clam values once again remain unchanged and therefore the values in Stevens may be used. Once the derived values are obtained they may be anti-logged and cumulated for each of the six situations. The total of the angler days generated for each price alternative in each fishery-disposal combination may then be multiplied by the price used in the derivation process to obtain the resulting monopoly revenues, by fishery, for each of the proposed effluent disposal alternatives.

Once these values are arrayed, that price which will generate the maximum monopoly revenues will be selected and these figures will be designated as measures of the value of the recreational

resource. For this discussion there would be three such figures, one for each of the disposal alternatives. These results are presented in table 12.

As concern in this study is with the change in the value of the fishery as we proceed from one disposal alternative to another rather than with the total value of each, the pertinent figures in this table are the changes in maximum monopoly revenue, or $5,896 for a, $6,910 for b, and $2,908 for c, all as compared to the original values as established in Stevens. The immediate temptation is to add these figures in the same manner to those derived in the previous section's discussion of the income changes derived through the use of the input-output model. However, in the process of determining the optimum price at which the monopoly revenues would be maximized for the fisheries in each disposal alternative one rather simple but nevertheless significant observation can be made. Though the optimum price can be ascertained to be $1.50 in virtually all instances, as in Stevens (93), one can also note that there is very little variation in the monopoly revenues for prices surrounding this maximum price (tables 13, 14, 15). This is to say that the demand for the recreational activity measured here is close to unitary price elasticity for this price range.

This information in and of itself would not be significant but for two additional observations which can be made with the

Table 12. Maximum monopoly revenues for four disposal alternatives with net changes.

Fishery	Original[1/]	Dilution at Toledo	net change	Dilution at McLean Point	net change	Dilution of 1/2 at Toledo	net change
Bottom Fish	$15, 366	$13, 458	$1, 908	$11, 463	$3, 903	$14, 019	$1, 347
Salmon	5, 383	1, 395	3, 988	4, 046	1, 337	3, 822	1, 561
Clam	1, 670	1, 670	0	0	1, 670	1, 670	0
Total	22, 419	16, 523	5, 896	15, 509	6, 910	19, 511	2, 908

[1/] See Stevens (87).

Table 13. Angler days and revenues associated with a range of alternative daily user charges, for the alternative of disposal by dilution at Toledo.

Fishery	angl days	gen rev.	angl days	gen rev.	angl days	gen rev.	angl days	gen rev.	angl days	gen rev.	angl days	gen rev.
	$.50		$.75		$1.00		$1.25		$1.50		$1.75	
Bottom Fish	18866	9433	14911	11183	12531	12531	10566	13208	8972	13458	74887	13102
Net Change			3975	1575	2380	1348	1965	677	1594	250	1485	356
Salmon	1725	862	1485	1114	1300	1300	1104	1380	930	1395	797	1395
Net Change			240	252	185	186	196	80	174	15	133	0
Clams	3592	1796			1988	1988			1113	1670		
Net Change					1594	206			885	328		
Total	24183	12091			15829	15829			11015	16523		
Net Change					8354	3738			4814	694		

Total net change from $.50 to "maximum" price

= -13, 168 angler days

= +$4, 432

Table 14. Angler days and revenues associated with a range of alternative daily user charges, for the alternative of disposal by dilution at McLean Point.

Fishery	$.50		$.75		$1.00		$1.25		$1.50		$1.75	
	angl days	gen rev	angl days	gen rev	angl days	gen rev	angl days	gen rev	angl days	gen rev	angl days	gen rev
Bottom Fish	15089	7544	12736	9552	10752	10752	9097	11371	7642	11463	6445	11279
Net Change			2353	2008	1984	1200	1655	619	1455	92	1197	184
Salmon	5286	2643	4424	3318	3730	3730	3167	3959	2697	4046	2226	3896
Net Change			862	675	694	412	563	229	470	87	471	150
Clam	0	0	0	0	0	0	0	0	0	0	0	0
Net Change			0	0	0	0	0	0	0	0	0	0
Total	20375	10187	17160	12870	14482	14482	12264	15330	10339	15509	8671	15175
Net Change			3215	2683	2678	1612	2218	848	1925	179	1669	334

Total net change from $.50 to "maximum" price

= 10,036 angler days

= +$5,322

Table 15. Angler days and revenues associated with a range of alternative daily user charges, for the alternative of disposal of 1/2 at Toledo and 1/2 by pumping to ocean.

Fishery	$.50		$.75		$1.00		$1.25		$1.50		$1.75	
	angl days	gen rev	angl days	gen rev	angl days	gen rev	angl days	gen rev	angl days	gen rev	angl days	gen rev
Bottom Fish	18496	9248	15593	11695	13163	13163	11268	14085	9346	14019	7859	13753
Net Change			2903	2447	2430	1468	1895	922	1922	66	1487	266
Salmon	4413	2206	3708	2781	3178	3178	2664	3330	2548	3822	2154	3770
Net Change			705	575	530	397	514	152	116	492	394	52
Clams	3592	1796			1998	1998			1113	1670		
Net Change					1594	206			885	328		
Total	26501	13250			18339	18339			13007	19511		
Net Change					8162	5089			5332	1172		

Total net change from $.50 to "maximum" price

= -13,492 angler days

= +$6,261

information presented in this study. First, at the lower extreme of the price range considered here, $.50, the monopoly revenues increase from zero to a total of $13,250 for alternative c as an example (table 15). As the price increases to $1.50 revenues reach a maximum of $19,511, or a gain from the $.50 price of $6,261. This indicates that the initiation of a price, any price, generates monopoly revenues, whereas the manipulation of prices will change the magnitude of these revenues only slightly. In this sense then, isolating a maximizing price is somewhat misleading, especially in such cases where a price of $1.25 or $1.75 results in differences of total revenues of less than $100 or even no change as for Salmon with prices of $1.50-$1.75 (table 13).

Second, one cannot justify focusing exclusively upon the prices and revenue figures when each price change involves change in the number of angler days also. With the data and mechanisms at hand it is possible to obtain at least a rough approximation of the monetary effect of these decreases in the number of angler days for each successive price increase. If this should indicate significant losses in income to the area economy, then it would seem appropriate to abandon the discussion of monopoly revenues as being misleading in this case.

A return to the input-output results will shed some light on this question. When comparing the alternative of dilution at Toledo

with the present procedure of pumping all effluent to an ocean outfall the $17,603 loss in incomes generated was associated with a 12,796 decrease in angler days (52,484 to 39,688). Though not exactly comparable these results may be compared with table 11, where the process of moving from $.50 to the maximum price of $1.50 results in a decrease of 13,168 angler days and the monopoly return of $4,432. Thus the hypothesized process of proceeding to this maximum price would in actuality result in a loss of approximately $13,500 ($17,603-$4,432) should the pricing scheme be enacted.

In light of this argument it would not seem justifiable to append any additional measure of the value of the fishery to the income change generated within the input-output model. Some slight consideration might be given to the value associated with the minimum price of $.50, but the fashion of ignoring fee collection cost surely would not be justifiable in this case.

Having settled upon the income changes generated by the input-output model as the sole measure of income losses, one question remains. This is a return to the original attempt to link the income effects to possible savings by the pulp industry and alternative ways in which these savings might be distributed either within or outside the study area. One serious limitation to ignoring these savings is the fact that present solutions indicated reductions in output in all sectors, whereas the injection of these savings as normally

allocated among inputs by the pulp mill might very well result in increased output in those sectors more closely associated with the output of the mill as opposed to the output of those sectors closely allied to sports fishing activities.

However, the realism of the situation helps to solve this problem in part. First, familiarity with the mill reveals that certainly a majority of expenditures are made for raw material and other capital items that are supplied external to the study area. In addition there is also the possibility that these savings may be treated as a windfall gain, with no immediate change in production patterns, though the atmosphere for accelerated future investment may be created. This is certainly beyond the concern of this study.

Summary

The results of this chapter may be summarized briefly as follows (see table 16). When each of the four disposal alternatives is compared with the present method of disposal the income losses resulting are $17,588 for both disposal by dilution at Toledo and for disposal by dilution at McLean Point: $9,125 for disposal of one half of the effluent generated at Toledo, and piping the remaining one half to an ocean outfall; and $59,332 for the unnamed possibility of total loss of the sports fishery. Only 6.2 percent of this figure may be designated as an indirect effect, or that portion of

Table 16. A summary of direct and indirect income effects for four effluent disposal alternatives.

Disposal Alternatives	Distribution of direct and indirect effects								
	Actual income losses			Monopoly revenues foregone[2/]			total[2/]		
	direct	indirect	total	direct	indirect	total	direct	indirect	total
Disposal by dilution at Toledo[1/]	$16,491	$1,097	$17,588	($15,499)	($1,024)	($16,523)	($31,990)	($2,121)	($34,111)
Disposal by dilution at McLean Point	16,491	1,097	17,588	(14,547)	(962)	(15,509)	(31,038)	(2,059)	(33,097)
Disposal of 1/2 at Toledo and 1/2 in the Ocean	9,125	605	9,725	(18,301)	(1,210)	(19,511)	(27,426)	(1,815)	(29,241)
Total loss	55,428	3,704	59,332	(21,029)[3/]	(1,390)[3/]	(22,419)[3/]	(76,657)	(5,094)	(81,751)

[1/] These two alternatives were treated as one in the evaluation of direct and indirect income effects. The figures presented here have been expanded proportionately to 100 percent to indicate actual magnitudes.

[2/] The parenthesis indicates the questionable value of these numbers as decision-making guides.

[3/] See Stevens (93, p. 135).

the total income losses occurring in those sectors not experiencing direct changes in expenditures generated by sports fishing activities.

Maximum potential monopoly revenues range from $15,509 to $22,419 for the alternatives considered. As suggested, extreme caution must be exercised when using these values, as the counteracting effect of the income losses associated with the decreases in the number of angler days associated with the $1.50 charge may more than cancel out these monopoly revenues. Issues such as the actual magnitude of such a reaction, the indirect effect of cost savings accruing to the mill for each disposal alternative, and costs associated with the implementation of each alternative and in addition the monopoly pricing arrangement, remain as items for further investigation.

IV. COMPENSATION AND INSTITUTIONAL ADJUSTMENTS

Notwithstanding the problems which have been and will be encountered, the concern of this examination has been an attempt to focus upon maximum social product and the ways and means to achieving this maximum. It is now possible to proceed to the allocation process with the data generated in the previous chapter serving both as a guide to indicating those economic groups that are (will be) primarily involved and a quantitative measure of the degree of their involvement.

Compensation

Resolution of Initial Problems

No longer concerned with only infra-marginal effects, it is now possible to approximate marginal changes for a limited range of pollution alternatives in the study area. Delaying for the moment the discussion of whether these are truly Pareto-relevant, it is nevertheless possible to indicate the magnitude of the pecuniary externalities which would have to be incorporated into the compensation processes which might be initiated in any attempt to achieve each of the alternative disposal methods considered here.

Two possible complications to this compensation process may be eliminated at an early stage in this portion of the examination.

First, there is the theoretical problem of who should compensate whom and the further concern that the compensatory payment itself may serve to encourage the activity generating the externality. This issue may be resolved by referring to the institutional arrangement presently in force.

Currently, the burden of maintaining an approved level of water quality is upon the mill in question. As this quality level is relatively high, the highest compared to the other disposal alternatives, any change would be in the direction of lower quality and could be under the approval of state administrative authorities and/or those individuals involved, i.e., affected externally. The only conceivable way this would be possible is if the change in disposal methods towards lower water quality was accompanied by compensatory payments. This would therefore determine the direction of the payments. The ability of enforcement authorities to measure the magnitude of the effects emanating from the change in water quality (presumably aided by the techniques and information presented here) would indicate the magnitude and the distribution of these payments.

A second potential complication is the returning issue of interpersonal comparison of utilities, as related through changes in the distribution of incomes resulting from any compensatory activity. Once again the institutional environment precludes some of the difficulties which would occur in a purely theoretical consideration of the

issues involved. That is to say, presently decisions are made which do indeed involve interpersonal comparisons. Therefore, any suggested alterations would not in fact introduce interpresonal comparisons, but merely indicate those whose income distributions are in fact being directly affected and to what relative magnitude. These individuals would then be given some opportunity to express their utility preferences, in varying degrees, concerning the changes in their income distributions which they are or will be experiencing.

Any resource management process will involve utility comparisons. The arguments used here are intended only to shed economic light on economic matters and the economic aspects of these comparisons. As this is in essence an attempt to ascertain what might be "better" solutions, the problems inherent in the attempts to achieve "best" solutions and the reliance of the latter on the precise ability to accurately quantify utility functions and their relation to income distribution need not be a seriously limiting factor.

In the immediately following pages the sole concern will be with efficiency considerations. Ultimately institutional issues will be introduced to complete the intended appraisal of various aspects pertinent to the initiation of any of the alternatives in particular and to some degree to the management of water resources in general.

Delineation of Compensatory Flows

The procedure to be used in delineating the compensation schemes proposed will involve a comparison between the proposed alternatives and the present method of effluent disposal, namely pumping to an ocean outfall. This is merely acknowledging the present arrangement as an unavoidable fact of the existing institutions rather than a random alternative. In a manner similar to that described in table 5, changes in generated income will be related to savings to the mill for each alternative. The allocation of the compensatory sum will be done according to the distribution of the income effects indicated by the results of the various runs of the input-output model of the area economy.

The statistics pertinent to a discussion of compensation are given in table 17. In the first column the changes in the values of the household sector for each run of the input-output model are given, one for each disposal alternative and for total loss of the sports fishery. These figures are obtained from row 16, table 9. The second column represents decreases in the cost of effluent disposal for each new alternative as compared to the present process of pumping to an ocean outfall. These figures are derived using the data in column 2, table 5. It may be appropriate to recall at this point that although the income effect for alternatives a and b are

Table 17. Income losses, cost savings, and monetary incentives to compensation for four disposal alternatives.

Alternatives[1/]	Change in generated income	Change in cost of effluent disposal	Residual as incentive for compensation
A	$17,603	133,000	115,397
B	17,603	73,000	55,397
C	9,736	38,500	28,764
D	59,298	139,000	79,702

1/

A: Disposal by dilution at Toledo plant location with the postulated effect of: 15 percent decrease in bottomfish success, 75 percent decrease in salmon success (600T. mill).

B: Disposal by dilution at McLean Point with the postulated effect of: 30 percent decrease in bottomfish success, 25 percent decrease in salmon success, 75 percent decrease in clam success (600T. mill).

C: Disposal by dilution of 300T equivalent at Toledo with effect equal to one half that in 'B', eg., $7\frac{1}{2}$ percent decrease in bottomfish success, and $37\frac{1}{2}$ percent decrease in salmon success.

D: Total loss of sports fishery. No cost for effluent disposal.

essentially of the same magnitude, the cost of the disposal technique associated with each is considerably different, and thus it is appropriate at this point to once again consider these two disposal alternatives separately.

By going through the process of subtracting the loss in incomes from the savings associated with the different disposal alternatives a residual may be obtained, as shown in column three, which may be thought of as an incentive for compensation on the part of the mill. This positive increment may be looked upon as a form of a new social product associated in each case with the adjustment from the original disposal technique to each of the new alternatives in turn. In fact, these figures in column three would also represent the residual if the mill owners or representatives compensated those groups (sectors) for the estimated amount of their income loss. The magnitude of the figures in column three indicates that there is considerable latitude for expanding the compensatory payments beyond the magnitude indicated in column three should decision-making or bargaining groups arrive at such a solution. These figures also indicate a potential preference ranking. In this sense alternative a, disposal by dilution at Toledo would be preferable, with $115,397 remaining after minimum compensation. If any portion of this sum is returned to the local economy in the form of factor payments then a true gain exists. Without speculating as to the size of this portion it seems a

fair assumption that not only will it exist, but it will serve as incentive to further expanded production, ceteris paribus, by removing the necessity of increased pollution disposal methods with increased production.

The remaining alternatives, in the order of d, b, and c, could be interpreted similarly, in decreasing order. Once again, the considerable difference that now exists between alternatives a and b should be emphasized.

What remains is the distribution of the compensation payments among those groups primarily affected. This can be easily computed from the previous input-output data which indicates the manner in which any alteration in the income effect, wages and salaries, will be distributed among the 16 sectors of the model (15 excluding the household sector itself).

This distribution can be derived from table 10. Rather than use the exact values from this table, which indicates an incomplete distribution of the income effect due to the absence of a multiplier in the reduced model, these figures shall be expanded proportionately to allocate the entire income effect. This will be done using the calculated percentages as shown in column one of table 18. In the interest of simplifying this allocation process the distribution of the compensatory payments is confined to the previously mentioned seven sectors accounting for approximately 94 percent of the income effect.

Table 18. The distribution of compensatory sums, for the disposal alternatives considered, among the seven principally affected sectors of the local economy.

Sector	% distribution of income change	Disposal alternatives		
		a and b	c	d
3	17.0%	$ 2,990	1,652	10,000
4	15.7	2,761	1,529	9,320
5	24.4	4,295	2,375	14,450
7	5.4	950	526	3,200
8	3.7	652	360	2,198
12	12.1	2,130	1,177	7,152
13	15.5	2,628	1,509	9,152
TOTAL	93.8	16,406	9,128	55,472

The remaining columns in table 18 indicate the minimum compensatory payments necessary to permit a Pareto-optimal adjustment in the resource use pattern. It would be appropriate to once again note that these sectors are the ones affected directly by a change in the gross expenditures generated by the sports fishery, with all remaining sectors being included in the residual six percent of income effect.

Implications

At the conclusion of this stage in the investigation it is possible to make some observations with respect to two of the hypotheses originally suggested for testing. Of these, the first, concerning the actual existence of pollution levels which would have a significant effect upon those sectors associated with sports fishing, tourism, and recreation, some qualified observations can be made. First, separate pollution levels can be evaluated in terms of their values to the local economy. Second, however, the magnitude of these effects is truly not great when compared to the total value of the gross output of the household sector as shown for example in column 16 of table 6. The values $17,603, $9,736 and $59,298 can never be considered significant when compared to slightly less than 25 million dollars. This is consistent when the total loss of the fishery results in a decrease in gross output of the area economy of $318,526 out of

a total of $123, 750, 990, or only about .25 of one percent. This is not to say however, that these values, whatever magnitude they may be, would not be sufficient to encourage compensation and adjustment in resource use patterns if the proper mechanism was established.

In addition to these observations, previous reference to tenure arrangements could yield further light on this decision-making process. From this viewpoint compensation schemes must be related to the concept of alternative or opportunity costs. These would take two forms for the firms under consideration in this study. For the pulp mill, these alternative costs would take the form of investments in production expansion which were not made due to concern over the likelihood of future unfavorable resource management decisions. This same hesitancy would of course exist with the present resource use pattern. For the sports fishing associated firms (marinas, bait and tackle shops, etc.), the loss would take the form of hesitancy to use inputs of a durable and semi-durable nature in providing services demanded. This would result in sub-optimal production patterns.

The existence of the compensation process described above would aid in reducing these alternative costs in part. Compensation for income lost through a change in resource allocation would in effect be compensation for losses in earnings to particular factors. The ex ante knowledge that the compensation process exists leads to the hypothesis that input investment patterns will more nearly

approximate an optimum production pattern.

Nevertheless, the data used here is for the present production pattern, and compensation based upon this information would only include some of these alternative costs if the analytical process used in this study were repeated at a time subsequent to the initiation of this compensation. In this manner the revised production processes would generate new coefficients which would in fact represent not only the present suggested measures of social product losses, but also any existing opportunity costs.

Therefore, though this study does not provide sufficient data for the actual determination of the social product lost to the study area due to the uncertainties, the enactment of a compensation process as suggested would lay the foundation for the determination of this opportunity cost.

Finally, it cannot be overemphasized that these measures are primarily concerned with the evaluation of the sports fishery as distinct and separate from additional tourism and recreational values which may very well be complementary with the fishery and in this sense dependent upon the very same resource characteristics and qualities which might cause variation in values generated by the sports fishery.[21] Another way to state this relationship is that the

[21] It must also be re-emphasized that it concerns only the sports fishing activities within the confines of the bay, and should not be implicitly associated with ocean fishing or complementarities between

discussion of the various disposal alternatives involved here and the resultant water quality levels does not denote the value of incremental changes in quality to the local economy per se, but rather it indicates the value of the sports fishery to the local economy at these various pollution levels. To fully ascertain the value of these quality differences it would be necessary to measure the value of each and every use of the water in both their separate and complementary existences. As will be re-emphasized in the summary chapter of this work, this observation has important implications with respect to future research in resource use evaluation.

In addition, hypothesis No. 4 is verified in that it is possible to construct compensation schemes which will, if acted upon, lead to an alteration of the present disposal methods to attain one of the alternatives evaluated here. This was in part made possible by the insertion of certain existing institutional factors which helped to determine the direction of the compensatory flow as well as the regulation of its magnitude and the regulation of the processes which determine the values involved in these flows. These compensation schemes are complete to the extent that 94 percent of income losses may be compensated and distributed among the sectors affected directly by changes in the gross expenditures generated by the

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bay and ocean fishing--as no data is available on these latter two items.

sport fishery.

Institutional Factors

Water rights laws, pollution laws, and the laws structuring the formulation and operation of governmental units will combine to form a framework in which these effluent disposal alternatives may be transformed into operative policy proposals. Considering these in reverse order, the first step to an evaluation of possible governing units would be to evaluate district, county and state levels in terms of the criterion for ideal operation as stated on previous pages.

Selection of a Governing Unit

The first criterion, incorporated in previous discussions of both rights and pollution laws, concerns the necessity of cooperation with Federal government agencies. With both estuarine waters and whatever might eventually come under the definition of navigable waters, there will be the necessity of cooperating with the Federal Government. As the federal government is likely to be concerned solely with basic (inter-state) or state water management problems it would be somewhat difficult to conceive of the appropriate federal agency communicating with something less than a state level agency, and even at this level the state agency would have to be a strong representative agency to avoid the likelihood that management of waters

designated as federal by whatever guideline would be undertaken entirely by some federal agency with the state or local agencies having only a minor role in the management process. This reasoning would be valid only if those federal agencies did not become concerned with intra-state management problems. Should this situation arise, examples such as irrigation and power districts indicate that there would be some possibility of local-federal cooperation.

Whatever the eventual degree of federal involvement, the simplicity and efficiency of having all matters channeled through a single state agency, whether the issues are inter-state or intra-state, has considerable appeal. This appeal would be tempered by the desire to retain some degree of local autonomy.

A second related issue to the need to settle the question of "navigable waters." The uncertainties associated with this phrase creates an atmosphere of decision-making which is detrimental to resource planning. State and local planners are constantly operating subject to the possibility that the federal government may supersede local decisions by including the water resource under its jurisdiction under the variable boundaries of this phrase. The over-lapping of management jurisdiction between federal, state and local agencies leads to inefficiencies in resource management. It is imperative that state or local agencies begin to negotiate with federal agencies with the express purpose of obtaining a more definitive delineation

of the boundaries of jurisdiction. Agreements, or attempts to reach agreements, with agencies other than state agencies would necessitate separate negotiations with each local agency according to the unique characteristics of the local water management problem. The inefficiencies inherent in this herculean task are readily apparent, and could play a major role in precluding an agreement on this crucial subject.

The above two issues serve as general guidelines for the formulation of a government agency to deal with water resource problems in general. The following are evaluations of alternative levels of government as the "best" location for agencies or an agency to deal with water resource management in the state of Oregon. The problem area in this study is used only as a guide to the general, inclusive area of water management.

The first criterion (see page 77) concerns governmental jurisdiction. Jurisdiction should be large enough to enable the benefits from the service to be felt primarily within the area. Also, the area of jurisdiction should be adequate for effective performance.

The state level of jurisdiction may be questioned in terms of these two measures. For the resource under consideration here, the management decisions will be first and foremost within the resource area as defined. Secondly, further effects will be felt within the state-wide economy, and thirdly, within some geographic area in

the Pacific Northwest and finally the total U.S. economy. A more appropriate method of measuring the geographic importance would be to measure the magnitude of these effects in each of the four above-mentioned areas. At the national level, although each change would make some alteration in a national tabulation of economic activity, the relative magnitude of these effects in each case would be minor. Indeed, as the actual effect within the study area has been somewhat minor compared to the hypothesized effect, the only truly relevant areas are the local and state dimensions. The state level would be considered the appropriate scope of administration from one important viewpoint, that there are many such management areas within the state with both similar and dissimilar problems. Treating each of these resource areas as totally separate problems could have a harmful effect on the state's economy if the degree of separability is not actually total. Therefore, state level administration would be important as a means of coordinating these individual areas to maximize total state economic welfare. Without this issue, the study area itself would be appropriate as the geographic management area, as it has been designed to include a considerable portion of the benefits from resource management decisions. To the degree that the boundaries of existing county or district government units coincide with a resource management area these units might also include the service benefits felt in this area and also achieve some

degree of effective performance. However, some more inclusive management unit would have to exist and exert an influence to maximize net economic benefits accruing to the greater areas of the state and/or the national economy.

A second criterion is that the unit of government would have the legal and administrative ability to perform the services assigned to it. With respect to this issue all government administrative units under consideration here have a complex listing of shortcomings and strong points. For the specific functions considered here, such as the measurement of the benefits derived from alternative resource plans, structuring compensatory arrangements, ascertaining the economic groups involved, and conceiving of and administrating the final plan, the alternatives are only two; the creation of a new agency or vesting these powers in an existing agency, such as the State Water Resources Board, which already has many similar functions. County or district organizations would rate as secondary choices because of their recognized inability to perform many of the functions already conceived for these units. It would be difficult to justify assigning additional functions to these units considering these failings.[22]

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[22] Provisions such as laws controlling district formation and the opportunity for functional and administrative home rule in rural counties, as introduced in California and Colorado, may make these alternatives more appealing in the future (25).

Also, the possibility of creating a new governing unit, either at a local or state level, can be dismissed for the already stated axiomatic reason; that the creation of new governmental units is seldom coincident with the elimination of old units, and the inevitable result is the duplication of functions. The Board already has many of the legal and administrative powers necessary to perform some of the above-mentioned functions and it would require only some modifications and additions to its authority, facilities and staff to perform any associated supplementary functions.

The third criterion concerns economies of scale and size. There are three guides to evaluation. These concern the functions of legal activity, data gathering, administration and planning. For each resource area a legal staff would be necessary to ascertain the limits established by past decisions and to indicate the opportunities available for future modification in use patterns. They might also be used to draft proposals for modification of existing water rights or pollution laws.

If each resource area were to become involved in this activity, few would have sufficient resources to have their own legal staff. This staff would have to be part-time or on a consulting basis. Either from this point of view or in the case of those resource units which had separate and distinct legal staffs, economies could possibly be realized if a single, comprehensive central staff were

available to work on the problems of each resource area as these problems arose. Thus, at least in the conceptualized form, a centralized legal staff would be hypothesized to result in economies of scale and size.[23]

To utilize the concepts described in this study, data collection in the area of economics, engineering and biology would be necessary. One or all of these areas would undoubtedly be pertinent for other resource areas and their unique problems. This sort of information would be virtually unattainable for each of these resource areas if they were managed as small, separate units. Two exceptions would be a public central data source, acting as a service agency only, or a private firm providing the needed information on a fee basis. These two choices must be considered valid alternatives.

Economies with respect to administration and planning of water resources may be viewed in much the same manner as other

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[23] Consider the "Ruhr area" of Germany as an example of what can be done. Here in a highly industrialized region of 4500 square miles, 450 professionals and 400 supporting staff manage 400 low flow cfs serving 10 million people (55). Oregon, with 96,240 square miles, though having only 1.85 million people, has an average annual cfs of 50,000 attributable to the Willamette river alone, not counting the Columbia, Snake, and several other lesser, though substantial rivers. The Yaquina has a low flow of 33 cfs. On a comparable basis, even with reductions for population differences and adjustments for low flow-annual flow comparisons, Oregon's indigenous water resources could easily justify a management staff of 100.

state and local functions. Many of the functions assigned to local levels have performed so imperfectly that these units have virtually forfeited control over many of these functions. Though many of these results have not been due to economic reasons, the inability of local units to operate within income restrictions and provide the level of services desired has undoubtedly contributed to the shift away from local units as important governing entities. Given the present state of these local units, the assignment of an additional function which would be important in many areas of the state would seem inappropriate.

The fourth criterion states that every unit of government should be responsible for a sufficient number of functions so that its governing process involves a resolution of conflicting interests, with significant responsibility for balancing government needs and resources. This may be further stated as in Maxim three (page 79) as the necessity of designing an area constituted of diverse interests, thereby assuring ensuing debate within and among the concerned interest groups.

This is a crucial qualification, for the discussion has heretofore centered solely upon the problems of water management. Using the study area as an example, this criterion implies that for an optimum form of government organization the governing unit should allow for representation of land, forest, conservation, business, and

other interests in the decision-making body.[24] In some forms of existing government organization this sort of representation does exist. In county government officials are chosen irrespective of occupational interests, and although some professional or occupational groups are more heavily represented than others, some broad-based representation does exist. This would be true to a lesser degree in special districts, as the word special implies. Administrators of these units tend to be representatives of the special interest that the district is designed to serve. At the state level there are usually specific entities which deal primarily with particular problem areas. In many cases, as with the State Water Resource Board, the representation of the decision-making group is cross-sectional.

Carrying this criterion to the extreme interpretation might lead to the conclusion that the optimum government management unit would include present agencies devoted to each of these specific areas into one all-inclusive supervisory and planning body. This would have the advantage of bringing each of the potentially conflicting sectors of the local economy to a conference table before resource management suggestions were made. Ad hoc conflicts of various

[24] Experience in Germany suggests that this cross-sectional representation of interests may be a key to success, especially with regard to the representation of industrial interests (55).

sorts could then, ideally, be minimized. However, this would also lead to some degree of moderation in the original formation of these decisions, since they would ultimately represent compromises between the various groups represented.

A fifth criterion states that the performance of functions by a unit of government should remain controllable and accessible to its residents (page 78). Any governing unit will be subject to this qualification and therefore it must be the directness of this relationship which is relevant. A unit consisting of appointive officials is subject to constituent control only through the appointing official, and although extreme reactions may be registered, these groups are somewhat more protected from direct public action or reaction. Officials directly elected or officials who supervise decisions handed directly from constituents are more subject to actual control by constituents. As an approximation, the more local units of government have a greater number of officials directly responsible to constituent reaction. As units of government approach the state level in scope and magnitude the proportion of officials with this direct responsibility decreases. To adhere to this criterion of accessibility it would seem necessary to adopt some form of either local administration or state-local cooperative administration.

A final criterion states that functions should be assigned to that level of government which maximizes the conditions and

opportunities for active citizen participation and still permits adequate performance. This criterion represents the resolution of the previously stated criteria. Separately they examine the necessary conditions for citizen participation and adequate performance. Combining these two qualities is left as an admirable goal, but the specific guidelines toward this end are neglected.

Nevertheless, attaining a solution consistent with the requirements of this criterion is possible. The solutions reached under each of the above discussions indicate a manner in which the various tasks associated with water resource management may be allocated so as to comply with this final criterion.

First, it is necessary to examine the issues of participation and performance. With respect to participation the guidelines suggested were that there should be some degree of direct control by the constituents. The controlling individuals and the form of the management unit should be broad-based among the various economic and other activity groups and the management unit should represent some combination of functions so as to best represent the complex interests involved and reach a resolution of these interests before a resource plan or decision is formulated. For each of these participation criteria the government level deemed as most consistent was the more local units such as the county or the special district. The conclusion therefore is that the level of government which

maximizes the conditions and opportunities for active citizen participation is the local level. But the other element of this dual criterion, performance, must be examined separately. The specific elements of this evaluation involve such questions as jurisdiction, ability to provide and generate pertinent data, and scale economies and efficiency. The qualified conclusions reached in this case were that more centralized forms of management at the state level were better suited to the attainment of these goals. Thus the attainment of maximum performance would involve some state agency, or to be more specific, the State Water Resources Board.

A governmental unit which would include both the elements of participation and performance would include both elements of the local and state government. Simply stated, this could be some form of cooperative arrangement with each level doing the function to which it was best suited. Specifically, the breakdown of functions would be as follows:

Functions of the Local Unit:

1. Register conflict and the desire for change.
2. Request information on economic, biological, legal and engineering parameters.
3. Petition for the designation of the area as a resource area.
4. Schedule elections or other local decision-making processes, conforming to alternatives allowed by the state agency.

5. Administer local operative details.

Functions of the State Unit:

1. Over-see the establishment of the local resource area.
2. Delineate alternatives and provide data.
3. Indicate solutions consistent with state resource planning.
4. Aid in the supervision of the elective or other decision-making processes.
5. Aid in enforcing state and local restrictions on a resource decision.
6. Serve as central accounting system for compensation or other monetary exchange schemes.
7. Serve as contact with other state agencies should resource decisions conflict with management planning in their realm.
8. Serve as contact with Federal agencies whenever appropriate.

These functions are consistent with three of the four general guidelines stated in Maxim four (page 78), which are: One, a process of last resort to settle intergovernmental disputes and questions of jurisdiction; two, a process of intergovernmental cooperation; and three, a process by which the several governments may act separately and independently, as well as in cooperation. The fourth, which calls for a process of organic change which can neither be dictated nor stopped by a minority of components, would have to be appended to the above criteria.

State Level Participation

Isolating the pertinent elements of possible forms of state level administration of water resources presents some unique problems. These are largely due to the fact that these functions would be relatively minor in comparison to other state level activities, as well as the fact that there is more than one agency within this government unit which could qualify to administer these functions. This would not be the case at the local government level. In addition there is the possibility of creating an entirely new agency for this purpose. Once again, to avoid proliferation of infinite possible alternatives, our attention will be confined to the State Water Resources Board as the logical candidate for this administrative responsibility. Before proceeding however, this choice deserves some explanation.

There are five basic reasons why the State Water Resources Board would be best suited to water resources management at the state level. First, the Board has been concerned with the problems of water resources since its inception. With this background the new tasks which might be added to its activities would only be a continuation of its present activities. The economies associated with extending the activities of this Board as opposed to creating an entirely new body or remaking an existing agency operating in some other realm can be appreciated by economists and political scientists

alike.

Second, the Board already has the authorization necessary to perform many of the administrative duties that might be imposed on a state agency. Indeed, some of these tasks are already being performed, such as the collection of the data needed to determine the importance and the appropriateness of certain uses of water in each of several geographic areas of the state.

Third, the Board, as the result of this activity, has acquired considerable experience which could be of value in its activities. In addition, as the Board has been extremely cautious in its previous activities it has gained a certain degree of acceptance and rapport with local authorities. Assuming that it would increase its activities gradually this atmosphere would be a great aid in initiating any newly prescribed activities with a minimum time lag.

Fourth, as the Board is an established agency, and political tradition is that new agencies seldom are created in conjunction with the dissolution of existing agencies, the creation of a new agency would be in fact the creation of an additional unit which would compete and conflict with those functions already carried out by the Board. This is not to say that ideally two agencies would not operate in different areas of water resource management with cooperative agreements breeching the gaps, but rather that actual practice indicates the probability of success of such an arrangement to be

negligible.

Finally, there is no existing administrative agency which is in any way better suited to the administration of water resources. With respect to pollution abatement, only the State Sanitary Authority is concerned, and its only experience is confined to enforcing existing laws directed toward the problems caused by specified levels of pollution. Certainly this activity need not be interfered with. The Sanitary Authority will continue to enforce the laws and would play an important role in specifying the effects of certain pollutants and pollution levels. As these are their only activities, they have no experience in resource management and also there would be little opportunity for conflict with the eventual administering unit.

Institutional Modification

As a starting point it is necessary to consider those necessary institutional changes which are associated with administration by a state level unit. To begin this examination, many of the changes may be phrased as changes in existing legislation which describes the legitimate range of activities under the jurisdiction of the State Water Resources Board.

First, and foremost, some attempt must be made to list and define measures of economic welfare and to set up and staff the machinery to achieve these goals. This would include strengthening

ORS 536.220, which makes general statements about maximizing the general welfare of the people through the best use of the resource.

These measures are somewhat arbitrary, as values such as changes in property value, proximity to full employment or the dispersion between income classes could be used. As the present proposal would be to utilize the information generated by an input-output model, measures of general welfare would be the direct and indirect changes in incomes generated in the individual sectors and the income generated for the total area economy.

The machinery necessary to generate these decisions will require a senior economist and a senior political scientist (local government specialist) as well as a supporting junior staff. Physical data relating to biological and engineering data could be provided by the Sanitary Authority, which now gathers this material and would merely have to present it in usable form to the Board. Further specification would be contrary to the governmental principle of allowing sufficient flexibility to meet the variety of problems which may occur at different times and different areas within the state.

Before the Board can proceed with these new functions some provisions must be made for coordinating the ultimate distribution of plans for the individual water resource areas that might be designated throughout the state. This problem is difficult in that one cannot legislate coordination. However, somewhere between the extremes

of one plan to be used throughout the state and an infinity of different plans, one for each resource area, there must exist some optimum number of plans which would account for the basic differences between the different areas of the state. The problems of Yaquina Bay would be somewhat similar to other coastal estuaries. Resource problems throughout Eastern Oregon would have many similarities. The inland streams of Western Oregon, including the Willamette, would provide the greatest variety. However by dividing these into small and large stream systems and those concerning small and large metropolitan areas, it would seem feasible to expect that approximately six to eight basic plans would be sufficient. Aside from the coordinating aspect of minimizing the number of basic plans, some attempt must be made to account for complementary relationships between resource areas within the state. This could possibly be legislated to some degree, the requirement being that a written report explaining the Board's decision in each case should contain a section dealing with the interrelationships between resource units with respect to the decisions at hand.

Once these provisions have been made the next logical step would be to amplify the phrase, "encourage, promote and secure" as it appears in ORS 536.220 (2). Previous statements have been concerned with the tasks to be performed by the Board, with little said about the authority and powers to initiate the plans which may

be generated. This is a crucial element; but it is also outside of the realm of economics. Would it be justifiable to change the phrase "encourage, promote and secure" to the word "require?"

An affirmative answer to this question would be unlikely. The voters of the state would not accept this degree of authority without more frequent opportunities to express approval or disapproval. This would be a particularly relevant issue whenever the Board was considering such matters as revising present patterns and present rights in light of new information. The rigidity of existing patterns could be affected by new information which showed potential benefits from new resource combinations and the steps necessary to achieve these new patterns of resource use. Future use of water resources will be more amenable to administration and guidance, as the Board already has certain powers in regard to designating beneficial uses and forbidding undesirable uses. This study will merely add to the methods to be used to make these evaluations, indicate certain obstacles and suggest how they might best be overcome. In this sense it is possible to promote and to encourage certain choices in the future, though with little hope of immediately securing major changes which involve long-established patterns.[25]

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[25] This problem of overcoming established institutions has been inherited from England, our common-law predecessor (55, p. 20).

In addition, existing law prescribes the necessity of considering only multiple use questions, with the possibility of a single use solution declared automatically not to be in the best interests of the state. Two possible courses of events could be followed. First, this statement and others like it could be removed from the statutes and decisions could be made purely on the merits of existing data, with multiple use resulting whenever factual evidence deemed it advantageous. This would be a more liberal approach and make resource planning that much more dynamic, but there would always be the danger that some decision which was irreversible might prove costly in the long run. This latter reasoning undoubtedly led to this provision initially. The second alternative would be to retain the provision that all results must contain potential multiple uses. In this case the additional functions performed by the Board would be two-fold. First, they could indicate those activities which were retained merely because of the provision that the ultimate resources plan be multiple use. In the event that there was considerable sacrifice involved in adhering to this multiple use principle, this could be emphasized by the provision of data which indicated the short run costs associated with retaining certain multiple uses in a given resource management area. This data, which is not now available, could then be used at some later date as a tool in any reconsideration of the necessity of retaining the option of multiple use.

An additional problem in resource management is ORS 536.310, which states that "-----the laws governing same (rights, duties, priorities) are to be protected and preserved subject to the principle that all of the waters within this state belong to the public for use by the people for beneficial purposes without waste." This is tatamount to saying that the board should strive for everything that is good just as long as it does not change anything. Certainly the crux of this study is that somewhere there should be the freedom to remove priorities, establish new duties and perhaps even modify water rights in the long run. In the sense that any activity will change the value of a right, it is virtually impossible not to effect water rights). Resource management cannot be carried on under the restrictions of this statute if it is rigorously interpreted and enforced. The only area left open is that of unassigned rights and priorities, of which there are few. This statute must be removed or modified before any significant changes in resource patterns may be initiated either under existing functions and rights of the Board or some of the new powers suggested here.

A further section of this law states that a minimum stream flow sufficient to sustain maximum stream life and to minimize pollution must be maintained. This would be another constraint to decision-making. This situation represents one possible solution among many. As this study is designed to examine the economic

facets of resource solutions associated with different pollution levels and different quantities of biomass, there should be some opportunity to consider these alternatives as valid research topics. In addition, to be able to pursue the goals of maximum benefits from the use of resources within that state there should be some freedom to initiate those use programs which would in fact be most likely to achieve this maximum; and this should be the case even if this particular plan might involve pollution levels which were not a minimum or if fish populations were not a maximum. To ensure interests of all concerned some compromise legislation might set limits to the deviations from these arbitrary levels. Future legislation on the Federal level could also set limits on the degree to which certain levels of pollution in intra-state waters might be permissible.

An additional permissive step would be the removal or alteration of ORS 536.320, which prevents 1) supervision or interference with other state or public agencies, 2) modification of existing rights or priorities, and 3) modification or amendment of any existing policy set forth in preceding statutes. Adhering to these statutory provisions would enforce the rigidity of previous decisions and inhibit any changes which might be desirable in the present and the future. This in itself is a modification of the existing statutes, which call for the use of water resources of the state in such a manner as to maximize net economic benefit to the state at all times, implying the necessity

of making changes in use patterns.

One statute which could serve as a significant aid in the administration of water resources is ORS 536.340. This law states that the Board may 1) classify and reclassify water resources of the state as to highest and best use for the future as an aid in developing a program which will be of benefit to the state as a whole, 2) give account to such factors as the economics of these sources of water supply and the economy of the affected areas and other pertinent data. This statement is (subject to the usual qualification about the rigidity of existing rights) the authorization necessary to carry out activities similar to this study. This statement, in conjunction with additional statements about a more liberal attitude with respect to existing rights and further provisions regarding some means of enacting and enforcing the provisions of such water resource programs, would form the core of any future environment for the areal, intra-state administration of water resources in Oregon. This law falls in the same category as the Board itself; it is an institutional element in water resources management which does not act as a constraint, but rather as an aid in this management process. Future attempts at resource management would logically use these positive institutional factors as a starting point.

Dilutions at Toledo. In accordance with previously described analysis, dilution at Toledo is assumed to have the ultimate effect of

a reduction of bottomfish success of 15 percent and a reduction in salmon angling success of 75 percent. These are associated with percent waste concentrations generated by a 600 ton Kraft process pulp and paper mill located at Toledo, Oregon. As this dilution process is assumed to have little effect on shellfish, attention may be confined to laws which will allow these reductions in the above mentioned two categories of sports angling.

To be acceptable, new laws specifying pollution levels must have some qualifying limits. It would be extreme to suggest that some governing body be given the right and power to eliminate existing controls and substitute some blanket power to increase pollution levels without some procedure for measuring the gains and losses associated with each increase in pollution and subsequent changes in resource use patterns. Present laws, which absolutely forbid pollution in any form which results in nuisance, loss of fish life, or loss of recreational activity are no more arbitrary than a substitute law which allowed pollution irrespective of losses in these cases. For coordinated management, these new pollution laws should have statements about maximizing economic benefits, etc., much in the same manner as the Board is compelled to make these measurements. This is to say that the nature of the pollution laws should be integrated with the activities of the Board, with each decision of the Board reflected in the pollution laws and in light of these

pollution laws; and conversely, that each change in the pollution laws should be reflected in and enforced by factual information generated through the activities of the Board.

In addition, to carry this reasoning one step further, these revised laws should be established with sufficient flexibility so that each time there is a change in the basic environment it will not be necessary to devise a complete new set of laws. Rather the laws would be a more efficient complement to management and still provide the required protection to rights holders if the range of economic, physical and socio-political values can be accommodated within the structure of one law or set of laws. Once again, if these pollution laws are tied to the above discussed old and new activities of the Board, the generated stream of information will be sufficient to provide a basis for this continuing (if necessary) re-adjustment of the form, levels and geographical limits imposed on all types of water pollution. In addition, secondary effects of the disposal of effluent into bodies of water may generate air pollution which would also be included in the management process.

Finally, in the change of pollution laws as in the administration of the resource, some attempt must be made to achieve added flexibility and prompt adjustment by avoiding the ad hoc process of adjudication to determine losses due to liability. As this process is in itself compensation through comparing losses and gains to

individual rights holders, the concept of compensation is not new. Changing this process to an ex ante position in the sequence of decision-making would aid in identifying those affected. By utilizing the information generated by the input-output model the values in the compensation process could be identified and debates about the degree to which changes in pollution are just to all concerned could be minimized by alleviating certain "unjust" (ie., uncompensated) aspects of these changes.

The following is a summary of the Oregon pollution statutes which would have to be eliminated or revised in order that certain pollution levels might be acceptable. The first of these laws is ORS 449.075, in which one section states: "Standard" or 'standards' means such measure of quality or purity for any waters in relation to their reasonable and necessary use as may be established by the Sanitary Authority pursuant to this chapter." The establishment of these standards must be related to all the measures under consideration by the management authority and therefore should be established under the supervison of this authority. The sanitary authority would retain the functions of providing the specific measures of the general pollution controls specified by the resource management unit and would also continue to enforce these measures. The sanitary authority would no longer be burdened with the task of making considerations as to the questions of reasonable and beneficial use.

ORS 449.077, which includes many of the typical statements exhorting compliance with the previously noted welfare goals could either be incorporated into the legal structure of the State Water Resources Board or eliminated entirely. It adds nothing that has not been stated repeatedly in other statutes. A law of greater importance is ORS 449.080. Here broad powers are given to the State Sanitary Authority. In order that the Water Resources Board may be able to operate in the manner envisioned on previous pages, these powers of the Sanitary Authority must be revised. Of the ten functions mentioned in this statute, seven would be an aid in the proposed management process. These include encouraging voluntary cooperation, conducting studies, enforcement, cooperation with other agencies, employing the necessary personnel, settling legal suits, and performing miscellaneous tasks. The first section needing revision concerns formulating, revising, and interpreting pollution load requirements. Without suggesting the specific mechanics here, these functions should be performed in conjunction with the Board, with the latter retaining ultimate responsibility. The second section in need of amendment is virtually of the same form. It relates to modifying or amending standards of quality and purity. The third section concerns the Authority's rights to issue or deny permits. This would be transferred to the Board, presumably acting upon information provided by the Sanitary Authority and other

information provided by its own staff. This would facilitate decision-making based upon a wider range of information, gathered by staff members representing a broader range of interests. One function, enforcement, would be shared by these state agencies, with each confined to its specialty areas, except that the Board would retain ultimate responsibility.

ORS 449.086 specifies the manner in which the Authority shall set about establishing the above mentioned standards. Despite the suggestion that this authority shall be transferred to the Board, this statute is still valuable in that it may now be used as a guide by the Authority as it prepares recommendations for the Board. The guides used are such criteria as floating solids, settleable solids, presence of organisms or virus, dissolved oxygen content, and health danger. These guides are preferable to other measures related to the economic welfare of the state.

ORS 449.095 declares that any disposal activities which may result in a public nuisance, as this is defined, must be prohibited. However, this law does not allow for the fact that a public nuisance is usually contingent upon some public complaint, and if this complaint can be avoided by compensation then there would be no need to enforce pollution laws in situations which have been ascertained as nuisance cases on the basis of previous decisions. This is to say that a given solution in one area might be defined as a nuisance

if it either was beyond the limits of a given solution and the compensation involved or if no provision had been made for compensation. The existence of such a situation might be a signal for the initiation of a review of resource management in the area in question, but would not be projected on a state wide basis.

ORS 449.110 prohibits the deposit of industrial wastes. This statute would be modified to state that the disposal of industrial waste was subject to regulation and would forbid the disposal of wastes other than in the form, quantity and location prescribed by the Board in conjunction with the suggestions of the Authority.

One additional law, ORS 509.460, prohibits any activity harmful to shellfish. As this consideration would already be included in any evaluation made by the Authority, there is little need for a statute concerning a specific activity, especially such an absolute limitation.

Remaining Alternatives. Once a framework has been established for the management of water resources within the scope of a state-local cooperative arrangement, with particular reference to changes from the present form of rights and pollution law, virtually all possible alternatives have been considered. If this proposed management scheme has sufficient flexibility there need be no special arrangements for either of the pollution alternatives of disposal by dilution at Toledo, disposal by dilution at McLean Point,

disposal by dilution of $\frac{1}{2}$ the effluent load at Toledo and $\frac{1}{2}$ into the ocean, or any other feasible alternative.

With respect to the local unit of government, little can be said in a study of this nature beyond the previous observations on the shortcomings and possible strong points of either county or special district government. In the few instances where the county unit might be the appropriate cooperative entity, a step-by-step examination of existing powers and subsequent evaluation of the alternatives of either county re-organization or the appending of additional powers and responsibilities would be necessary to make the above-outlined management plan operative. Special districts, which would be geographically appropriate more often, could be established in their present general manner, with adjustments appended to account for the necessary cooperative interrelationships with the state agency.

V. SUMMARY, CONCLUSIONS AND SUGGESTIONS FOR FUTURE RESEARCH

Summary

This study has been a two-step analysis. First, possible forms of resource allocation have been determined which meets some measure of increased efficiency and then the likelihood of achieving any proposed re-allocation has been examined in light of the existing institutions. This has led to suggested modifications in such areas as water rights and pollution law and local and state government as applied to the administration of water resource allocation.

By means of a 16 sector input-output model using primary data collected as part of this study the Yaquina Bay estuary and its surroundings on the Pacific coast of Oregon were examined to determine the interrelationships between the sports fishery sector, the lumber products sector and the 14 other sectors of the economy of the study area.

Aside from the development of the technical model, the objectives of the study were to examine various disposal alternatives associated with a pulp mill at the head of the estuary so as to ascertain the economic effect of these alternatives on the various sectors of the economy. Biological and engineering data from earlier studies were used as starting points in this process. The alternatives

examined were disposal by dilution at the Toledo plant site; disposal by dilution at McLean point, a mid-estuary location; disposal by pumping to an ocean outfall; disposal by pumping $\frac{1}{2}$ of the effluent load to the ocean and by dilution of the other half at Toledo; and finally, an unspecified alternative which would result in the elimination of the sports fishery.

Once these alternatives have been quantified in terms of net economic benefits, certain compensation schemes, as described in a section on welfare theory, were delineated as possible means to achieving a "better" use of the water resources of the study area. These alternatives were then exposed to pertinent elements of water rights and pollution law, as well as the legal specification of the organization and function of the units of state and local government in order to ascertain the alterations that would be necessary to adopt and administer a particular resource management plan. A further examination on this subject involved an evaluation of the various potential forms of state and local government which could be available for the administration of the resource plan. Criteria drawn from the literature on local and state government operation and efficiency were used as guidelines for this portion of the study.

Thus, the results of this study include: an evaluation of the input-output model as a tool in the investigation of resource management in small geographical areas; measures of the direct and

indirect effects of changes in the methods of efficient disposal; net benefits associated with the costs and gains resulting from the hypothetical initiation of either of the effluent disposal alternatives, this net to be used as the numerical portion of an example of types of compensation agreements which could be used to achieve either of the resource use alternatives; an evaluation of the magnitude of earnings which could be obtained by a pricing mechanism enacted by a non-discriminating monopolist, and the additional effect this increment might have on decision-making; the modification of water rights and pollution laws which would be necessary to actually proceed in the enactment of one of the disposal alternatives considered; and finally, the exposition of an administrative framework which would be most able to cope with the variety of problems encountered in water resource administration and still meet various criteria of an ideal governmental unit.

Conclusions

An appropriate method of summarizing the conclusions of this study is with reference to the hypothesis stated earlier in this dissertation. The first of these states that a range of pollution levels exists which will make a significant difference in the income levels generated in those sectors associated with sports fishing, tourism, and recreation.

An initial measure of these effects, changes in gross output, is shown in tables 8 and 9. These figures indicate that the greatest change occurs when considering alternative d, the total loss of the sports fishery. The magnitude of this change is from $124,068,793 to $123,750,990, or $317,803 (.3% of the total gross output for the study area). Specific alternatives resulted in lesser decreases of magnitude $94,120 for alternatives a and b (disposal by dilution at Toledo and disposal by dilution at McLean pt.) and $52,056 for alternative c (dispose $\frac{1}{2}$ at Toledo and pump $\frac{1}{2}$ to ocean).

A more precise measure, the distribution of the income effect generated in the new household figures for the separate runs of the input-output model of the study area, gives a further indication of the magnitude of the effects of the various disposal alternatives. For the total loss alternative, sector 16, the household sector, showed a decrease of $59,298 associated with the above change of $317,803 in gross output. Corresponding figures for a and b were $17,603 and $9,736 for alternative c. The magnitude of these changes is somewhat greater than that of gross output, approximately two percent.

A further measure of the extent of the effects of these disposal alternatives, subject to theoretical qualifications, is an opportunity cost associated with a potential pricing policy that could be enacted by a non-discriminating monopolist. Table 12 shows that as

compared to the present disposal method, maximum attainable monopoly revenues would decrease $5,896, $6,910, and $2,908 for alternatives of disposal at Toledo, McLean Pt. and $\frac{1}{2}$ at Toledo in that order. These could be assigned to the 16 sectors according to the distributive pattern revealed in table 10.

These figures are for the total local economy. Further examination of those sectors associated with sports fishing, tourism, and recreation reveals that a majority of these quantitative changes were confined to the five sectors where the initiating monetary transaction took place. For example "84.6 percent of the decreases in income were registered in five sectors (3, 4, 5, 12, 13)"..."an additional 9.1 percent was registered in the two remaining directly affected sectors (7, 8), with only 6.2 percent being registered in the remaining nine sectors subject to an indirect effect" (Page 113).

These statistics and their magnitude indicate that although the differences in income levels associated with each of the disposal alternatives can be measured, it would be extreme to claim that these differences are significant. This should not be interpreted as a normative statement, as the size of these differences may still be sufficient to stimulate and justify adjustment in resource use patterns.

The second hypothesis states that a range of pollution levels exists which would lead to alterations in the production levels of the

Georgia-Pacific pulp mill located in the city of Toledo on Yaquina Bay. Although the original intention was to include the testing of this hypothesis in the quantitative procedures of the input-output model, this intention was inhibited by one situation which was not wholly unexpected. To obtain the information necessary to calculate possible alterations in the production pattern of this mill it would be necessary to go to the mill personnel responsible for decision-making and pose such questions as: "Would you increase production and hire more employees if pollution laws were changed in such a manner as to result in a cost saving to you?" Given the institutional environment and the attitudes prevailing in the study area, as might be indicated by an examination of the relative position of this firm in the area's economy, answers to questions such as these would not be acceptable as a basis for further examination. Also, it was feared that the posing of such questions would jeopardize relationships crucial to other aspects of the study.

However, this does not mean that some general conclusions cannot be obtained from an examination of data generated from other portions of this study. Table 17 will serve as a guide. Here, for example, a comparison of the change in generated income and the change in the cost of effluent disposal for a change from the present disposal methods to the alternative of disposal by dilution at Toledo reveals a residual available for compensation of $115,397. After

applying some appropriate portion of this residual to actual compensation the remainder would be available for additional investment into the productive process. As the alternatives would be either this investment or retaining this sum as a windfall gain, it should be possible to approximate the possible courses of action. The likelihood of this firm continually retaining this increment as a windfall gain is irrational. This might occur if this residual were to be a once only occurrence. With a continuing compensation mechanism this increment, or some portion of it, would be recurring, and as such would be a regular portion of the input-output calculations of the firm. In this manner it would enter into the pool of funds available for input purchases, leading to an increase in employment, the key variable endogenous to this study area. These wage incomes would then enter into the calculations of sector 16, adding further importance to the consideration of these disposal alternatives.

Hypothesis three stated that "the different production levels of the pulp mill will result in significant changes in the income levels generated in those sectors associated with pulp, paper, and lumber production." Although it was possible to reach some tentative conclusions regarding the previous hypothesis, projection to the degree required to test this hypothesis cannot be justified without additional information. The mechanism established to measure other changes in sectoral inputs would be adequate to determine the test of this

hypothesis should this data be obtained. This hypothesis remains untested at this time.

The fourth hypothesis states that "as an alternative to present legislation and legal dictation of certain distribution, compensation schemes exist which will lead to whatever solution may be chosen by the appropriate decision-making body." Sufficient information has been generated from the procedures of this study so that it would be possible to construct a compensation framework as an aid to the initiation of changes in the resource use patterns. The quantity of new legislation required however, need not be large.

Table 17 contains the residuals available for compensatory payments. As this residual is in all four cases greater than the income losses resulting from the enactment of one of the disposal alternatives, it may be used as both a guide to the magnitude of the possible compensation as well as an indication of a possible preference ranking among the alternatives available. The order of preference would be: First, disposal by dilution at Toledo ($115,397); second, total loss ($79,702); third, disposal by dilution at McLean Point ($55,397); and finally, disposal by dilution of $\frac{1}{2}$ at McLean Point ($28,764).

Actual compensation is determined by referring to the distribution of the re-calculated income effects for each disposal alternative. As compensation is a form of income effect, compensatory

payments can be distributed in the same proportional manner as the changes resulting from the enactment of each of these disposal alternatives. As shown in table 18, seven sectors account for 94 percent of the income changes, and the percentage distribution of the top five of these is as follows: sector 5, marines and marine supplies (24.4%); sector 3, hotel, motel and trailer parks (17.0%); sector 4, cafes and taverns (15.7%); sector 13, other service-oriented wholesale and retail (15.5%); and sector 12, other product oriented wholesale and retail (12.1%). The remaining of seven sectors are much less significant, with sector 7 (service stations, auto parts, sales and repair (5.4%) and sector 8, communication, transportation, including shipping (3.7%) accounting for the remainder of the 94 percent distribution in the income effect. These percentage distribution figures may be used as guides to the proportional distribution of monetary flows which might be part of any proposed compensatory mechanism.

Legislative or statutory barriers to compensation of the sort described here are not prohibitive. In virtually all discussion of water rights these rights are stated as either inviolable or subject to some measure of compensation if violated. Though the issues here do not concern actual rights per se, as rights to water use in the study area have not in fact been established, the protection provided by the pollution laws have in fact established guarantees

which are the equivalent of rights. It would seem logical that the violation of these pollution laws, or the violation of these de facto rights, might also be subject to some consideration of compensation within the framework of existing law. At a minimum, the foundation exists for further modification of these laws to more explicitly provide for compensation in the cases of deviation from the guidelines of pollution law. This circumvention would of course not be necessary if the basic pollution laws now in existence were modified to provide directly for alternative levels of water purity, as determined by resource users in cooperation with administrative officials. Though the latter of these two methods for providing a legal basis for compensation would involve greater actual legal modification, neither of these procedures involves great conceptual difficulty beyond the framework described and used in this study.

The final hypothesis states that

> ...an appropriate organization does not exist which has the necessary powers and authority to implement the desires of those individuals principally affected by the allocation and/or re-allocation of water uses on Yaquina Bay and it is not possible to design an appropriate unit within the framework of water rights and pollution laws and government organization.

This hypothesis may be neither totally accepted nor rejected. First of all, appropriate organizations do exist which have many of the powers necessary for water resource management. What is needed is supplementary powers, some re-organization, and the

information crucial to the manipulation of the variables central to the administrative process. Many of the institutions prevalent in the present environment could serve as positive factors in management in that they serve as a foundation in the formulation of the management structure resulting from the investigation described on the previous pages.

Using certain criterion the issue of the "best" management unit was resolved in favor of a cooperative arrangement between the State Water Resources Board and some local unit, either the county or a special district. These criterion included the need for federal cooperation, the resolution of certain legal questions, jurisdiction and distribution of functions, legal and administrative ability and economies of scale and size, and accessibility, participation and performance. Evaluation of state and local units of government in terms of each of these criteria lead to the conclusion that no single unit of government could be deemed exclusively appropriate in light of this evaluation. The logical conclusion was a division of power with one unit reserving the right of final authority in its own special area, bound together by a cooperative agreement. After designating the State Water Resources Board the ideal State level organization based on its prior experience, authority, and the desire to avoid unnecessary duplication, it was possible to design a division of functions in which the Board would be primarily responsible for the

establishment and partial supervision of the local resource area, the provision and supervision of all pertinent statistical materials, the coordination of state resource planning, aid in the supervision and enforcement of local resource decisions, and the cooperation with other state and local agencies. The local unit, possibly the county, but most often a special district, would initiate the process of forming a resource area and requesting the needed information, as well as performing all local decision-making functions and administering local details. It would have the ability to have some control in state administrative procedures.

In addition to these administrative issues, this hypothesis must be considered with respect to specific water rights and pollution laws which could preclude specific management alternatives. It is not the place of this study to consider the political likelihood of modifying or eliminating such laws. Rather, the purpose has been to designate such laws and indicate either revision or elimination or perhaps strengthening these laws directly related to the implementation of specific resource management plans. With respect to the hypothesis this can and hopefully has been done.

In general, this study has indicated not only the possibility of measuring direct and indirect benefits associated with different methods of effluent disposal, but it has also served as an introduction to means of using these results in the process of resource

management. The resultant data may act as necessary if not sufficient stimulus for the attainment of an array of possible "second best" or "better" solutions, as compared with the total product now generated by resource use patterns existent in the present institutional structure. It is the existence of these institutions which inhibits the attainment of perfect "first best" solutions. The degree to which the institutional surroundings may be incorporated into the decision-making structure will determine in large part the likelihood of achieving second (third, fourth, etc.) best solutions.

This can be done by means of a compensation scheme such as the one described here. Though the proposals emanating from this examination may be subject to the criticism that they involve substantial institutional revision, some of this revision bordering on the ideal, they are presented as a "better" alternative than the course of merely presenting sterile economic solutions which are completely incompatible with the existing institutional structure.

There are, nevertheless, several issues which find comment to emphasize certain possible limitations of this study. First of all, it must be emphasized that the values generated in this study should be associated solely with the use of the water resource as an input in the sports fishery. This is a measure of the variability of water quality as a catalyst in economic activity through this avenue only. It is not a measure of the effects of changes in water

quality per se, but merely a measure of the effects of these changes directly upon the sports fishery and indirectly upon the total economy in subsequent interactions. This study does not present a measure of the economic value of tourism complementary to sports fishing, such as those who travel through the study area solely because of its charm as a fishing village, with their expenditures not being part of the statistical measures in this study. The fact that these complementary relationships are not measured must be acknowledged as a severe limitation of this study, though the magnitude of their conceptual and measurement problems justify their exclusion as separate areas of study.

The second limitation of this study is related to the issues unearthed in the discussions of the similarities between land tenure and water rights ownership with respect to the existence and extent of undetermined opportunity costs associated with uncertainties of resource ownership. Measurement and compensation schemes discussed in this study do not include any ex poste adjustments in production patterns which might result due to the dimunition of uncertainty resulting from the initiation of a perpetuating compensatory framework. All data used herein was generated in the ex ante environment of ownership uncertainty. This suggests the advisability of re-examining the technical coefficients of the input-output model in the ex poste compensation framework, as a possible step

in achieving further precision in the measurement of the compensatory flows as they may more accurately stimulate adjustments in resources toward the goal of even "better" solutions.

In addition to these two items, there are two other issues which are relevant to policy questions. The first of these concerns flexibility in resource management decisions.

What values can be attached to flexibility in resource decisions such as those considered here? At issue are the possible cumulative losses resulting due to irreversibility. Such an incident could occur in this study with respect to the loss of the sports fishery. Ignoring such a possibility in the process of policy formation would constitute a misuse of the results of this study.

Nevertheless, the flexibility question does not effect the procedural contribution of this study. For example, a decision leading to the reduction in the fish population could be examined for a period of time equivalent to the years necessary to reverse this decision. This would require short term projections of the input data for the input-output model. Considering the likelihood of the total loss of the fishery (the only alternative where the question of irreversibility is crucial) and the relatively quick restoration of the bottom fishery in the area of Zone one (the most important element of the sports fishery) these adjustments should not prove insurmountable.

For the pulp mill, the time range on its flexibility are a

function of the building requirements and the construction period associated with a particular effluent handling procedure. Beyond this limit flexibility can be achieved, though both the threat of change and/or actual change on a frequent basis will increase operating costs and effect investment through the risk factor. These are measurable variables however, and can be included in an evaluation if necessary.

For the remaining sectors of the input-output model it would be necessary to determine what the planning period will be, as determined by flexibility limits, and then run the model for this period. The issue of adjustment in the technical coefficients will have to be resolved, either allowing these coefficients to remain constant for this planning period, or providing for some adjustment based on supplemental information.

In summary, though the question of flexibility may dictate the need for adjustments in the management procedure discussed here, these adjustments should be of only a technical nature, entirely within the bounds of existing knowledge. Conceptually, this would merely involve an adjustment in terminology, to consider each disposal alternative in terms of some planning period defined by certain indeces of flexibility.

The final issue concerns the advisability of actually making one of the changes considered in this study. In addition to questions as

to the irreversibility of a given decision, one must also consider the actual costs of making the decision versus the gains to the economy generated by the revised management pattern. Perhaps it is sufficient to merely indicate those sectors (individuals, groups) which should be involved in the decision-making process, without actually suggesting an actual compensatory procedure to be implemented.

A relevant factor in devising an answer to this question is the comparison of the costs associated with adjustment in an individual economic area as considered in this study as opposed to costs associated with state-wide resource management in a state-wide combination of similar resource areas.

At the local level management costs would in virtually all cases be so great as to negate the value of the input-output procedures and welfare and institutional economics as actual guides in decision-making. In this instance one can only conclude that the present resource-management procedures are the best possible, and that the results of this study serve primarily to indicate institutional modifications which may improve this process. In this instance the compensatory procedure merely serves to indicate those involved, and the degree and scope of their involvement, with no intention of suggesting actual steps to be taken.

On a larger geographic basis the dividing line between design and action is less distinct. Costs associated with data collection,

economic and legal counsel and management and coordination may experience sufficient economies so that certain alternatives may be validly considered as action proposals. Once again, a likely candidate would be total loss of the fishery, with its greater discrepancy between gains and losses. Nevertheless, this remains as a problematical issue.

The primary value of the mechanism developed here, and one which is surely subject to greater irrefutability, is as a guide to the design of institutional modifications which will enhance the maximizing tendencies of the present resource management system; the generation of a "better" solution.

Suggestions for Future Research

Briefly, the following are some suggestions for future research related only to the economic aspects of this cooperative research project.

1. Some attempt should be made to establish a multi-level input-output model for the state. Rather than focusing exclusively on a single resource area, such a model may be used to examine the effects of resource plans involving several or all the designated resource areas of the state. This would at least in part answer the criticism aimed at the procedure of maximizing resource use in one area of the state to the exclusion

of others.

2. A second information gap concerns the investment patterns of the pulp mill in this study and other waste disposal firms with respect to cost savings associated with different disposal alternatives. The manner in which these savings are "used" could have a significant impact on the direct and indirect money flows in the affected economic areas. These flows would then provide a further measure of the potential compensatory sums available to guide resource use toward an increase in net social product.
3. The uncertainties associated with the "ownership" of water and rights to its use at certain quality levels can be hypothesized to have perverse effects on optimum resource planning. This hypothesis should be tested to determine if this effect is significant to a degree to distort the measures proposed in this study.
4. Tourism as an economic activity complementary but not included in the measurement of the economic value of the sports fishery should be examined to determine the magnitude of the activities and their effect on decision-making in water resource management in this and other resource areas within the state.
5. The present examination, reflecting statistics gathered for the year 1963, though a significant achievement in static measurement for a small area economy, nevertheless is subject to the threat of obsolescence soon after the results have been generated, thereby reducing its usefulness as a guide to resource use planning. The values of this study would be enhanced if

future research could establish either that variability in the technical coefficients is not great for short periods or that certain trends in change exist and these trends may be used as reliable guides to adjusting crucial technical coefficients over time. A third, though less attainable solution, would be the creation of a completely dynamic model fed by a continuing supply of basic statistics.

6. Of prime importance to the implementation of the results generated in this study is the inflexible, irreversible nature of the alternative solutions considered. Though this need not be crucial should the use of these results be confined solely to the design or alteration of the pertinent institutional elements, further use of such devices as compensation must be restricted until more precise measures of flexibility in resource decisions can be ascertained and quantitative measures attached.

7. To attach a normative weight to an alternative solution or a series of alternative solutions without some attempt to quantify the costs associated with the operation of the management mechanism itself would be improper use of this study. Though approximations of such costs can be made through casual observation, this issue merits further study, especially with respect to the economies derived from state-wide or regional coordination and provision of many of the requisite management services.

8. In this study no attempt was made to ascertain the relationship between the bay sports fishery and the ocean sports fishery. Though any inter-relationships of this sort may be negligible, they should be clarified by means of research designed specifically to delineate economic effects of quality changes on the ocean based sports fishery and also any complementarities that may exist between bay and ocean fisheries.
9. Though considered in part in this study, local government forms have not been analyzed thoroughly with respect to their capabilities as resource managers. It would seem appropriate that research efforts be devoted exclusively to the efficiency of these entities as natural resource administrations.

These nine areas of potential research represent issues related solely to the economic portions of this cooperative research project, and are the direct result of problem areas uncovered as part of this dissertation.

BIBLIOGRAPHY

1. Alderdice, D. F. and J. R. Brett. Some effects of kraft mill effluent on young pacific salmon. Journal of the Fisheries Research Board of Canada 14:783-795. 1957.

2. Allen, Clark Lee. Modern welfare economics and public policy. Southern Economic Journal 19:28-36. 1952.

3. American Law Review. Vol. 38, sec. 1388.

4. _____. Vol. 46, sec. 9.

5. _____. Vol. 47, sec. 43.

6. _____. (Second series) Vol. 49, sec. 253.

7. American Jurisprudence. Vol. 56. Waters, sec. 273-83.

8. Background information on the proposed constitutional amendment for county home rule. Bureau of Municipal Research, University of Oregon, Eugene, Oregon, 1958, 24 p.

9. Bailey, M. J. The interpretations and application of the compensation principle. Economic Journal 66:39-52. 1954.

10. Bator, Francis. The simple analytics of welfare maximization. American Economic Review 47:22-60. 1957.

11. _____. The anatomy of market failure. Quarterly Journal of Economics 72:351-379. August 1958.

12. Baxter, Robert L. Western water and the reservation theory - the need for a water rights settlement act. Montana Law Review 26:199-217. Spring 1965.

13. Bollens, John C. Special district governments in the United States. Berkeley, California, University of California Press, 1957. 280 p.

14. Bowen v. Spaulding, 128 Pacific Reporter 37 (1912).

15. Bower, Blair T. Some physical, technological, and economic

characteristics of water and water resources systems: implications for administration. Natural Resources Journal 3:215-238. 1963.

16. Bromage, Arthur W. and Kirk H. Porter. County home rule: pro and con. National Municipal Review, October, 1934, p. 514-519.

17. Brown v. Gold Coin Min. Co., 86 Pacific Reporter 361 (1906).

18. Buchanan, James M. Private ownership and common usage: the road case re-examined. Southern Economic Journal 3: 305-316. 1956.

19. _____. Politics, policy, and the Pigovian margins. Economica 29:17-29. 1962.

20. _____. The calculus of consent, logical foundations of constitutional democracy. Ann Arbor, Michigan, University of Michigan Press, 1962. 361 p.

21. Buchanan, James M. and William Craig Stubbelbine. Externality, Economica 29:271-285. November 1962.

22. Burke, C. R. Rights and remedies in the law of stream pollution. Virginia Law Review 35:775-786.

23. California-Oregon Power Co. v. Beaver Portland Cement Co., 73 Federal Reporter (second series) 555, 567. (1934).

24. Coase, R. H. The problem of social cost. The Journal of Law and Economics 3:1-44. 1960.

25. Colorado. Governor's Local Affairs Study Commission. Local government in Colorado, findings and recommendations. 1966. Denver, Colorado. 140 p.

26. Corpus Juris Secundum. Vol. 93. Waters, sec. 10 and 18.

27. Crutchfield, James A. Common property resources and factor allocation. The Canadian Journal of Economics and Political Science 22:292-300. 1956.

28. Davis, Otto A. and Andrew Whinston. Externalities, welfare, and the theory of games. Journal of Political Economy 70: 241-263. 1962.

29. Engelbert, Ernest A. Federalism and water resources development. Law and Contemporary Problems 22:327-346. Summer, 1957.

30. Federal Water Pollution Control Act. 62 Stat. 1155, as amended, 33 U. S. Code 466 et seq.

31. Ferguson v. Firmenish Mfg. Co., 77 Iowa Reports 576, 42 Northwest Reporter 448 (1889).

32. Fisher, Franklin M. Income distribution, value judgements, and welfare. Quarterly Journal of Economics 70:380-424. 1956.

33. Fox, Irving K and Lyle E. Crane. Organizational arrangements for water development. Natural Resources Journal 2:1-45. 1962.

34. Fox, Irving K and Orris C. Herfindahl. Attainment for efficiency in satisfying demands for water resources. American Economic Review 54:198-206. 1964.

35. Gibbs, Kenneth C. Arriving at the least cost combination for disposing of waste from a kraft process pulp and paper mill located on the Yaquina estuary in Toledo, Oregon. Department of Agricultural Economics, Oregon State University, Corvallis, Oregon. 1965. (unpublished paper).

36. Gordon, Scott H. The economic theory of a common property resource. Journal of Political Economy 62:124-142. 1954.

37. Gross, Alan D. Condemnation of water rights for preferred uses - a replacement for prior appropriation? Willamette University School of Law, Salem, Oregon. 1965. (unpublished paper).

38. Harris, v. Brooks, 225 Arkansas Reports 436: 283 Southwest Reporter (second series) 129 (1955).

39. Harris, Dennis R. Alternatives for disposal of kraft mill wastes in Yaquina estuary, Oregon. Department of Civil Engineering, Oregon State University, Corvallis, Oregon. 1964. (unpublished paper).

40. Hanson, Ivan R. Some aspects of water pollution. Ph. D. thesis. Madison, University of Wisconsin, 1963. 163 numbered leaves.

41. Harrod, R. F. The scope and method of economics. Economic Journal 58:386-397. 1938.

42. Heady, Earl O. Economics of farm leasing systems. Journal of Farm Economics. 29(3):559-578. 1947.

43. Heady, Earl O. and John F. Timmons. Economic framework for planning efficient use of water resources. In: Iowa's water resources, ed. by J. F. Timmons et al. Ames, Iowa State College Press, 1956. p. 47-61.

44. Hicks, J. R. The foundations of welfare economics. Economic Journal 59:696-712. 1939.

45. Holland, G. A. et al. Toxic effects of organic and inorganic pollutants on young salmon and trout. Seattle, 1960. 264 p. (Washington. Department of Fisheries. Research Bulletin no. 5).

46. Hutchins, Wells A. The common law riparian doctrine in Oregon: legislative and judicial modification. Oregon Law Review 36:193-220. April 1957.

47. _____. Background and modern developments in water law in the United States. Natural Resources Journal 2:416-444. 1962.

48. In re Hood River, 227 Pacific Reporter. 1065 (1924).

49. In re Schollmeyer, 138 Pacific Reporter. 211 (1914).

50. In re Willow Creek, 144 Pacific Reporter. 505 (1914).

51. Johnson, Ralph W. Riparian and public rights to lakes and streams. Washington Law Review 35:580-615. 1960.

52. Kaldor, Nicolas. Welfare propositions of economics and interpersonal comparisons of utility. Economic Journal 49: 549-552. 1939.

53. Kamien, M. I., N. L. Shwartz, and F. T. Dolbear. Asymmetry between bribes and charges. Water Resources Research 2:147-159. 1966.

54. Kennen, Peter B. On the geometry of welfare economics. Quarterly Journal of Economics 71:426-447. 1957.

55. Kneese, Allen v. Approaches to regional water quality management. Prepared for Pollution and Our Environment, A national conference sponsored by the Canadian Council of Resource Ministers, October 31 to November 4. (1966). (unpublished paper).

56. Kyser, v. New York Cent. R. R. Co., 271 New York Supplement 182(1934). 151 N. Y. Misc. 226.

57. Little, I. M. D. The foundations of welfare economics. Oxford Economic Papers 1:227-246. 1949.

58. Lipsey, R. G. and R. K. Lancaster. The general theory of second best. Review of Economic Studies 24:11-32. 1956-57.

59. McKensie, Lionel W. Ideal output and the interdependence of firms. Economic Journal 61:785-803. 1951.

60. Meade, J. E. External economies and diseconomies in a competitive situation. Economic Journal 62:54-67. 1952.

61. Milliman, Jerome M. Commonality, the price system, and use of water supplies. The Southern Economic Journal 22:428-437. 1956.

62. _____. Water law and private decision making. Journal of Law and Economics 11:41-63. October 1959.

63. Mishan, E. J. A survey of welfare economics, 1939-59. Economic Journal 70:197-265. 1960.

64. _____. The principle of compensation reconsidered. Journal of Political Economy 60:312-322. 1952.

65. _____. Welfare criteria for external effects. American Economic Review 51:594-613. 1961.

66. _____. Second thoughts on second best. Oxford Economic Papers 14:205-217. 1962.

67. Mishan, E. J. Reflections on recent developments in the concept of external effects. Canadian Journal of Economics and Political Science 30:3-32. 1965.

68. Munro, James. The Pelton decision: a new riparianism? Oregon Law Review 36:221-252. 1957.

69. 14 Opinions of the Attorney General of the State of Oregon. (May 6, 1930) 535.

70. 17 Opinions of the Attorney General of the State of Oregon. (Dec. 31, 1935) 636.

71. 23 Opinions of the Attorney General of the State of Oregon. (June 24, 1948) 541.

72. 24 Opinions of the Attorney General of the State of Oregon. (Nov. 23, 1949) 350.

73. Oregon. Legislative Interim Committee on Local Government. Findings and recommendations. Salem, State of Oregon, 1956. 204 p.

74. Oregon. Legislative Interim Committee on Local Government. Metropolitan and urban area problems in Oregon. Salem, State of Oregon, 1963. 57 p.

75. Oregon. State Planning Board. Advisory Committee on Stream Purification. An analytical digest of existing legislation in Oregon and other states relating to stream pollution. Salem, State of Oregon, 1956. 57 p.

76. Oregon, State University, Water Resources Institute. Seminar proceedings in water quality control, fall quarter, 1964. Corvallis, Oregon State University, 1964. 120 p.

77. Ostrom, Vincent. The water economy and its organization. Natural Resources Journal 2:55-73. 1962.

78. Pacific Reporter, Vol. 95. p. 732.

79. Parrish, Loys Phillip. The predicted influence of kraft mill effluent on the distribution of some sports fishes in Yaquina Bay, Oregon. Master's thesis. Corvallis, Oregon State University, 1966. 88 numb. leaves.

80. Pavelis, George. Irrigation policy and long-term growth functions. Agricultural Economics Research 17:50-60. April 1965.

81. Quesseth, Cecil H. Water Pollution control laws of Oregon - Problems of enforcement. Salem, Oregon, 1965. 14 p. (unpublished paper).

82. Roberts, Victor J., Jr. Purity and utility: diversity of interest in river pollution. University of Pennsylvania Law Review. 84(5):630-640. 1936.

83. Samuelson, Paul A. Evaluation of real national income. Oxford Economic Papers 12:1-20. 1950.

84. _____. Further commentary on welfare economics. American Economic Review 33:604-607. 1943.

85. Schickele, Ranier. Effect of tenure systems on agricultural efficiency. Journal of Farm Economics 23:185-207. 1941.

86. _____. Obstacles to agricultural production expansion, Journal of Farm Economics 24:447-462. 1942.

87. Scitovsky, Tibor. Two concepts of external economies. Journal of Political Economy 62:143-152. 1954.

88. Scott, Anthony. The fishery: the objectives of sole ownership. Journal of Political Economy 63:116-124. 1956.

89. Smith, Stephen C. The role of the public district in the integrated management of ground and surface water. In: Economics and public policy in water resource development, ed by Stephen C. Smith and Emery N. Castle. Ames, Iowa State University Press, 1964. p. 341-352.

90. _____. Organizations and water rights in the rural-urban transfer of water. In: Economics and public policy in water resource development, ed. by Stephen C. Smith and Emery N. Castle. Ames, Iowa State University Press, 1964. p. 353-367.

91. Snider, Clyde F. American county government: a mid-century review. American Political Science Review 46:66-80. 1952.

92. Stein, Murray. Problems and programs in water pollution. Natural Resources Journal 2:388-415. 1962.

93. Stevens, Joe Bruce. A study of conflict in natural resource use: evaluation of recreational benefits as related to changes in water quality. Ph. D. thesis. Corvallis, Oregon State University, 1966. 205 numb. leaves.

94. Stigler, George J. The new welfare economics. American Economic Review 33:355-359. 1943.

95. Taylor v. Welch, 6 Oregon Reports. 198, 200.

96. Timmons, John F. Problems in water use and control. Iowa Law Review 41:160-180. Winter 1956.

97. Trelease, Frank J. Policies for water law: property rights, economic forces and public regulation. Natural Resources Journal 5:1-49. 1965.

98. Turvey, Ralph. On divergences between social cost and private cost. Economica 30:309-314. 1963.

99. University of Oregon Bureau of Municipal Research. Background information on the proposed constitutional amendment for county home rule. Eugene, University of Oregon Press, 1958. 24 p.

100. _____. Planning by local government in Oregon, Eugene, University of Oregon Press, 1963. 65 p.

101. U. S. Advisory Commission on Intergovernmental Relations. An information report, performance of urban functions: local and area wide: Washington, D. C. 1963. 281 p.

102. U. S. Statutes at Large (14) 1866, Sec. 353. U. S. Rev. Stat. (1875) sec. 2339.

103. U. S. Statutes at Large (16) 1870, sec. 218. U. S. Rev. Stat. (1875) sec. 2340.

104. U. S. Statutes at large (19) 1877, sec. 377.

105. Water Laws of Oregon. Oregon Revised Statutes. Prepared under the direction of Chris L. Wheeler. Salem, State of Oregon, 1963. 137 p.

106. Wantrup, S. V. Ciriacy. Some economic issues in water rights. Journal of Farm Economics 37:875-885. 1955.

107. _____. Concepts used as economic criteria for a system of water rights. Land Economics 32:295-312. 1956.

108. Wellisz, Stanislaw. On external diseconomies and the government assisted invisible hand. Economica, 31:345-362. 1964.

109. Williams v. Altnow, 51 Or. 275, 299 (1916) 95 Pacific Reporter 200, (1906) 97 Pacific Reporter 539 (1909).

110. Ylvisaker, Paul. Some criteria for a "proper" areal division of governmental powers. In: Area and power, a theory of local government, ed by Arthur Maass et al. Glencoe, Illinois, The Free Press, 1959. p. 27-52.

APPENDIX

APPENDIX I: RELATED STATUTORY DELIMITATIONS

Water Rights

The following are excerpts of pertinent water laws now in force in Oregon:

537.120/ Subject to existing rights, ---, all waters within the state may be appropriated for beneficial use, ---; but nothing may be so construed as to take away or impart the vested right of any person to any water or to the use of any water.

537.110/ All water within the state from all sources of water supply belongs to the public.

537.130/ (1) Any person intending to acquire the right to the beneficial use of any waters shall, ---make an application to the state engineer for a permit to make such appropriation.
(2) No person shall use, store, or divert any waters until after the issuance of a permit to appropriate such waters.

537.140/ Each application for a permit to appropriate water shall set forth---, the source of water supply, the nature and amount of the proposed use, the location and description of the proposed ditch, canal, or other work.

537.160/ (1) Subject to the provision of -----, the state engineer shall approve all applications made in proper form which contemplate the application of water to a beneficial use, unless the proposed use conflicts with existing rights.

537.170/ If, in the judgement of the state Engineer, the proposed use may prejudicially affect the public interests----., he shall refer the application or amended application to the State Water Resources Board for consideration.
(2) If, after the hearing, the board determines that the proposed use would impair or be detrimental to the public interest, it shall enter an order rejecting the application or requiring its modification to conform to the public

interest, to the end that the highest public benefit may result from the use to which the water is applied.
(3) In determining whether the proposed use would be detrimental to the public interest, the State Water Resources Board shall have due regard for:

(a) conserving the highest use of the water for all purposes, including irrigation, domestic use, municipal water supply, power development, public recreation, protection of commercial and game fishing and wild-life, fire protection, mining, industrial purposes, navigation, scenic attraction, or any other beneficial use to which the water may be applied for which it appears to have a special value to the public.
(b) the maximum economic development of the waters involved.
(c) the control of the waters of this state for all beneficial purposes, including drainage, sanitation and flood control.
(d) the amount of waters available for appropriation for beneficial use of the waters involved.
(f) all vested and inchoate rights to the waters of this state or to the use thereof, and the means necessary to protect such rights.

537.250/ (2) Rights to the use of water acquired under the provisions of the Water Rights Act, as set forth in any such certificate, shall continue in the owner thereof so long as the water shall be applied to a beneficial use under and in accordance with the terms of the certificate, subject only to loss by nonuse as specified and provided in ORS. 540.610.

540.030/ When waters of any natural stream are not sufficient for the service of all those desiring that use of the same, those using the water for domestic purposes shall, subject to such limitations as may be prescribed by law, have the preference over those claiming such water for any other purposes, and those using the water for agricultural purposes shall have the preference over those using the same for manufacturing purposes.

540.140/ The state Engineer shall have authority to make reasonable regulations to secure the equal and fair distribution of water in accordance with the rights of the various

users. Such regulations shall not be inconsistent with the laws of the state. The regulations made pursuant to this subsection shall apply to all water rights that have been established.

540.720/ No person shall use without authorization water to which another person is entitled, or willfully waste water to the detriment of another. The possession or use of such water without legal right shall be prima facie evidence of the guilt of the person using it.

Water Management and Pollution Control

449.075/ (2) "water" or "waters" of the state shall be construed to include lakes, bays, ponds, impounding reservoirs, springs, wells, rivers, streams, inlets, creeks, estuaries, marshes, the Pacific ocean within the territorial limits of the state of Oregon and all other bodies of surface or underground waters, natural or artificial, inland or coastal, fresh or salt, public or private (except ----) which are wholly or partially within or bordering the state or within its jurisdiction.
(4) "industrial waste" means liquid, gaseous or solid waste substance or a combination thereof resulting from any process of industry, manufacturing, trade or business, or from the development or recovery of any natural resources, which may cause or might reasonably be expected to cause pollution of the waters of the state in contravention of the standards adapted as provided herein.
(6) "Standard" or "standards" means such measures of quality or purity for any waters in relation to their reasonable and necessary use as may be established by the sanitary authority pursuant to this chapter.

449.077/ (1) In the interest of public welfare, safety, peace and morale of the people, it is declared to be the public policy of the state of Oregon to:

(a) maintain reasonable standards of purity of the water of all rivers, streams, lakes, watersheds and coastal areas of the state consistent with the protection and conservation of public health, recreational enjoyment of the people, the economic and industrial development of the state, and for the

protection of human life and property and conservation of plant, aquatic, and animal life.
(b) foster and encourage the cooperation of people, industries, incorporated cities and towns and counties in preventing and controlling the pollution of these waters.
(2) This chapter shall be liberally construed for these purposes.

449.080/ Declaration-Powers and Duties of Sanitary Authority in Relation to Water Pollution (Summary)
(1) encourage voluntary cooperation.
(2) formulate, revise and interpret, pollution load requirements as stated in ORS. ch. 183.
(3) establish, modify or amend standards of quality and purity pursuant to ORS 536.210-356.550.
(4) conduct studies, etc., on this subject.
(5) enforcement.
(6) issue or deny permits.
(7) co-op with other agencies, etc.
(8) employ necessary personnel.
(9) settle suits.
(10) do other miscellaneous necessary.

449.086/ (1) The Sanitary Authority is authorized and empowered to establish standards of quality and purity of the waters of this state in accordance with the public policy of the State of Oregon as set forth in ORS. 449.077, and in establishing such standards, consideration shall be given to the following factors:
(a) The extent, if any, to which floating solids may be permitted in the water;
(b) The extent to which suspended solids, settleable solids, colloids or a combination of solids with other substances suspended in water may be permitted;
(c) The extent to which organisms of the coliform group, and other bacteriological organisms or virus may be permitted in the waters.
(d) The extent of the oxygen demand which may be permitted in the waters.
(e) the minimum dissolved oxygen content that shall be maintained.
(f) other limits.
(g) extent of health danger.
(h) value of stability of these over time to permit all to act accordingly.

449.095/ The discharge into the waters set forth in ORS 449.077 of any sewage which is or may become detrimental to human, plant, animal or aquatic life, or the recreational enjoyment of the people, by any person, firm, association or corporation, whether public, municipal, or private, or by any state owned institution or industry, is declared to be not a reasonable or natural use of such waters, contrary to public policy of the state of Oregon, as set forth in ORS 449.077, and to be a public nuisance.

449.100/ Enjoining and Abating Water Pollution.
(2) However, notwithstanding any other provisions of law to the contrary or provisions of ORS 449.077, the Sanitary Authority, without the necessity of prior administrative procedures or hearing and entry of an order or at any time during such administrative proceedings if such proceedings have been commenced, may institute a suit at law or in equity in the name of the state of Oregon to abate or restrain threatened or existing pollution of waters of this state, whenever such pollution or threatened pollution creates an emergency which requires immediate action to protect the public health, safety or welfare. --------

449.110/ Deposit of Industrial Wastes in Waters Prohibited.
No person, or proprietor, operator, agent, superintendent, or employee of any railroad company, sawmill or other lumbering or manufacturing concern, or any pulpmill, wood saw, tannery, woolen mill, dye works, gravel crushing or washing operation, chemical works, slaughterhouse, or any manufacturing concern, or any steamboat or any other craft shall cast or suffer or permit any sawdust, planer shaving, wood pulp or other lumber waste or any element or chemical extracted therefrom, or any unclarified wash water from gravel crushing or washing operations or other substances, which do or may render the waters of a stream or any other body of water destructive of fish or aquatic life, or any slashing of trees or brush, or any oil, coal, tar, petroleum or extract therefrom, or any dye or chemical to be thrown, cast or discharged in any manner, or to deposit the same, where high waters may take or carry same, into the waters of the state.

509.460/ It is unlawful for any person, municipal corporation,

political subdivision, or governmental agency to deposit or allow to escape into, or cause or permit to be escaped into any public waters of this state, any substance of any kind which will or shall in any manner injuriously affect the life, growth or flavor of shellfish in or under such waters.

The State Water Resources Board

The pertinent portions of statutory guidelines of the State Water Resources Board are the following:

536.220/ (1)(a) The maintenance of the present level of the economic and the general welfare of the people of this state for the increased economic and general welfare of the people thereof are in large part dependent upon a proper utilization and control of the water resources of this state, and such use and control is therefore a matter of greatest concern and highest priority.

(b) A proper utilization and control of the water resources of this state can be achieved only through a coordinated, integrated state water resources policy, through plans and programs for the development of such water resources and through other activities designed to encourage, promote and secure the maximum resources, all carried out by a single state agency.

(2) The legislative Assembly, therefore, finds that it is in the interest of the public welfare that a coordinated integrated state water resources policy be formulated and means provided for its enforcement, that plans and programs for the development and enlargement of the water resources of this state be devised and promoted and that other activities designed to encourage, promote and secure the maximum beneficial use and control of such water resources and the development of additional water supplies be carried out by a single state agency which, in carrying out its function, shall give proper and adequate consideration to the multiple aspects of the beneficial use and control of such water resources with an impartiality of interest except that designed to best protect and promote the public welfare generally.

536.300/ (1) The Board shall proceed as rapidly as possible to study; existing water resources of this state; means and methods of conserving and augmenting such water resources for domestic, municipal, irrigation, power development, industrial, mining, recreation, wildlife, and fish life uses and for pollution abatement, all of which are declared to be beneficial uses, and all other related subjects, including drainage and reclamation.
(2) Based upon said studies and after an opportunity to be heard has been given to all other state agencies which may be concerned, the board shall progressively formulate an integrated, coordinated program for the use and control of all the water resources of this state and issue statements thereof.

536.310/ In formulating the water resources program under subsection (2) of ORS 536.300, the board shall take into consideration the purposes and declaration of policy:
(1) Existing rights, established duties of water, and relative priorities concerning the use of the waters of this state and the laws governing the same are to be protected and preserved subject to the principle that all of the waters within this state belong to the public for use by the people for beneficial purposes without waste;
(2) It is in the public interest that integration and coordination of uses of water and augmentation of existing supplies for all beneficial purposes be achieved for the maximum economic development thereof for the benefit of the state as a whole.
(5) Competitive exploitation of water resources of this state for single purpose uses is to be discouraged when other feasible uses are in the general public interest.
(7) The maintenance of minimum potential stream flows sufficient to support aquatic life and to minimize pollution shall be fostered and encouraged if existing rights and priorities under existing laws will permit.
(9) Due regard shall be given in the planning and development of water recreation facilities to safeguard against pollution.
(12) When proposed uses of water are in mutually exclusive conflict or when available supplies of water are insufficient for all who desire to use them, preference will be given to human consumption purposes over other uses and for livestock consumption, over any other use,

and thereafter other beneficial purposes in such order as may be in the public interest consistent with the principles of this act under the existing circumstances.

536.320/ The board shall not have the powers
(1) to interfere with, supervise or control the internal affairs of any state agency or public corporation.
(2) To modify, set aside or alter any existing right to use water or the priority of such use established under existing laws, or
(3) to modify or amend any standard or policy as prescribed on ORS 536.310 not to adopt any rule or regulation in conflict therewith.

536.330/ This act shall be construed by the board as supplemental to existing statutes and not in lieu thereof.

536.340/ Subject at all times to existing rights and priorities to use waters of this state, the board:
(1) May, by a water resources statement referred to in subsection (2) of ORS 536.300, classify and reclassify the lakes, streams, underground reservoirs or other sources of water supply in this state as to the highest and best use and quantities of use thereof for the future in aid of an integrated and balanced program for the benefit of the state as a whole-----
(3) -----In prescribing such preferences the board shall give effect and due regard to the natural characteristics of such sources of water supply, the adjacent topography, the economics of such sources of water supply, the economy of the affected areas, seasonal requirements of the various users of such waters, the type of proposed use as between consumptive and non-consumptive uses and other pertinent data.

536.430/ The board shall devise plans and programs for the development of the water resources of this state in such a manner as to encourage, promote and secure the maximum beneficial use and control thereof.