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of a Water Resource System
and Issues of Water Allocation and Use:
Umatilla River Basin, Oregon**

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ABSTRACT

Most recent research regarding the design of optimal capacity expansion plans for water resource systems has emphasized minimization of total cost, given an increasing schedule of water requirements. This focus limits the full applicability of optimal capacity expansion techniques by inadequately treating the criteria of economic efficiency. Projections of net benefits and issues of allocation are critical and may be addressed as well.

This study explores scheduling water resource project facilities based on anticipated economic benefits provided. The Umatilla River Basin in northeast Oregon was analyzed with optimal capacity expansion techniques. The objective was to increase the net benefits from irrigated agriculture and fisheries enhancement. This basin is the site of previous federal water resource planning and development. A basic scheduling model for irrigation and instream flow maintenance was implemented for the study area and for alternate projects. The ramifications of exchange-theoretic and distribution-theoretic criteria on timing of facilities and ultimate allocation of water among purposes was then examined. The model, designed along integer programming lines, maximized the present value of net benefits. Three different solution techniques were explored to realize a desirable level of efficiency in basic model solution. Reasonably efficient solutions were obtained. By optimally timing the facilities, the total present value of net benefits of the project could be significantly enhanced when compared to the original schedule proposed in the project planning documents.

Of great interest is the issue of incorporating into the planning process (and specifically into the capacity expansion mode of planning) considerations of appropriative doctrine water rights exchangeable in legal transfers between project beneficiaries or contestable in court. Such exchanges and other distributional criteria can affect and be affected by the selection and timing of project facilities within an overall project design. These interrelationships are explored paying particular attention to the way in which exchanges of water (via water rights transfers) could establish higher levels of benefits in future years. Noneconomic processes such as enforcement of extant property rights relating to water resources are another issue which complicates water planning. Such distributional criteria are difficult to incorporate into the capacity expansion mode of planning analysis. However, ways are explored by which the basic model may be modified and used to take into account those problems.

FOREWORD

The Water Resources Research Institute, located on the Oregon State University campus, serves the State of Oregon. The Institute fosters, encourages and facilitates water resources research and education involving all aspects of the quality and quantity of water available for beneficial use. The Institute administers and coordinates statewide and regional programs of multidisciplinary research in water and related land resources. The Institute provides a necessary communications and coordination link between the agencies of local, state and federal government, as well as the private sector, and the broad research community at universities in the state on matters of water-related research. The Institute also coordinates the inter-disciplinary program of graduate education in water resources at Oregon State University.

It is Institute policy to make available the results of significant water-related research conducted in Oregon's universities and colleges. The Institute neither endorses nor rejects the findings of the authors of such research. It does recommend careful consideration of the accumulated facts by those concerned with the solution of water-related problems.

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PREFACE

In many parts of the western United States there remains a persistent notion that water resource development can proceed unhesitatingly while considerations of water allocation recede to the background. On the other hand, it may be claimed that all man's activities with respect to water, especially development, constitute an unavoidable and sometimes irreversible decision about allocation. Water resource planning has, at the same time, reached levels of sophistication and (reputed) efficacy unmatched in any other natural resource planning area. Yet the effort often seems to neglect a critical need to address allocative issues in the actual planning process.

This project represents an attempt to employ a quantitatively oriented planning technique in a manner which would address some crucial allocative (if not reallocative) problems in river basins characterized by an existing level of development and plans for further development.

The project was initiated in response to the authors' observations on watershed development planning as well as emerging conflicts over water supplies in the Umatilla River Basin of northeastern Oregon. The planning for an extensive new irrigation project was proceeding without much consideration for the possible reassignment of very secure (i.e., senior) water rights to a Native American tribal organization for use in development of a salmon and steelhead fishery. The planning for the new project was also proceeding without explicit recognition for the possibility of transfers of water rights. Individuals and districts holding secure rights to water may in some cases have been willing to transfer water rights to members of the new project. These possible outcomes should be more fully explored in planning, considering not only the flows of water involved but also the economics of the reallocation/transfer processes. Existing planning procedures should not, however, be unduly criticized. Practical-minded water resource development planners must focus attention on the considerable problems of project financing, technological feasibility, and the organizing of potential project members, to name a few. Having to successfully negotiate the actual source of water as an additional step may be difficult enough to discourage developmental efforts altogether. Nevertheless, there may be times in the future when this latter obstacle will not be so uncommon in water development planning.

For the time being, the problem is to simply encourage comprehensive planning of watersheds in the context of developmental incentives. Planning techniques, however, vary as to their requirements for data and the "fineness" or detail that characterizes the final product of the planning process. In order for a potential development project to be effectively incorporated in a comprehensive watershed plan (and vice versa), the planning technique must be quantitative in nature. Moreover, it should be able to address average water discharges in specific reaches of the watercourse as well as diversions from the watercourses. It should be able to address annual and seasonal volumes of water which flow into the system as well as the volumes diverted. Most importantly, however, it should be able to assign economic valuations to out-of-stream consumptive uses wherever they occur as well as valuations to water remaining in natural watercourses.

It is the objective of this report to pursue the application of this planning technique in the context of the Umatilla River Basin. This report, representing the initial stage of the research, (1) develops the methodology of the optimal capacity expansion technique, (2) applies the methodology in the form of a computerized model to investigating the consequences of a possible multipurpose project to be sited in the basin, and (3) discusses the potential for treating allocation issues in the confines of the optimal capacity expansion technique.

In a subsequent stages of the analysis, the modeling effort will be continued with the objective of implementing the network flow model complementary to the capacity expansion model. This phase will address the possibility of transferring water from specific reaches where potential project development could be undertaken. The last phase will also include a discussion of the public policy implications of the various development options in the Umatilla River Basin, considering allocation and reallocation possibilities analyzed in the modeling. By carefully examining how development in the Umatilla has proceeded, it may be possible to infer the political/economic feasibility of those development options which are feasible in a modelling sense.