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LEVEL II

MISCELLANEOUS PAPER Y-78-2

PROFILE AND MEASUREMENT OF SOCIAL WELL-BEING INDICATORS FOR USE IN THE EVALUATION OF WATER AND RELATED LAND MANAGEMENT PLANNING

by

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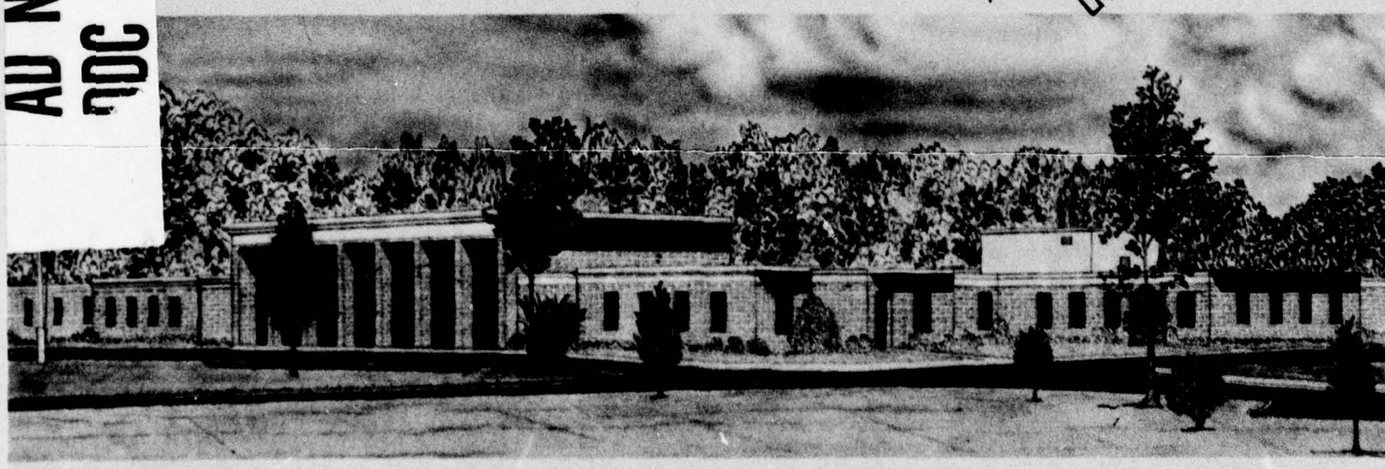
June 1978

Final Report

Approved For Public Release; Distribution Unlimited



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P. O. Box 631, Vicksburg, Miss. 39180

DEPARTMENT OF THE ARMY
WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS
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IN REPLY REFER TO: WESYR 30 June 1978

SUBJECT: Transmittal of Miscellaneous Paper Y-78-2

TO: All Report Recipients

1. The Water Resources Assessment Methodology (WRAM) is being developed at the Waterways Experiment Station (WES) by the Environmental Laboratory as a tool to assist the Army Corps of Engineers in the conduct of environmental impact assessment and alternative evaluation. For a detailed (though interim) presentation of WRAM, one should consult WES Technical Report Y-77-1 entitled "Water Resources Assessment Methodology (WRAM)--Impact Assessment and Alternative Evaluation" by R. Charles Solomon, et al. In essence, WRAM consists of:

I. Selection and Familiarization of the Interdisciplinary Team that is to Conduct the Assessment

II. Selection of Assessment Variables and Completion of an Environmental Inventory of the Study Area

III. Impact Prediction, Assessment, and Evaluation

IV. Documentation

This report, which is a product of WES's continuing program to extend and improve WRAM, is focused on the Social Well-Being (SWB) Account as defined by the Water Resources Council's Principles and Standards.

2. Included in this document are SWB variables with definitions, information about measurement, and suggestions for prediction. Although the set of variables discussed in this report assists in defining SWB, the list is tentative--a starting point for impact assessors--and is not definitive or exhaustive. The particulars of each planning project and the judgment of assessors and publics will dictate omission of some variables and inclusion of others.

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3. The report also includes preliminary information about units to be employed and measurement techniques which are suitable for the variables. The need to predict SWB impacts is responded to for each variable by outlining some aspects of the problem and by indicating rudimentary approaches toward prediction of impacts on the variable. Further resources are made available in the form of references to more detailed documents, both published and unpublished.

JOHN L. CANNON
Colonel, Corps of Engineers
Commander and Director

Unclassified

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As a part of the continuing development of the Water Resources Assessment Methodology (WRAM), this report focuses on the Social Well-Being (SWB) account as defined by the Water Resource Council's Principles and Standards. An outline of SWB categories, subcategories, and variables as interpreted from Principles and Standards is included. In addition, for selected variables, definitions, information about measurement, and suggestions for prediction are provided. It is noted that although the set of variables discussed in this

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20. ABSTRACT (Continued).

report assists in defining SWB, the list is tentative, not exhaustive, and is intended for use within the framework of WRAM. The particulars of each planning study and the judgment of professionals and publics will dictate omission of some variables and inclusion of others.

PREFACE

The work described in this report was performed under Purchase Order DACW39-77-M-1632 titled, "List of Social and Related Variables for Use in the Evaluation of Water and Related Land Management Planning," dated February 22, 1977, between the U.S. Army Engineer Waterways Experiment Station (WES) and Texas A&M Research Foundation. The sections on Noise and Aesthetic Value categories were prepared under Purchase Order DACW39-77-M-4272, titled "Profile and Measurement of the Noise and Aesthetic Value Categories of the Social Well-Being Account" dated July 13, 1977, between WES and Katheryn T. Dietrich. The research was sponsored by the Office, Chief of Engineers, U. S. Army, Washington, D. C., and directed by the Environmental Laboratory, WES.

The report was prepared under the Texas Transportation Institute by Dr. Patricia K. Guseman, Assistant Research Sociologist, and Katheryn T. Dietrich, Research Associate. The report follows specific guidelines established by WES. Two major tasks were requested by WES: (1) a comprehensive listing of variables relevant to the social well-being objective of water-resource planning; and (2) descriptions of measurement of the variables deemed most salient for social well-being impact assessment of water and related land-management studies. Regarding the latter task, WES personnel advised the authors of this report of the general categories of variables to be described. In addition, the format of the measurement descriptions was specified largely by WES. The authors have also attempted to meet the concern of Corps personnel that the report be of practical utility to Corps planners who are involved in social well-being impact assessment at the District level.

The contract was managed by Mr. R. Charles Solomon, Special Assistant, Environmental Resources Division, WES, and Ms. Sue E. Richardson, Environmental Resources Division, WES. The study was under the general supervison of Dr. Conrad J. Kirby, Chief, Environmental Resources Division, and Dr. John Harrison, Chief, Environmental Laboratory. The Director of WES is COL J. L. Cannon, C. E., and the Technical Director is Mr. F. R. Brown.

Special acknowledgement is given to Mr. Charles Solomon and Ms. Sue Richardson, WES, and Dr. Evan Vlachos, Colorado State University, for their professional advice. In addition, the authors acknowledge Mrs. Melinda Morgan, Mrs. Susie Carter, Mrs. Judi Gilliam, and Mr. Seth Bovey for their clerical and illustrative assistance in the preparation of this manuscript.

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INTRODUCTION

In 1973, the Water Resources Council delivered a multi-objective mandate for the formulation of water and related land resources planning (Water Resources Council, 1973). This document, referred to as *Principles and Standards* (P&S), specifies two equal national objectives toward which Federal and Federally-assisted water and related land planning be directed: National Economic Development (NED) and Environmental Quality (EQ). "P&S also requires that the impacts of a proposed action be measured and the results displayed or accounted for in terms of contributions to four accounts: National Economic Development (NED), Environmental Quality (EQ), Regional Development (RD), and Social Well-Being (SWB)" (Office of the Chief of Engineers, U. S. Army, 1975). This report focuses on the Social Well-Being account. The purpose of the report is to define the distinctive concerns of the Social Well-Being account and to operationalize the variables that are most salient to the Social Well-Being account.

A VARIABLE LISTING

The term *social well-being* often is used more or less synonymously with *quality of life* to refer to a broad variety of variables that reflect people's welfare or well-being (Liu, 1975). When incorporated within the objectives of resource planning, the concept implies that the goals of technological progress should be tempered with humanistic concerns for equality, justice, and a generally high quality of life for all Americans (Liu, 1975). The theory behind the *social well-being* concept encompasses two components, one indicating how people themselves evaluate various aspects of their lives and the other indicating the external or environmental conditions relevant to each of those aspects (Andrews and Withey, 1976:7). The general goal of the

Social Well-Being account is to enhance the development of individual capability, health, self-reliance, and opportunities for individual choice.

This report will define the more specific concerns of the Social Well-Being account of water resources planning by presenting a listing of the most pertinent variables that are relevant for social well-being impact assessment of water-resource studies. The purpose of impact assessment generally " . . . is to facilitate decision-making by determining the full range of costs and benefits of alternative proposed courses of action" (Finsterbusch and Wolf, 1977:2). A secondary purpose is to improve the design and administration of policies and projects in order to promote positive impacts and to avoid or mitigate negative impacts (Finsterbusch and Wolf, 1977). The Social Well-Being account is generally concerned with what social science literature refers to as *social impact assessment* (i.e., determining social well-being). In keeping with the terminology of the Water Resources Council, this report will refer to this research process as *social well-being impact assessment*.

The task of identifying the variables that fall within the province of the Social Well-Being account for water resource planning is a much needed but formidable task. The situation Duhl addressed in 1967 has not been entirely resolved: social scientists frequently do not know the specific variables that are important for social well-being impact assessment. Finsterbusch and Wolf (1977:8) claim that "the major problem in identifying impacts is inclusiveness; no significant impact should be overlooked." However, as Baur (1973) points out, the variables that might be affected by a water project are virtually infinite if one considers higher-order as well as primary and secondary impacts. And to omit the former is no solution, because higher-order impacts are frequently among the most significant for social well-being (Baur, 1973). An agonizing result of this problem for water-resource planning has been indiscriminant collection of large masses of data that has exhausted available resources and does not even guarantee that potentially significant impacts have been explored.*

The major criterion for variable selection employed in this report was *to select only those variables whose change or non-change by a water project would make a significant difference in the decision of whether to implement a project plan or to assist in delineation of differences between project alternatives.* The authors acknowledge that this process of selection of variables for study is a subjective process, as is the evaluation of impacts.

The authors have tried to maintain as much objectivity in their selection as possible, however, by perusing the results of previous studies, giving especial consideration to actual as compared with predicted impacts (see Shields', 1974, annotated bibliography). In addition, the authors have relied on the intuitive sensitivity of themselves and other social scientists, which Baur (1973) emphasizes as essential at this early stage of development of social well-being impact assessment. The authors have also included all of the specific concerns delineated in the Water Resources Council's *Principles and Standards.*

The listing of variables and their categorization are delineated in Figure 1. The starred variables are considered to be especially critical by the authors and will be discussed in detail later in the report. A bibliography of references which aided in the selection of variables is presented at the end of this report.

The variables have been categorized into six major classifications. The first four of these classifications were specified by the Water Resource Council's *Principles and Standards:*

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* J. D. Priscoli, personal communication, 1977.

(1) Real Income Distribution

(2) Life, Health, and Safety

(3) Educational, Cultural, and Recreational Opportunities and Other Community Services

(4) Emergency Preparedness

Two additional categories were included at the request of the U.S. Army Engineer Waterways Experiment Station (WES):

(5) Community Cohesion

(6) Other Population Characteristics

The variables have also been placed into meaningful subcategories to help clarify the specific concerns of social well-being impact assessment.

In using this variable listing, the planner should be especially aware of the need to consider differential impacts. As Shields (1974:31-5) states: "The point is that the impacts of high-technology projects affect different people in different ways at different times. Some people lose a great deal, others gain, most probably fall somewhere in-between, gaining in some ways but losing in others. And there are some--indeed, many--who are virtually unaffected by project impacts." Although the names of the variable concepts do not always make explicit a concern with differential impacts, this concern is relevant and is implied for every variable.

Other important analytical dimensions of impact assessment are interactive and cumulative impacts and the timing of impacts (i.e., short-term versus long-term effects). These dimensions will be addressed in the following discussion of measurement.

It is stressed that the variable listing given in this report is meant to help define the Social Well-Being account for water-resources planning. The listing is by necessity broad, because of the many types of water and related land-management projects. The variables that will be relevant for water-resource planning has been indiscriminant collection of large masses of data that has exhausted available resources and does not even guarantee that potentially significant impacts have been explored.*

The major criterion for variable selection employed in this report was to select only those variables whose change or non-change by a water project would make a significant difference in the decision of whether to implement a project plan or to assist in delineation of differences between project alternatives. The authors acknowledge that this process of selection of variables for study is a subjective process, as is the evaluation of impacts.

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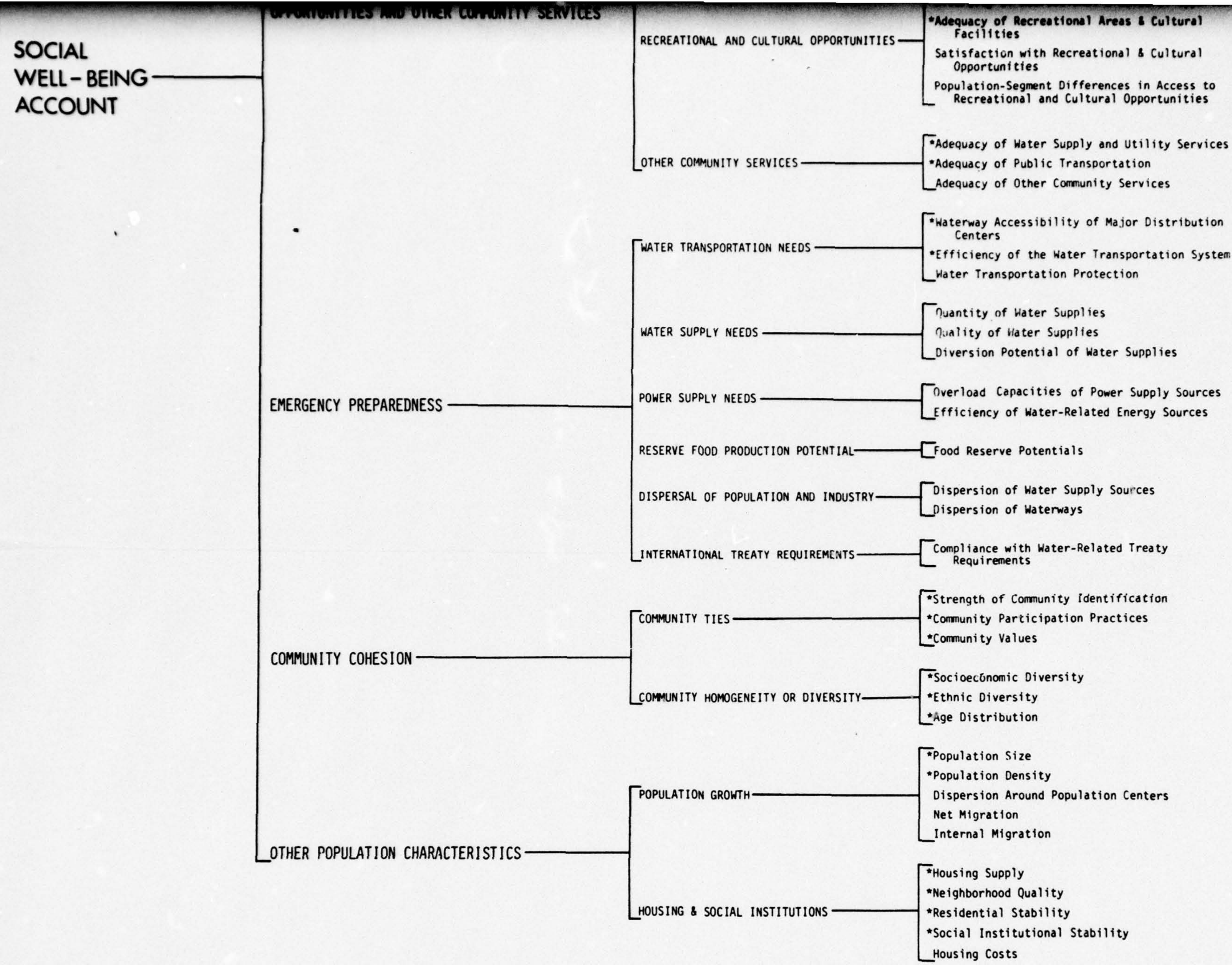
* J. D. Priscoli, personal communication, 1977.

ACCOUNT	CATEGORY	SUBCATEGORY	VARIABLE
SOCIAL WELL-BEING ACCOUNT	REAL INCOME DISTRIBUTION	INCOME OPPORTUNITIES	*Personal Income Generated
			*Income Dispersion
			Income Stability
			Sources of Income
		LABOR-FORCE CHARACTERISTICS	*Economic Activity of the Population
			Labor-Force Diversity
			Labor/Job Stability
			*Occupational Distribution
			Accessibility of Work
		INCOME EXPENDITURES	*Major Consumer Expenditures
			Discretionary Income
			*Taxes
		SUBJECTIVE SATISFACTIONS	Satisfaction with Life Quality
			Job Satisfaction
			Satisfaction with Family Income
	LIFE, HEALTH, AND SAFETY	PERSONAL HEALTH AND SAFETY	*Risk of Injuries
			*Morbidity
			*Mortality
			Population-Segment Differences in Health & Safety
		SAFETY OF PROPERTY	*Risk of Property Damage
			Effects of Damage on Quality of Life
			Population-Segment Differences in Risk to Property
		INSTITUTIONAL PROTECTION	*Adequacy of Medical Facilities & Personnel
			Quality of Medical Care
			*Adequacy of Protection Against Crime
			Adequacy of Emergency Protection
			Population-Segment Differences in Access to Institutional Protection
	EDUCATIONAL, CULTURAL, AND RECREATIONAL OPPORTUNITIES AND OTHER COMMUNITY SERVICES	EDUCATIONAL OPPORTUNITIES	*School Enrollment
			*Educational Achievement
			*Adequacy of Educational Services
			Diversity of Educational Programs
			Satisfaction with Educational Opportunities
		RECREATIONAL AND CULTURAL OPPORTUNITIES	*Recreational and Cultural Participation
			*Diversity of Recreational & Cultural Opportunities
			*Adequacy of Recreational Areas & Cultural Facilities
			Satisfaction with Recreational & Cultural Opportunities
			Population-Segment Differences in Access to Recreational and Cultural Opportunities
			*Adequacy of Water Supply and Utility Services



NOTE: The variables denoted by an asterisk (*) are operationalized in this report.

Figure 1
Structure of the Social Well-Being Account

social well-being impact assessment of any particular water project may comprise only a small proportion of this listing, especially in the case of small-scale water-resource projects.

VARIABLE MEASUREMENT

Only those variables thought to be most salient for social well-being impact assessment of water projects have been operationalized. The specification of variable measurement includes two types of measurement:

(1) measurement of baseline conditions of the variable;

(2) prediction of the state of the variable at later time periods.

Throughout the discussions about measurement, efforts have been made to present the most meaningful and simplest measures. It is stressed that the saliency of measures for a particular variable, like the importance of the variables themselves, may differ for different kinds of projects. For example, more detailed and sophisticated measurement may be warranted by very large-scale water projects, whereas one simple measure per pertinent variable may suffice for small, routine water projects.

One or more of the following four measurement procedures are recommended for measuring baseline conditions and for prediction of the variables:

(1) Surveys--Often the only means of providing specific, detailed information on people in a target area. A randomized survey can provide representative data on people's attitudes, concerns, and perceptions.

(2) Informant Interviewing--According to Finsterbusch (Finsterbusch and Wolf, 1977), informant interviewing is the backbone of social well-being impact assessment, especially prediction of effects. It involves soliciting experts' opinions and the opinions of potentially impacted parties.

(3) Field Observation--This refers to the immersion of the researchers in the potentially impacted community(s) or area.

(4) Secondary Data Sources--These data sources have been emphasized in this report if they are available, because they greatly simplify the data collection process and save valuable resources. In addition, extrapolation of historical data trends from secondary sources may be valuable for predicting effects. The main disadvantages of secondary sources are the limited types of data that are available and the fact that the data may not be current.

It is emphasized with respect to the discussions of variable prediction that the intention was only to provide a starting point for researchers involved in social impact assessment of water-resource projects. In the delineation of potential impacts, discussion is provided where possible regarding long-term as opposed to short-term effects. More complete specification of post-construction phased impacts and of cumulative impacts is needed but is beyond the purview of this report. This manuscript should be viewed as a necessary but preliminary step toward the development of detailed procedures for predicting the variables of concern to the Social Well-Being account of water-resource planning.

In each variable discussion, an *hypothesized functional curve* has been included. This curve defines the beneficial and adverse levels of the variable according to a presumed quality index (the scale value of 1.0 represents optimum variable levels and 0 represents the most adverse variable levels). Because social well-being is a subjective phenomenon, the precise nature of these curves is a matter of subjective professional opinion. Moreover, the definition of what is beneficial or adverse will vary for different populations, depending on their preferences and may vary according to certain conditions. Therefore, the hypothesized functional curves presented in this report are meant to serve only as crude indicators reflecting the authors' interpretations of the general value system of our country's population. Findings in the literature have aided in this interpretation.

Also included for each variable discussion is a brief listing of references. These references were carefully selected to help the planner understand the variable measurements that have been suggested and to provide information on additional, more sophisticated, measurement if needed.

REAL INCOME DISTRIBUTION

For the Social Well-Being account, the major concern with respect to real income distribution is who will benefit from the economic development that might be generated by a water project. Studies of actual impacts of water projects have shown considerable differences in economic benefits for people having different sources of income (Shields, 1974). The incomes of some people in a community have been adversely affected by income-generating water projects, while the incomes of others in the same community have increased substantially (Mack, 1974; Gold, 1974). A water project's impact on real income of individuals and families, therefore, should be compared for all substantial, viable population groupings, such as race, ethnic, age, sex, and income

The major variables subsumed under the real-income distribution classification of the Social Well-Being account include factors directly affecting income differences, such as labor-force participation and factors affecting the buying power of income, such as costs of goods and services. The variables that are starred in Figure 2 are those thought to be most salient for the assessment of real income distribution.

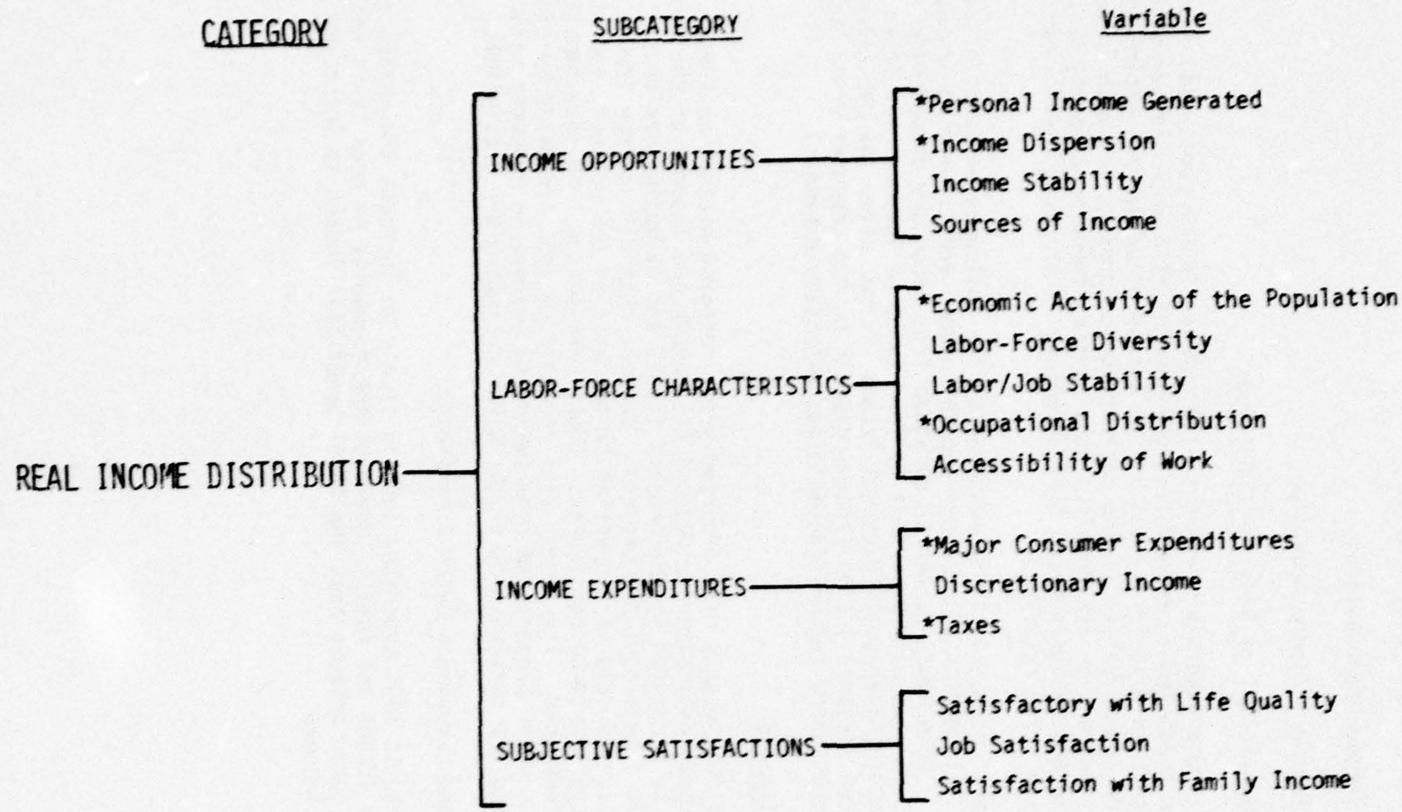


Figure 2

Structure of the Real Income Distribution Category

Account: Social Well-Being

Category: Real Income Distribution

Subcategory: Income Opportunities

Variable: *Personal Income Generated*

Definition & Measurement of Baseline Conditions

Personal income generated refers to the changes in per capita and family income that are predicted to result from development of a water resource project. The concern is with income that might accrue directly from employment for construction and operation of the water-resource project and with income that indirectly accrues as the result of businesses, improved property values, and other income-generating sources that accompany water project development, such as that of a large reservoir.

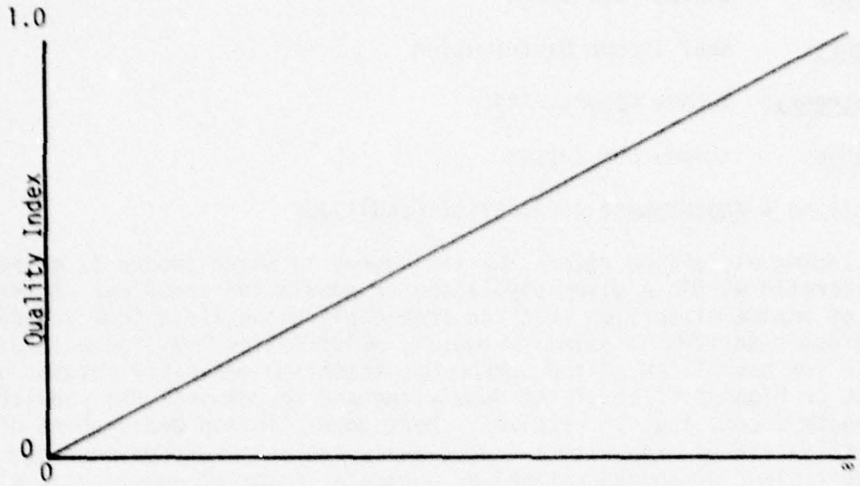
These income increases can be measured by the following measures of central tendency: (1) median or mean per capita income, and (2) median or mean family income. These measures can be obtained from secondary demographic sources and can be used with reference to four types of income: (1) gross personal income, (2) disposable personal income (income after tax deductions), (3) cost-adjusted personal income (income divided by the consumer price index), and/or (4) discretionary income (income minus necessary expenses).

Prediction of Impacts

To predict the impacts of a proposed water resource project on these measures of income, estimates are made of the number and incomes of the new jobs that will be generated by the project itself and by businesses that might develop as a result of the project. Incomes that will accrue from business profits, the sale of properties in the area of the project, and other such sources also should be considered. Short-term versus long-term impacts should be distinguished. The former will result from jobs generated by construction of the water project and from immediate changes in property values that the planning and construction of the water project might precipitate.

Hypothesized Functional Curve & Rationale

A water project that generates jobs is likely to increase the median and mean per capita income and family income of the community or area it is near. The functional curve assumes that the ideal beneficial impact is increased median or mean incomes.



Remarks

This variable might also be considered by the Regional Development (RD) account.

Data Sources

Bureau of the Census, Census of the Population, *Characteristics of the Population; Current Population Reports, Series P-20, 23, 28, 60; Public Use Sample Tapes;* County and City Data Book; Bureau of Labor Statistics, *Consumer Expenditures and Income;* OBERS,* Series E.

References

Executive Office of the President, Office of Management and Budget, *Social Indicators, 1973.* Washington, D.C.: U.S. Government Printing Office, 1973, Pp. 151-87.

Liu, Ben-Chieh, *Quality of Life Indicators in U.S. Metropolitan Areas, 1970: A Comprehensive Assessment.* Washington, D.C.: Washington Environmental Research Center, U.S. Environmental Protection Agency, 1975, Pp. 54-8.

Shryock, Henry S., Jacob S. Siegel, and Associates, *The Methods and Materials of Demography*, Washington, D.C.: U.S. Bureau of the Census, 1975, p. 367.

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* Office of Business Analysis and Economic Research Service.

Account: Social Well-Being

Category: Real Income Distribution

Subcategory: Income Opportunities

Variable: *Income Dispersion*

Definition & Measurement of Baseline Conditions

Income dispersion refers to the degree to which income is dispersed or concentrated within a given population or population grouping. A measurement of income dispersion that can frequently be obtained from secondary demographic sources is *quintile values*, which define the income limits or ranges for each fifth of the population. Attention generally focuses on the lowest or highest fifth of the population and the share of the population's aggregate income that it receives. More sophisticated measurement of income dispersion can be made with a *Lorenz curve* and *the Gini Concentration ratio* (a coefficient of concentration) or *Duncan's "index of concentration."* Instructions for calculating the Lorenz Curve and its corresponding statistics are presented in U.S. Bureau of the Census (Shryock et al., 1975) and Duncan (1957). These statistics are generally used with reference to gross family incomes but could also be used with reference to disposable personal income, cost-adjusted personal income, or discretionary income. (See discussion of *"Personal Income Generated."*)

Income dispersion can also be measured by calculating differences in incomes among all viable, substantial population groupings for which income might be unequally generated by a given water-resource project. Examples of such population groupings include various race and/or ethnic groups, age, sex, residence groupings and population groupings having different sources of income (e.g., wage-salary workers, small business owners, farmers, etc.). Income data are frequently reported separately for these groups. Differences in the following indexes of central tendency can be calculated: (1) *median per capita income*, and (2) *median family income*. Two additional recommended measures are: (3) *mean or median family income divided by the number of income earners in the family*, and (4) *the percentage of families in poverty*. The foregoing median measures can be used with reference to four types of income: (1) *gross personal income*, (2) *disposable personal income*, (3) *cost-adjusted personal income*, and/or (4) *discretionary income* (see discussion of *"Personal Income Generated."*) Poverty families can be determined by a poverty index used by the Bureau of Census and the Office of Economic Opportunity which divides a family's total gross income by the estimated income needed to sustain a typical family of its size, age composition, and residence (region of U.S., metropolitan or nonmetropolitan, farm or nonfarm).

Prediction of Impacts

To predict impacts of a proposed water project on the foregoing indicators of income dispersion, estimates are made of the number and requirements of new jobs which will be generated by the project. These estimates are then considered in conjunction with the approximate proportion of the various population groupings that will be eligible for the new jobs and the wages or salaries which might then accrue to these population groupings from the new jobs.

Hypothesized Functional Curve & Rationale

Whether a water project will increase or decrease income dispersion will depend on the baseline conditions with reference to income dispersion as well as on the nature of the water project and the wage/salary levels of the jobs that it generates. Given a baseline condition of relatively concentrated incomes, whereby the lower fifth of the population accrues much lower incomes than the top echelons of the population or a particular ethnic, residence or other type grouping has much higher median incomes than the remainder of the population, a water project which generates higher paying jobs for the lower income population is likely to increase income dispersion.

Remarks

The variable of income dispersion is essential to answer the question of who benefits from economic development resulting from a water project. A water project's impact on income dispersion is indirect via the jobs that the project helps to generate. Consequently, changes in income dispersion are contingent on changes in business patterns and labor-force characteristics. Furthermore, the variable of income dispersion interacts with other economic variables, such as taxes and income expenditures, to effect changes in real income distribution.

Data Sources

Bureau of the Census, Census of the Population, *Characteristics of the Population; Current Population Reports, Series P-20, 23, 28, 60; Public Use Sample Tapes;* County and City Data Book; Bureau of Labor Statistics, *Consumer Expenditures and Income;* OBERS, Series E (allows for residence comparisons only).

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Shryock, Henry S., Jacob S. Siegel, and Associates, *The Methods and Materials of Demography*, Washington, D.C.: U.S. Bureau of the Census, 1975, Pp. 178-80, 367.

Account: Social Well-Being

Category: Real Income Distribution

Subcategory: Labor-Force Characteristics

Variable: *Economic Activity of the Population*

Definition & Measurement of Baseline Conditions

The "economically active" population is defined as all persons who furnish the supply of labor for economic production. It includes the employed and unemployed (i.e., persons who, during a given period, were not working but who were seeking gainful employment). The "not economically active population" is comprised of all persons not gainfully employed or seeking employment including recipients of income from investments, pensions, etc., and persons who receive public aid or private support.

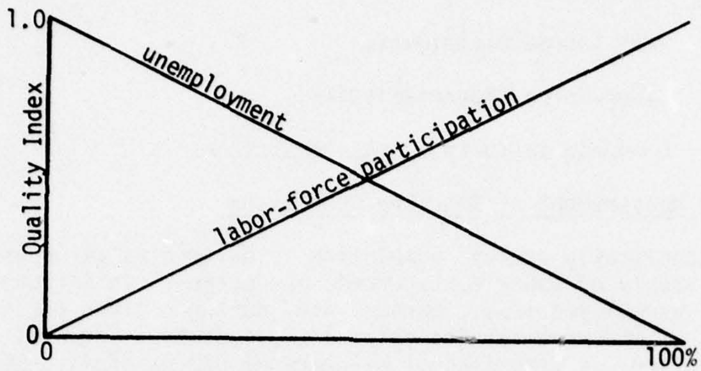
Data about the economic activity of a population can usually be obtained from secondary demographic sources. Two specific indicators of economic activity of a population that are especially relevant to social well-being are: (1) *labor-force participation rates*, and (2) *unemployment rates*. Labor-force participation rates are calculated as either (a) the number of economically active persons as percent of the total population (termed the "crude labor-force participation rate"), or (b) the number of economically active persons as percent of the total working-age population. Unemployment rates, on the other hand, are expressed as the percentage of an economically active population which is not gainfully employed. Additional measures of employment which are meaningful to social well-being are (3) *the proportion underemployed*, which refers to the proportion of the economically active population who perform less than the amount of gainful work than they would normally be able and willing to perform, and (4) *the ratio of employed persons to the total population.*

Two of the foregoing indicators of economic activity tend to vary significantly among population groupings: unemployment and underemployment rates. In addition to measuring these rates for the population as a whole, group differences in unemployment and underemployment rates should be ascertained with respect to all viable, substantial population groupings.

Prediction of Impacts

Prediction of a water project's impact on the foregoing indicators of economic activity of a population requires estimates of the number and requirements of jobs that will be generated by the project. Job requirements must then be compared with the educational and other qualifications of persons comprising the unemployed and underemployed to determine if these persons would be eligible for the jobs generated by the water project. In addition, one must consider population and labor-force increases which are projected to result from the water project.

Hypothesized Functional Curve & Rationale



ECONOMIC ACTIVITY INDICATORS

The indicators of economic activity are expected to increase if a water project generates jobs for persons previously unemployed and if the project does not precipitate an influx of retired persons, welfare recipients, or other persons who would not be classified "economically active." Beneficial impacts are assumed to accrue from higher economic activity of a population.

Remarks

The foregoing indicators of economic activity of a population represent opportunities for self-support. Such opportunities improve the social as well as the economic health of a community and its members by maximizing independence and self-reliance. A water project's impact on economic activity of a population is via the jobs and businesses that the project helps to generate and the population increases that it encourages. A population's economic activity, in turn, determines personal incomes and their dispersion.

Data Sources

County and City Data Book; Bureau of the Census, Census of the Population, *Characteristics of the Population; Current Population Reports, Series P-50, 57, 59;* Bureau of Labor Statistics, *Employment and Earnings;* Bureau of Employment Security; U.S. Manpower Administration; state employment commissions.

References

Executive Office of the President, Office of Management and Budget, *Social Indicators, 1973.* Washington, D.C.: U.S. Government Printing Office, 1973, Pp. 111- 50.

Liu, Ben-Chieh, *Quality of Life Indicators in U.S. Metropolitan Areas, 1970: A Comprehensive Assessment.* Washington, D.C.: Washington Environmental Research Center, U.S. Environmental Protection Agency, 1975: Pp. 69-75.

Milliken, J. Gordon, and H. E. Mew, Jr., *Economic and Social Impact of Recreation at Reclamation Reservoirs: An Exploratory Study of Selected Colorado Reservoir Areas.* Denver: Denver Research Institute, University of Denver, 1969.

Shryock, Henry S., Jacob S. Siegel, and Associates, *The Methods and Materials of Demography*, Washington, D.C.: U.S. Bureau of the Census, 1975, Pp. 336-59.

Account: Social Well-Being

Category: Real Income Distribution

Subcategory: Labor-Force Characteristics

Variable: *Occupational Distribution*

Definition & Measurement of Baseline Conditions

Occupational distribution refers to differences among population groupings with respect to their concentrations in certain occupational categories. A simple but useful categorization scheme reported in Census publications is:

- White-collar workers
  - Professional, technical, and kindred workers
  - Managers and administrators, except farm
  - Sales workers
  - Clerical and kindred workers
- Blue-collar workers
  - Craftsmen and kindred workers
  - Operatives, except transport
  - Transport equipment operatives
  - Laborers, except farm
- Farm workers
  - Farmers and farm managers
  - Farm laborers and farm foremen
- Service workers
  - Service workers, except private household
  - Private household workers

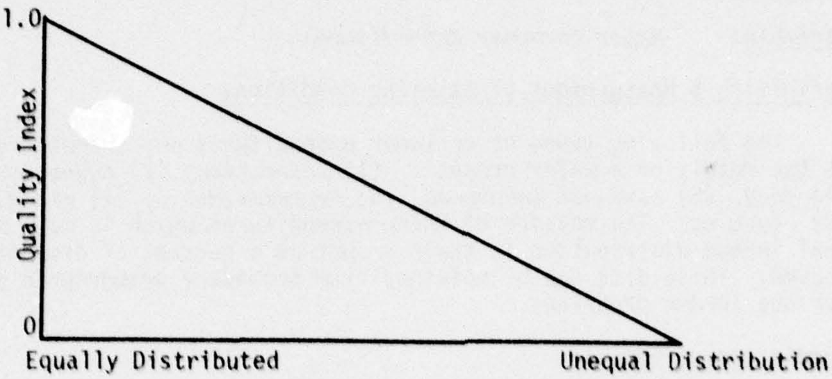
Median wages or salaries for these occupational categories are presented in demographic publications.

Percentage distributions among these categories can be calculated for the economically active persons of each population grouping. These percentage distributions of the various population groupings can then be compared. An example of the kind of occupational differences between population groupings which one might expect to find is the concentration of blacks in lower prestige, lower paid blue-collar (operatives or laborers) and service (private household workers) categories and the concentration of whites in white-collar and the higher prestige blue-collar (craftsmen and kindred) categories.

Prediction of Impacts

Assessment of a water project's impact on occupational distribution requires estimates of the number, kind, and requirements of new jobs which will be generated by the project. The jobs that will be generated will vary by the type and size of the water project. These job requirements are then compared with the qualifications of the economically active persons of specific population groupings to determine if the new job market generated by the water project might precipitate shifts to higher prestige, higher paying occupations.

Hypothesized Functional Curve & Rationale



OCCUPATIONAL DISTRIBUTIONS AMONG
POPULATION GROUPINGS

Beneficial impacts are assumed to accrue from similar occupational distributions of various population groupings.

Remarks

Occupational distribution is the major determinant of income distribution. Therefore, a water project's effect on occupational distribution can have a substantial impact on real income distribution.

Data Sources

Bureau of the Census, Census of the Population, *Characteristics of the Population; Current Population Reports; Special Reports, Series PC(2), 7A Occupational Characteristics, 7B Occupation by Earnings and Education; Public Use Sample Tapes;* Bureau of Labor Statistics, *Employment and Earnings;* U.S. Manpower Administration.

References

Bonjean, Charles M., *Sociological Measurements: An Inventory of Scales and Indices.* San Francisco: Chandler Publishing Co., 1967.

Shryock, Henry S., Jacob S. Siegel, and Associates, *The Methods and Materials of Demography*, Washington, D.C.: U.S. Bureau of the Census, 1975, Pp. 338-39.

U.S. Bureau of the Census, *Census of the Population, 1970, Census Users Guide.* Washington, D.C.: U.S. Government Printing Office, 1970.

Account: Social Well-Being

Category: Real Income Distribution

Subcategory: Income Expenditures

Variable: *Major Consumer Expenditures*

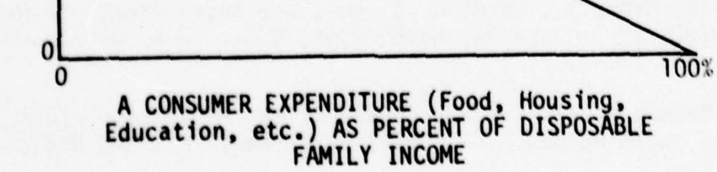
Definition & Measurement of Baseline Conditions

The following types of consumer expenditures may increase or decrease as the result of a water project: (1) *recreation*, (2) *education*, (3) *housing*, (4) *food*, (5) *personal insurance*, (6) *transportation*, (7) *medical care*, (8) *clothing*. The measure of these expenditures which is most meaningful to real income distribution is their amount as a percent of disposable family income. These data can be obtained from secondary demographic sources for various income groupings.

Prediction of Impacts

Consumer costs of goods, services, housing, and other needs are dependent on numerous economic factors which might be affected by a water project. Such factors include changes in land values, transportation of goods, availability of housing to accommodate population increases or relocations, labor demands and supplies, etc. Impacts on these economic factors should be assessed in the Regional Development account. The task for the Social Well-Being account is to estimate how these changing economic factors will affect major expenditures and the abilities of families of various income levels to meet these expenses. Impacts of these changing expenses on real income distribution can be measured further by estimating changes in cost-adjusted incomes or discretionary incomes and by recalculating income inequalities and income dispersion based on these income estimates. See "*Income Dispersion*."

Hypothesized Functional Curve & Rationale



The functional curve assumes that beneficial impacts on real income distribution accrue from decreases in consumer expenditures as a percent of disposable family income for all population segments. These beneficial effects will occur as a result of decreases in consumer expenditures and/or increases in disposable family income.

Remarks

"Real" income is a function of income and the costs of goods and services. It is possible that a water project might increase expenditures more than income for some segments of a population, thereby decreasing their "real income" and, consequently, their living standards.

Data Sources

Bureau of Labor Statistics, *Expenditures and Income;* Bureau of Economic Analysis, *The National Income and Product Accounts of the United States; Survey of Current Business;* the Federal Reserve System, *Survey of Financial Characteristics of Consumers.*

References

Executive Office of the President, Office of Management and Budget, *Social Indicators, 1973.* Washington, D.C.: U.S. Government Printing Office, 1973, Pp. 151-87.

<u>Account</u>: Social Well-Being

<u>Category</u>: Real Income Distribution

<u>Subcategory</u>: Income Expenditures

<u>Variable</u>: *Taxes*

Definition & Measurement of Baseline Conditions

Property, or real-estate, *taxes* are the kind of taxes most frequently measured in social well-being impact studies. City, county, or other areal property tax rates and property valuation levels can be obtained from district tax assessors and collectors.

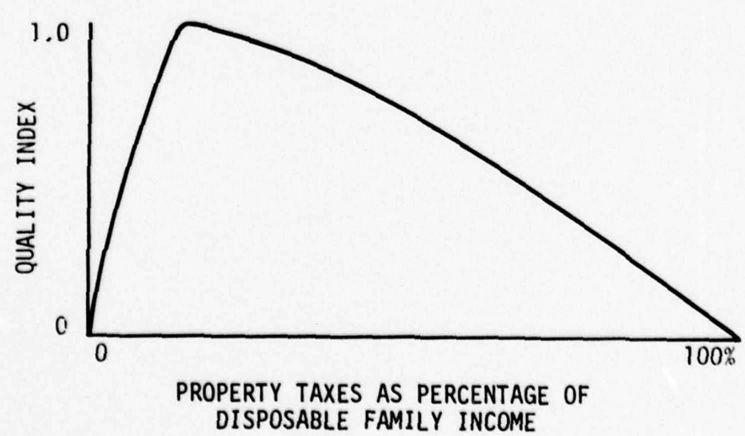
Prediction of Impacts

Changes in tax rates and property valuation levels are contingent on two primary factors: (1) a tax district's needs for tax revenues, and (2) its tax bases. To predict needs for tax revenues, one must estimate changes in a population's size and characteristics and the changing demands for government services. Measurement of the former is delineated in the "Other Population Characteristics" category of the Social Well-Being account. See variables relating to community services and institutions to determine the changing demands for government services.

Tax bases should be considered in the Regional Development account, because they are contingent on the numerous factors which contribute to an area's economic growth. Specifically, property tax bases are the valuation of lands and other taxable properties. Other tax bases are important to the extent that the tax revenues that they provide are adequate to meet the needs for tax revenues, thereby reducing the need to increase property tax rates.

The task with reference to real income distribution is to determine how changing tax rates will affect disposable family incomes of various population segments. This can be done by recalculating *Income Dispersion* based on these estimates of disposable income.

Hypothesized Functional Curve & Rationale



The functional curve assumes that beneficial impacts on a community and its members accrue from moderate tax rates and property valuations.

Remarks

Previous social impact assessments have shown increased property taxes to penalize some population segments, such as ranchers, more than others (Gold, 1974; Hogg and Smith, 1970). A water project which increases land values and the need for tax revenues might increase such inequities in taxation and, consequently, in "real" income.

Data Sources

District tax assessors and collectors.

References

Gold, Raymond L. "Social Impacts of Strip Mining and Other Industrializations of Coal Resources," in C.P. Wolf (ed.), *Social Impact Assessment.* Milwaukee: Environmental Design Research Association, 1974, Pp. 123-46.

Hogg, Thomas C. and Courtland L. Smith. *Socio-Cultural Impacts of Water Resource Development in the Samtiam River Basin.* Corvallis: Water Resources Research Institute, Oregon State University, 1970.

Milliken, J. Gordon, and H. E. Mew, Jr. *Economic and Social Impact of Recreation at Reclamation Reservoirs: An Exploratory Study of Selected Colorado Reservoir Areas.* Denver: Denver Research Institute, University of Denver, 1969.

Peele, Elizabeth. "Social Effects of Nuclear Power Plants," in C.P. Wolf (ed.), *Social Impact Assessment.* Milwaukee: Environmental Design Research Association, 1974, Pp. 113-20.

U.S. Bureau of the Census, *The U.S. Fact Book, The Statistical Abstract of the U.S.* New York: Grosset and Dunlap, 1977, Pp. 283.

LIFE, HEALTH, AND SAFETY

The life, health, and safety classification of the Social Well-Being account is concerned with aspects of health, mortality, and safety of individuals, their families, and their property which might be affected by a water project. Subsumed under this classification is the quality of health and safety protection provided by a community's institutions as well as population characteristics of morbidity and mortality. The reader will notice in this section a change of emphasis from individual to collective indicators.

The social well-being indicators presented in this section should be investigated for the community in general and for all viable, substantial population groupings whose life, health, and safety might be differentially affected by a water or related land-management project.

The starred variables in Figure 3 are the indicators of life, health, and safety deemed most salient for social well-being impact assessment.

CATEGORY	SUBCATEGORY	Variable
LIFE, HEALTH, AND SAFETY	PERSONAL HEALTH AND SAFETY	*Risk of Injuries
		*Morbidity
		*Mortality
		Population-Segment Differences in Health and Safety
	SAFETY OF PROPERTY	Risk of Property Damage
		Effects of Damage on Quality of Life
		Population-Segment Differences in Risk to Property
	INSTITUTIONAL PROTECTION	*Adequacy of Medical Facilities and Personnel
		Quality of Medical Care
		*Adequacy of Protection Against Crime
		Adequacy of Emergency Protection
		Population-Segment Differences in Access to Institutional Protection

Figure 3

Structure of the Life, Health, and Safety Category

Account: Social Well-Being

Category: Life, Health, & Safety

Subcategory: Personal Health & Safety

Variable: *Risk of Injuries*

Definition & Measurement of Baseline Conditions

The two most frequently cited social well-being indicators with reference to risk of injury are: (1) *incidence of injuries requiring medical attention*, and (2) *incidence of deaths due to injuries.* These indicators are usually reported in secondary demographic sources as the number of injuries or deaths, respectively, per 100 persons in the population. These measures are generally reported separately for (a) accidental injuries, and (b) nonaccidental injuries as the result of assaults. In addition, these statistics are frequently reported separately by classifications of cause of injury (i.e., natural disasters such as floods or water transportation accidents).

Prediction of Impacts

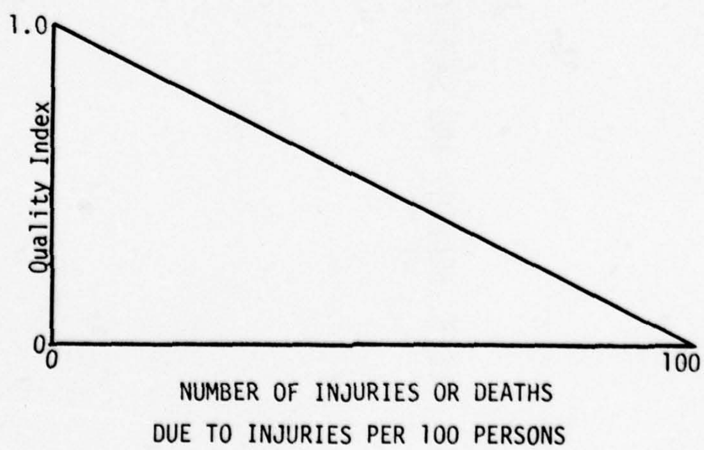
Prediction of a water project's impact on risk of injury requires the following estimates:

(a) estimated reduction in the number of accidental injuries and deaths which will occur as a result of a project's control of natural disasters, such as floods;

(b) estimated increases or decreases in the numbers of injuries and deaths which will occur as a secondary impact of a water project via its primary impact on population density/dispersion (sources of injuries which vary positively with population density are motor vehicle accidents);

(c) estimates of the number of injuries and deaths which are likely to occur as the result of the project's construction, maintenance, and usage.

Hypothesized Functional Curve & Rationale



Beneficial impacts are identified as decreases in the incidence of injuries requiring medical attention and in the incidence of injuries causing death.

Remarks

The evaluation of a water project's impact on risk of injury will differ depending on the time interval and unit of analysis (e.g., community or region) specified for impact assessment. Regarding the former, injuries which occur as the result of project construction will be short-term impacts and, thus, irrelevant to long-run predictions. With regard to unit of analysis, a project might increase population density and, consequently, increase the incidence of injuries in certain communities or areas of a region but disperse the population and, consequently, decrease the incidence of injuries in the region as a whole.

The indicators of incidence of injuries and incidence of deaths due to injuries can be differentially affected by the same water project. For example, a project might increase the incidence of injuries requiring medical attention but decrease the number of injuries causing death.

Data Sources

U.S. Public Health Service, U.S. National Center for Health Statistics, *Vital & Health Statistics; Vital Statistics-Special Reports; Monthly Vital Statistics Reports;* Metropolitan Life Insurance Company, *Statistical Bulletin;* state and county health departments.

References

Executive Office of the President: Office of Management and Budget, *Social Indicators, 1973.* Washington, D.C.: U.S. Government Printing Office, 1973, Pp. 1-73.

U.S. Bureau of the Census, *The U.S. Fact Book, The Statistical Abstract of the U.S.* New York: Grosset and Dunlap, 1977, Pp. 67, 88.

Account: Social Well-Being

Category: Life, Health, & Safety

Subcategory: Personal Health & Safety

Variable: *Morbidity*

Definition & Measurement of Baseline Conditions

The two indicators of morbidity most salient to impact assessment of water projects are: (1) *incidence of new cases of diseases reported during a specified time period;* and (2) *incidence of deaths due to diseases.* These indicators are usually reported in secondary demographic sources as the number of new reports of diseases or deaths per 100 persons in the population. The indicators should be ascertained for all disease types whose incidence might be reduced by a given water project. For example, diseases caused by (a) disease-carrying insects and related pathological factors; (b) concentration and exposure to water and air pollution; and (c) inadequate nutrition levels. A third meaningful index of morbidity is *length of illness;* however, this is less often reported in secondary demographic sources.

Prediction of Impacts

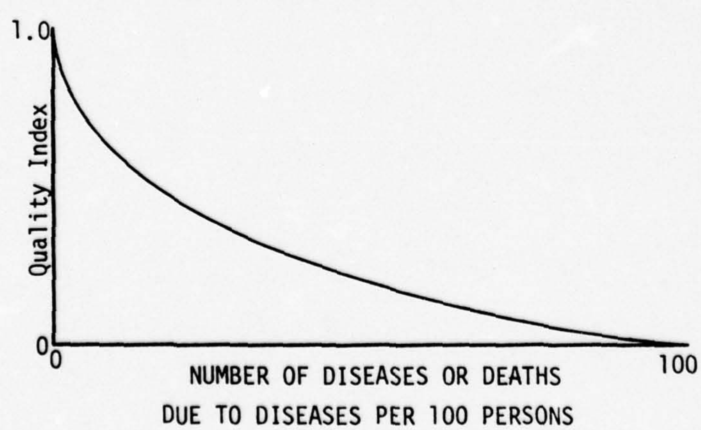
The following factors should be considered in predicting a water project's impact on the incidence of these diseases:

(a) the project's capability to reduce conditions which aid the breeding of disease-carrying insects;

(b) the project's capability to reduce the concentrations of water and air pollution, the areal scope of such pollution, and the exposure of dense population areas to such pollution;

(c) the project's capability to improve conditions necessary to provide a year-round consumer choice of foods (e.g., by aiding irrigation of crop lands, by providing waterways for food transport, etc.).

Hypothesized Functional Curve & Rationale



Beneficial impacts are identified as reduction in the incidence of diseases and deaths due to diseases. The functional curve assumes that the quality of social well-being drops quickly after a certain morbidity level.

Remarks

The unit of analysis to be used for most of the morbidity assessments should represent the scope of population that is likely to be affected by the disease. However, *Principals and Standards* suggests that a project's impact on nutrition be assessed in terms of national nutritional levels.

Data Sources

U.S. Public Health Service, U.S. National Center for Health Statistics, *Vital and Health Statistics, Series 10 & 11; Vital Statistics - Special Reports; Monthly Vital Statistics Reports; Findings of Health & Examination Survey;* U.S. Public Health Service, Center for Disease Control, *Morbidity & Mortality Weekly Report,* and its supplements; U.S. Department of Agriculture, *National Food Situation.*

References

Shryock, Henry S., Jacob S. Siegel, and Associates, *The Methods and Materials of Demography,* Washington, D.C.: U.S. Bureau of the Census, 1975, Pp. 401-5.

U.S. Bureau of the Census, *The U.S. Fact Book, The Statistical Abstract of the U.S.* New York: Grosset and Dunlap, 1977, Pp. 50, 65, 88, 91, 94.

Account: Social Well-Being

Category: Life, Health, & Safety

Subcategory: Personal Health & Safety

Variable: *Mortality*

Definition & Measurement of Baseline Conditions

The concern here is with indicators of the effects a water project will have on general mortality levels in a given population. Three useful mortality indicators are: (1) *the crude death rate for the population;* (2) *the exogenous death rate;* and (3) *life expectancy.*

The crude death rate is the mortality indicator most frequently cited in secondary demographic sources. It is measured by the number of deaths in a year per 1,000 persons in the population. Often the crude death rate is calculated separately for different age, race, and sex groupings.

If reported for a population, the exogenous death rate is more relevant than the crude death rate to impact assessment, because it refers specifically to those deaths which might be prevented in the future by technological advances, such as by a water project. The exogenous death rate is measured by the number of deaths per 1,000 persons which are caused by environmental or external causes (as distinguished from endogenous causes such as genetic deficiencies, prenatal complications, or the birth process).

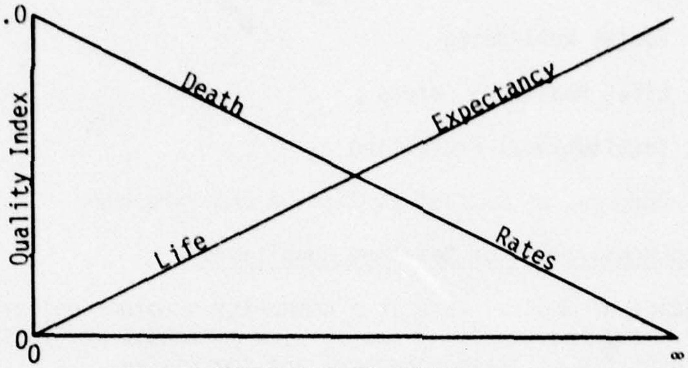
Life expectancy refers to "the expected number of years to be lived, on the average" (U.S. Bureau of the Census (Shryock et al., 1975)). Various life expectancy measures are available, but the most frequently used measures are (a) the expectation of life at birth, and (b) the median age at death for various birth cohorts.

Prediction of Impacts

Prediction of impacts of a water project on these indicators of mortality levels requires projections of how much the project will reduce or increase deaths caused by injuries, infectious diseases, or pollution-related health disorders (see *"Risk of Injuries"* and *"Morbidity"*).

Hypothesized Functional Curve & Rationale

Beneficial impacts are identified as decreases in crude or exogenous death rates and as increases in life expectancy.



Remarks

The general indicators considered here should reflect the total effect a water project is projected to have on a population's level of mortality because of the project's control of natural disasters, its reduction of pollution and conditions which breed disease-carrying insects, its precipitation of population density or dispersion, etc.

Data Sources

County and City Data Book; U.S. Department of Health, Education, and Welfare, *Vital Statistics of the United States;* Public Health Service, National Center for Health Statistics, *Vital and Health Statistics; Vital Statistics--Special Reports; Monthly Vital Statistics Reports;* Metropolitan Life Insurance Company, *Statistical Bulletin.*

References

Executive Office of the President, Office of Management and Budget, *Social Indicators, 1973.* Washington, D.C.: U.S. Government Printing Office, 1973, Pp. 22-9.

Liu, Ben-Chieh, *Quality of Life Indicators in U.S. Metropolitan Areas, 1970: A Comprehensive Assessment.* Washington, D.C.: Washington Environmental Research Center, U.S. Environmental Protection Agency, 1975, Pp. 66-9.

Shryock, Henry S., Jacob S. Siegel, and Associates, *The Methods and Materials of Demography,* Washington, D.C.: U.S. Bureau of the Census, 1975, Pp. 394-406; 429-49.

U.S. Bureau of the Census, *The U.S. Fact Book, The Statistical Abstract of the U.S.* New York: Grosset and Dunlap, 1977, Pp. 60-5.

Account: Social Well-Being

Category: Life, Health, & Safety

Subcategory: Institutional Protection

Variable: *Adequacy of Medical Facilities and Personnel*

Definition and Measurement of Baseline Conditions

The adequacy of medical care in a community or other defined area is determined by: (1) *the supply of health-care personnel and facilities;* and (2) *the accessibility of these personnel and facilities.*

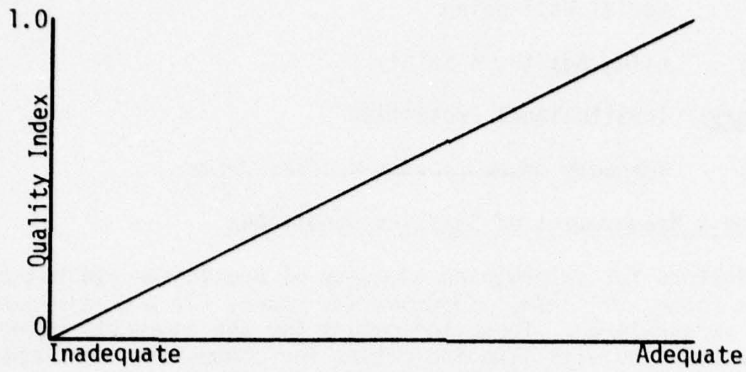
Data regarding the supply of health-care personnel and facilities can be obtained from secondary demographic sources or from local medical associations, Chambers of Commerce, etc. The most relevant data with reference to medical personnel are the ratios of physicians, dentists, and registered nurses to the total population. These statistics with reference to physicians are frequently reported separately by type of practice or specialization (e.g., general practice, internal medicine, pediatrics, psychiatry, etc.). The most relevant data with reference to health-care facilities are the ratios of hospital beds to the population (often expressed as the number of hospital beds per 1,000 population). These data are reported separately for large population areas by type of hospital (e.g., short-term general, long-term general and special, psychiatric, tuberculosis, etc.). The adequacy of the supplies of both health-care personnel and facilities can be assessed by comparing the supply ratios for the community or area of study to the corresponding supply ratios for the nation or state as a whole.

The accessibility of physicians, dentists, and hospitals in a community is generally measured in terms of: (a) locational accessibility--dispersion of doctors' and dentists' offices and hospitals throughout the community and/or public transportation access to these locations; and (b) economic accessibility--doctors', dentists', and hospital fees and the capability of families to pay these fees. Data regarding locational accessiblity can be obtained by field observation, but determination of economic accessibility may require surveys of the families or a combination of survey and field-observation techniques.

Prediction of Impacts

The impact of a water project on adequacy of medical care in a community or other defined area is secondary via its primary impact on population size and population density/dispersion. Consequently, prediction of impacts on adequacy of medical care requires projections of population increases and changes in ecological placement. Estimates should then be made of what increases in medical services are necessary to provide adequate supplies, accessiblity, and quality medical care for the population. One should also consider the ability of the community, which is not necessarily traceable to a water project, to attract the medical personnel needed to accommodate population influx. For example, communities in or adjacent to metropolitan areas are more likely to attract medical personnel than are remote rural areas.

Hypothesized Functional Curve & Rationale



Beneficial effects are assumed to accrue from adequate supplies of health-care personnel and facilities, accessibility of these personnel and facilities to all population groupings, and high-quality health care services.

Remarks

The influx of construction workers and others connected with a water project's construction may create short-term demands which strain a community's existing medical services. If medical services are expanded to meet this temporary need and if the population decreases after project construction is completed, the community may be faced with underutilized but costly services which precipitate higher taxes.

Data Sources

U.S. National Center for Health Statistics, *Health Resource Statistics;* American Medical Association, *Distribution of Physicians in the U.S.; Reference Data on Profile of Medical Practice;* American Dental Association, *Inventory of Registered Nurses;* American Hospital Association, *Hospitals,* Guide Issue; *Hospital Statistics; Hospitals, A County and Metropolitan Area Data Book;* State and Local Medical, Dental, and Nurses Associations; Field Observation; Surveys.

References

Liu, Ben-Chieh, *Quality of Life Indicators in U.S. Metropolitan Areas, 1970: A Comprehensive Assessment.* Washington, D.C.: Washington Environmental Research Center, U.S. Environmental Protection Agency, 1975, Pp. 66-9.

Shields, Mark A., *Social Impact Assessment, An Analytic Bibliography,* IWR Paper 74-96. Fort Belvoir, Va.: Institute for Water Resources, U.S. Army Corps of Engineers, 1974.

U.S. Bureau of the Census, *The U.S. Fact Book, The Statistical Abstract of the U.S.* New York: Grosset and Dunlap, 1977, Pp. 76-85.

<u>Account</u>: Social Well-Being

<u>Category</u>: Life, Health, & Safety

<u>Subcategory</u>: Institutional Protection

<u>Variable</u>: *Adequacy of Protection Against Crime*

<u>Definition & Measurement of Baseline Conditions</u>

Indicators for determining adequacy of protection against crime are: (1) *crime rates*, (2) *crime victimization rates*, (3) *law enforcement employment and expenditures*. These indicators for the community being studied should be compared with like indicators for communities of comparable size.

Crime rates are measured by the number of criminal offenses known to police in relation to the population size. For large areas, these statistics are expressed as offenses per 100,000 population. These statistics are calculated separately by class or type of crime. For example:

- Violent Crime
  - Murder
  - Forcible Rape
  - Robbery
  - Aggravated Assault
- Property Crime
  - Burglary
  - Larceny-Theft
  - Motor Vehicle Theft

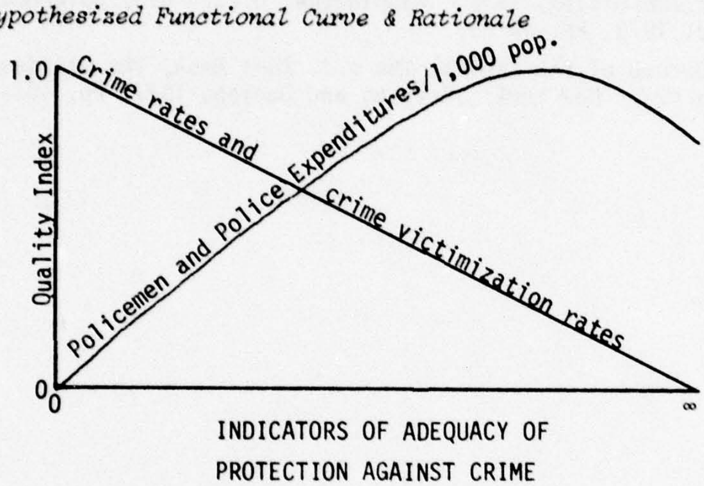
Victimization rates of crimes against persons are frequently measured as the number of persons victimized by crime per 1,000 persons in the population. These are generally reported for the population as a whole and separately by race and sex. These victimization rates are also reported separately by types of crime (e.g., rape, robbery with injury, robbery without injury, etc.). Victimization rates of crimes against households and businesses are calculated similarly (rates per 1,000 households and per 1,000 business establishments) by type of crime. The statistics are reported for the population in general and separately for households and businesses having certain characteristics (e.g., income, age, and race of head of household).

Law enforcement employment and expenditures refers to amounts for (a) police protection, and (b) corrections. For social impact studies on a local level, the major concern is with police protection. Measures of law enforcement employment and expenditures for police protection that frequently are reported in secondary demographic data sources are the number of policemen and amount of expenditures, respectively, per 1,000 population.

Prediction of Impacts

The impact of a water project on adequacy of protection against crime may be secondary via its primary impact on population size and population density/dispersion. A water project that provides recreation will also affect the need for protection of its users. Projections should be made of population size, dispersion, and composition (race, age, sex, composition, etc.) within the community. Projections of future crime rates and crime victimization rates can be estimated from the rates characterizing communities of similar size, density, and composition as the projected population of the study community. Likewise, needs for police protection personnel and expenditures can be estimated from the amounts used in communities similar to the projected population.

Hypothesized Functional Curve & Rationale



Beneficial effects are defined as low crime rates and crime victimization rates. Beneficial effects also are generally assumed to accrue from higher numbers of policemen and greater amounts of expenditures per 1,000 population. However, it is assumed that these amounts for adequate police protection and corrections will peak at a certain point and that excesses beyond this point will accrue additional costs with no additional benefits to a community.

Remarks

The population influx due to project construction may differ in size, density, and composition from the population influx expected after the water project is operational. Consequently, short-term and long-term impacts on adequacy of protection against crime should be assessed separately.

Data Sources

U.S. Federal Bureau of Investigation, *Uniform Crime Reports for the United States;* U.S. Law Enforcement Assistance Administration and U.S. Bureau of the Census, *Expenditure and Employment Data for the Criminal Justice System;* U.S. Bureau of the Census, *Government Finances; Public Employment;* U.S. Law Enforcement Assistance Administration, *Criminal Victimization in the United States;* State and local law enforcement agencies.

References

Executive Office of the President, Office of Management and Budget, *Social Indicators, 1973.* Washington, D.C.: U.S. Government Printing Office, 1973, Pp. 44-59.

U.S. Bureau of the Census, *The U.S. Fact Book, The Statistical Abstract of the U.S.* New York: Grosset and Dunlap, 1977, Pp. 151-65.

EDUCATIONAL, CULTURAL, AND RECREATIONAL OPPORTUNITIES AND OTHER COMMUNITY SERVICES

This classification of the Social Well-Being account refers to major services that are or need to be provided in a community. Recreational opportunities are likely to be directly affected by some types of water projects, whereas educational, cultural, and other kinds of services may be secondarily affected via the population influx generated by a water project. This population influx will create a need for community services. A project may also affect the economic capability of a community to provide these services. Projects having these kinds of secondary effects, especially those affecting educational opportunities, are generally large scale. Therefore, assessment of impacts on educational opportunities and the like will be unnecessary for small-scale water projects.

The variables of this category are shown in Figure 4. The variable, *adequacy of community services*, is not described in detail in this report because its measurement is so similar to the measurement recommended for adequacy of utility and public transportation services.

CATEGORY	SUBCATEGORY	Variable
EDUCATIONAL, CULTURAL, AND RECREATIONAL OPPORTUNITIES AND OTHER COMMUNITY SERVICES	EDUCATIONAL OPPORTUNITIES	*School Enrollment
		*Educational Achievement
		*Adequacy of Educational Services
		Diversity of Educational Programs
		Satisfaction with Educational Opportunities
	RECREATIONAL AND CULTURAL OPPORTUNITIES	*Recreational and Cultural Participation
		*Diversity of Recreational and Cultural Opportunities
		*Adequacy of Recreational Areas and Cultural Facilities
		Satisfaction with Recreational and Cultural Opportunities
		Population-Segment Differences in Access to Recreational and Cultural Opportunities
	OTHER COMMUNITY SERVICES	*Adequacy of Water Supply and Utility Services
		*Adequacy of Public Transportation
		Adequacy of Other Community Services

Figure 4

Structure of the Educational, Cultural, and Recreational Opportunities and Other Community Services Category

Account: Social Well-Being

Category: Educational, Cultural, & Recreational Opportunities & Other Community Services

Subcategory: Educational Opportunities

Variable: *School Enrollment*

Definition & Measurement of Baseline Conditions

School enrollment refers to enrollment in public or private formal educational institutions such as kindergartens, elementary schools, high schools, colleges, or universities. The indicators of school enrollment that are most relevant to social well-being are: (1) *school enrollment rates*, and (2) *school dropout rates*.

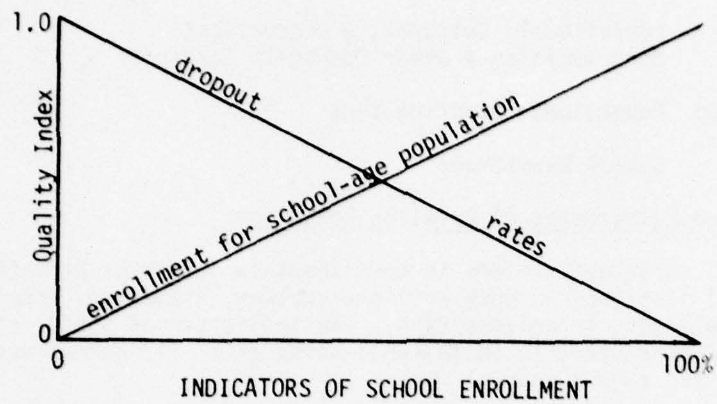
School enrollment rates are expressed differently in various secondary demographic sources. The *crude enrollment rate* is the population enrolled in school as a percent of the total population. The *general enrollment rate* is the population enrolled in school as a percent of the total school-age population. *Age-specific* and *grade-* or *level-specific enrollment rates* are also calculated for a given age population or for the age-group population that corresponds to a given school level, respectively. School dropout rates are also expressed as *grade-* or *age-specific dropout rates*. They usually measure school-leaving at a given age or grade during the span of a year.

Prediction of Impacts

Additional indicators that are important for school enrollment projections are: *past enrollment trends* and *educational expectations*. Past enrollment trends refers to the numbers of students enrolled in specific school levels (e.g., elementary, high school, college) or grades and in specific types of schools (public versus private, schools for the blind, deaf, mentally deficient, epileptic and delinquent, etc.). Educational expectations refers to the plans that persons have, or that others have for them, regarding entering or attaining a given school level at a future date. Especially relevant are the college plans that parents have for their children. A large-scale water project that attracts college-educated residents who are likely to have college expectations for their children can create a demand for more and better qualified educational facilities and personnel.

Other important factors affecting school enrollment projections are the ages, race-ethnicity, and educational characteristics of the projected population. One should consider the birth rates of these population groupings that would be attracted to the area. For example, the birth rates among persons between 18 and 27, among blacks and Mexican-Americans, and among the lower educated are much higher than for the population generally. One should also consider the educational behaviors and expectations of the projected population. Blacks and Mexican-Americans, for example, are likely to have higher dropout rates, and college-educated parents are more likely to plan on their children going to college.

Hypothesized Functional Curve & Rationale



Low school dropout rates and high enrollment rates for the school-age population are defined as beneficial.

Remarks

Projections of school enrollment rates, dropout rates, past enrollment trends, and educational expectations are essential for predicting a community's needs for educational institutions. The impact of a water project on these indicators is secondary via its primary impact on population size and composition. Another important factor is tne community's preparedness to provide these facilities (e.g., their predicted budget compared to the facilities and personnel that they will need to provide).

Data Sources

U.S. National Center for Education Statistics, *Biennial Survey of Education in the United States; Digest of Education Statistics; Projections of Education Statistics; Fall Statistics of Public Schools; Opening Fall Enrollment in Higher Education;* U.S. Bureau of the Census, Census of the Population, *Current Population Reports, Series P-20; Characteristics of the Population;* State and local educational agencies, surveys.

References

Executive Office of the President, Office of Management and Budget, *Social Indicators, 1973*. Washington, D.C.: U.S. Government Printing Office, 1973, Pp. 75-101.

Folger, John K., and Charles B. Nam, *Education of the American Population*, Washington, D.C.: U.S. Government Printing Office, 1967.

Levine, Daniel B., and Charles B. Nam, "The Current Population Survey: Methods, Content, and Sociological Uses," *American Sociological Review* 27 (August, 1962): 585-90.

Nam, Charles B., "Some Comparisons of Office of Education and Census Bureau Statistics on Education," *Proceedings of the Social Statistics Section, 1962.* Washington, D.C.: American Statistical Association, 1962.

Shryock, Henry S., Jacob S. Siegel, and Associates, *The Methods and Materials of Demography,* Washington, D.C.: U.S. Bureau of the Census, 1975, Pp. 313-21.

U.S. Bureau of the Census, *The U.S. Fact Book, The Statistical Abstract of the U.S.* New York: Grosset and Dunlap, 1977, Pp. 111-22.

Account: Social Well-Being

Category: Educational, Cultural, & Recreational Opportunities & Other Community Services

Subcategory: Educational Opportunities

Variable: *Educational Achievement*

Definition & Measurement of Baseline Conditions

Three major indicators of educational achievement are: (1) *literacy or illiteracy*, (2) *formal educational attainment*, and (3) *vocational and technical training*. Each of these indicators should be measured for the population in general. In addition, inequalities in educational achievement should be determined by calculating the differences in these indicator values among all viable, substantial population groupings.

Literacy is defined as the ability of a person to read and write. A measure of illiteracy used in the U.S. Census is the number of illiterate aged 14 years or over as a percent of the total population aged 14 years or over. This statistic is sometimes reported only for those persons who have completed less than five years of school. Illiteracy rates are also reported for more specific age groupings in order to show historical change in literacy status.

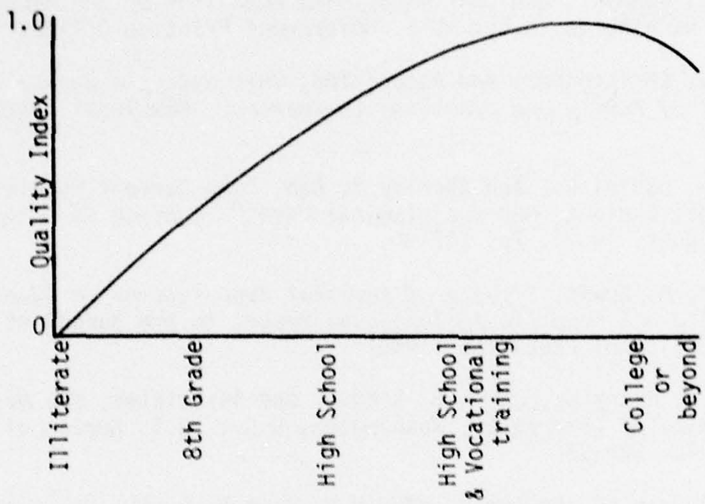
Formal educational attainment refers to the highest grade or degree completed within the country's formal educational system. The most frequently reported measures of formal educational attainment are measures of central tendency: (a) *the median years of school completed*, and (b) *the mean years of school completed*. Measures of distribution are often reported as: (a) *the attainment rate for a specific grade*, which is the percentage of the population that completed a given grade or level of school, no more or less; and (b) *the cumulative grade attainment rate*, which is the percentage of the population of a specified age that completed a given grade or level of school or beyond.

Vocational and technical training as used here refers to any such training received through instructional classes that was not part of a formal educational program (e.g., high school or college) and was not on-the-job training.

Prediction of Impacts

Prediction of a water project's impact on these indicators of educational achievement requires consideration of: (1) previous trends in these indicators for the baseline population; (2) general trends in these indicators for the types of population groupings projected to migrate to the area; (3) educational opportunities projected to be available to the various population groupings; and (4) the educational expectations of the youth and parents in the projected population. A project's impact on educational opportunities of population groupings can be estimated primarily from its projected impact on the incomes of these groupings and, consequently, on their ability to pay for higher education (see "*Income Dispersion*"). The educational expectations of youth and their parents can be estimated from research findings regarding educational expectations and plans of population groupings like those expected to migrate to the area (see Sociological Abstracts) and from surveys of the baseline population.

Hypothesized Functional Curve & Rationale



EDUCATIONAL ACHIEVEMENT OF THE POPULATION AGED 14 YEARS AND OVER

Beneficial impacts are defined as increases in educational achievement of the population in general and of equality of educational achievement among population groupings. It is assumed that ideally the bulk of the population should at least be vocationally trained or have a college education, but to fill many of the jobs a community needs, a college education for everyone is unnecessary.

Remarks

The impact of a water project on the educational achievement of a population is contingent on the type of population projected for the area and the educational opportunities that the area provides. A project might affect the educational opportunities provided in an area via its impact on the area's tax bases and, consequently, on the tax revenues available for educational funding.

Data Sources

County and City Data Book; Bureau of the Census, Census of the Population, *Characteristics of the Population; Current Population Reports, Series P-20 and P-23; Subject Reports: Educational Attainment*, *PC(2)-5B*; National Center for Education Statistics, *Vocational and Technical Education.*

References

Folger, John K., and Charles B. Nam, *Education of the American Population*, Washington, D.C.: U.S. Government Printing Office, 1967.

Jencks, Christopher, and Associates, *Inequality, A Reassessment of the Effect of Family and Schooling in America*. New York: Harper and Row, 1972.

Levine, Daniel B., and Charles B. Nam, "The Current Population Survey: Methods, Content, and Sociological Uses," *American Sociological Review*, 27 (August, 1962), Pp. 585-90.

Rhodes, A. Lewis, *Effects of Parental Expectations on Educational Plans of White and Nonwhite Adolescents*, report to the Bureau of Research, U.S. Office of Education, 1968.

Shryock, Henry S., Jacob S. Siegel, and Associates, *The Methods and Materials of Demography*, Washington, D.C.: U.S. Bureau of the Census, 1975, Pp. 325-33.

U.S. Bureau of the Census, *The U.S. Fact Book, The Statistical Abstract of the U.S.* New York: Grosset and Dunlap, 1977, Pp. 111-27.

Account: Social Well-Being

Category: Educational, Cultural, & Recreational Opportunities & Other Community Services

Subcategory: Educational Opportunities

Variable: *Adequacy of Educational Services*

Definition & Measurement of Baseline Conditions

The following factors should be considered in evaluating the adequacy of the educational services of a community: (1) *capacity and accessibility of educational facilities;* (2) *the number and qualifications of educational personnel;* and (3) *educational expenditures.*

The main concerns with reference to facilities are: (a) enrollment capacity of the schools in a community or area; (b) locational accessibility--dispersion of schools of different types throughout the community or area, availability of transportation to these schools, and length of time necessary for students to travel to the schools; (c) economic accessibility--the tuition and/or fees required for the different types of instruction available and the capability of families of all viable population groupings to pay for this instruction; and (d) social accessibility--whether the schools and all of their educational services are open to all races, ethnicities, religions, etc.

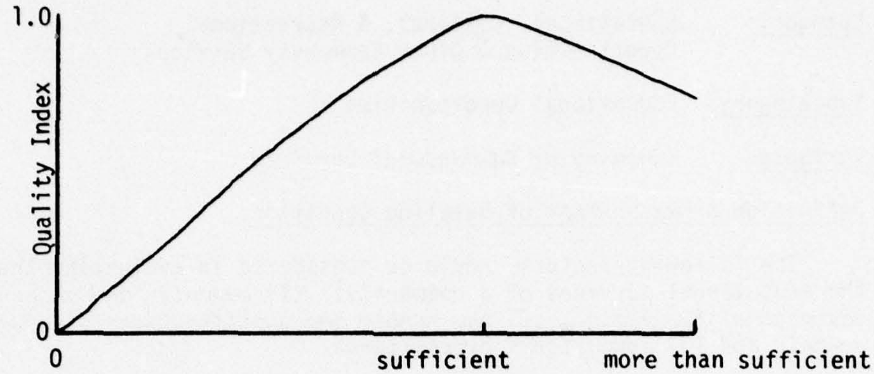
Some important indicators with reference to educational personnel are: (a) the ratio of teachers to students; (b) the ratio of counselors to students; and (c) the academic training of the teachers. The latter can be measured by the academic degrees acquired by the teachers and the relevance of their subject areas of academic training for the subjects taught by them.

The educational expenditures of a community or area can be measured as: (a) total expenditures; (b) average expenditures per pupil in average daily attendance; and/or (c) per capita expenditures, which is the total expenditures divided by the estimated mid-year population of the community or area. The measure of average expenditures per pupil can be compared with comparable figures for the state or nation as a whole to determine adequacy of the amount spent on education. The other measures of educational expenditures are important for prediction of impacts and will be discussed below.

Prediction of Impacts

Prediction of a water project's impact on adequacy of educational services requires projections of future population size, density/dispersion, and composition and estimates of the educational needs that these projections imply. These educational needs include educational achievement levels desired or planned by the types of population groupings projected for the area, the diversity of types of educational programs, and the educational facilities and personnel that will be needed to accommodate the population. These educational needs, in turn, can be used to project total educational expenditures. Additional aids for projecting total educational expenditures are to consider population projections in conjunction with per capita educational expenditures and/or average expenditures per pupil for populations comparable to that projected for the area.

Hypothesized Functional Curve & Rationale



INDICATOR OF ADEQUACY OF EDUCATIONAL SERVICES:
FACILITIES, PERSONNEL, AND EXPENDITURES

Beneficial impacts are assumed to accrue from educational programs, facilities, personnel, and expenditures that are sufficient to meet the needs of the population. However, educational services that exceed these needs would incur unnecessary costs that would reduce overall optimum benefits.

Remarks

Assessment of the adequacy of educational services of a community or area should be concerned with two types of impacts: (1) the effect of a project on the need for educational services; and (2) the effect of a project on the abilities of a community to meet the needs for adequate educational services. A project's impact on the latter is largely via its impact on an area's tax bases and, consequently, the revenues available for educational funding.

Data Sources

U.S. National Center for Education Statistics, *Digest of Education Statistics; Revenues and Expenditures for Public Elementary and Secondary Education; Financial Statistics of Institutions of Higher Education; Vocational and Technical Education*; state and local education agencies; field observations; surveys of the population.

References

Executive Office of the President, Office of Management and Budget, *Social Indicators, 1973.* Washington, D.C.: U.S. Government Printing Office, 1973, Pp. 75-101.

Fitzsimmons, Stephen J., Lorrie I. Stuart, and Peter C. Wolff, *Social Assessment Manual: A Guide to the Preparation of the Social Well-Being Account,* report for the Bureau of Reclamation, U.S. Department of the Interior, Cambridge, Mass.: Abt Associates, 1975, Pp. 138-9.

Fitzsimmons, Stephen J., and Warren G. Lavey, "Socio Economic Accounts System (SEAS): Toward a Comprehensive Community-Level Assessment Procedure," *Social Indicators Research* 2 (1976): Pp. 389-452.

Liu, Ben-Chieh, *Quality of Life Indicators in U.S. Metropolitan Areas, 1970: A Comprehensive Assessment.* Washington, D.C.: Washington Environmental Research Center, U.S. Environmental Protection Agency, 1975, Pp. 66-9.

U.S. Bureau of the Census, *The U.S. Fact Book, The Statistical Abstract of the U.S.* New York: Grosset and Dunlap, 1977, Pp. 111-22, 138-49.

<u>Account</u>: Social Well-Being

<u>Category</u>: Educational, Cultural, & Recreational Opportunities & Other Community Services

<u>Subcategory</u>: Recreational & Cultural Opportunities

<u>Variable</u>: *Recreational & Cultural Participation*

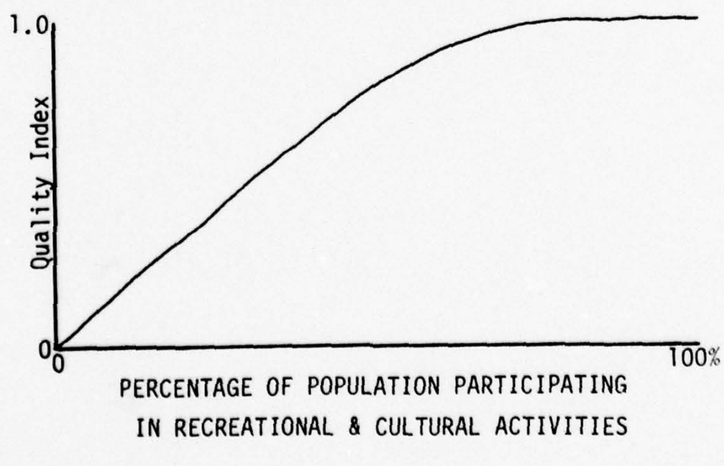
Definition & Measurement of Baseline Conditions

Recreational and cultural participation can be measured in two ways: (1) *attendance counts at recreational and cultural facilities and events;* and (2) *percentages of the population using recreational facilities and attending cultural events.* These data can be obtained from the various recreational and cultural agencies and facilities in the community and from surveys of the population, respectively. The data should be specified by the types of recreational and cultural facilities and events that exist in the community. The data can be further specified by the population groupings who participate in various types of recreational and cultural activities.

Predictions of Impacts

Prediction of a water project's impact on these indicators of recreational and cultural participation requires projections of population size and composition and estimates of the kinds of recreation and cultural activities that the projected population groupings would be likely to participate in. The latter can be estimated from the baseline conditions and from secondary data sources.

Hypothesized Functional Curve & Rationale



Beneficial impacts are defined as increases in recreational and cultural participation. It is assumed that optimum impacts will accrue if most of the population participate in some kind of recreational/cultural activity.

Data Sources

U.S. Bureau of Outdoor Recreation; National Recreation and Park Association, *State Park Statistics; Parks and Recreation;* Local recreational and cultural agencies and facilities; surveys of the population.

References

Brown, Robert, and Donald Fisk, *Recreational Planning and Analysis in Local Government*. Washington, D.C.: The Urban Institute, 1973.

Committee on Assessment of Demand for Outdoor Recreation Resources, National Academy of Sciences, *Assessing Demand for Outdoor Recreation*. Washington, D.C.: U.S. Government Printing Office, 1975.

Fitzsimmons, Stephen J., Lorrie I. Stuart, and Peter C. Wolff, *Social Assessment Manual: A Guide to the Preparation of the Social Well-Being Account*, report for the Bureau of Reclamation, U.S. Department of the Interior, Cambridge, Mass.: Abt Associates, 1975, Pp. 152-5.

Account: Social Well-Being

Category: Educational, Cultural, & Recreational Opportunities & Other Community Services

Subcategory: Recreational & Cultural Opportunities

Variable: *Diversity of Recreational & Cultural Opportunities*

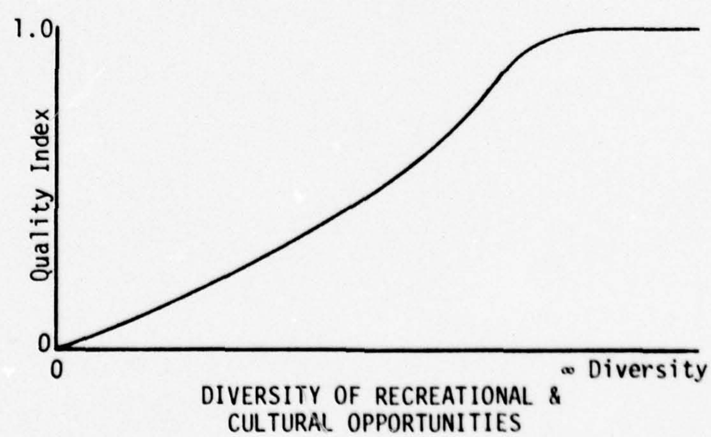
Definition & Measurement of Baseline Conditions

Diversity of recreational and cultural opportunities refers to the variety of types of these opportunities that are available in or near a community. Major categories of these opportunities include: (1) *outdoor recreation*; (2) *indoor recreation*; (3) *spectator sports*; (4) *performing arts*; (5) *libraries*; and (6) *museums, art galleries, etc.* The balance of opportunities among these categories should be specified as well as the different recreational or cultural activities within the categories. The different appeal of these activities to diverse populations groupings should also be considered.

Prediction of Impacts

By providing water resources, surrounding picnic and camping areas, etc., a water project might improve the diversity or balance of recreational activity in a community. A water project can also affect the diversity of recreational and cultural opportunities in a community by its effect on the tax bases of the community and, consequently, on the revenues that are available for recreational and cultural funding. A project may also affect the need for recreational diversity by its impact on population size, density/dispersion, and composition.

Hypothesized Functional Curve & Rationale



Beneficial impacts are assumed generally to accrue from a variety of recreational and cultural activities which will appeal to diverse population groupings. The idealized curve assumes that after a moderate point of diversity is reached, further diversity rapidly increases the benefits to be derived, but there is a point of sufficient diversity when additional types of recreational and cultural offerings are no longer necessary.

Remarks

Social well-being impact analysis of recreational and cultural diversity should be concerned with two types of impacts: (1) effect on the need for recreational and cultural diversity; and (2) effect on actual recreational and cultural diversity within a community.

Data Sources

Field observation; local recreational and cultural agencies.

References

Brown, Robert, and Donald Fisk, *Recreational Planning and Analysis in Local Government*. Washington, D.C.: The Urban Institute, 1973.

Committee on Assessment of Demand for Outdoor Recreation Resources, National Academy of Sciences, *Assessing Demand for Outdoor Recreation*. Washington, D.C.: U.S. Government Printing Office, 1975.

U.S. Bureau of the Census, *The U.S. Fact Book, The Statistical Abstract of the U.S.* New York: Grosset and Dunlap, 1977, Pp. 217-21.

<u>Account</u>: Social Well-Being

<u>Category</u>: Educational, Cultural, & Recreational Opportunities & Other Community Services

<u>Subcategory</u>: Recreational & Cultural Opportunities

<u>Variable</u>: *Adequacy of Recreational Areas & Cultural Facilities*

Definition & Measurement of Baseline Conditions

Two of the major indicators of adequacy of recreational areas and cultural facilities that might be affected by a water project are: (1) *capacity of the areas and facilities to accommodate potential users without overcrowding;* (2) *accessibility of areas and facilities to potential users.*

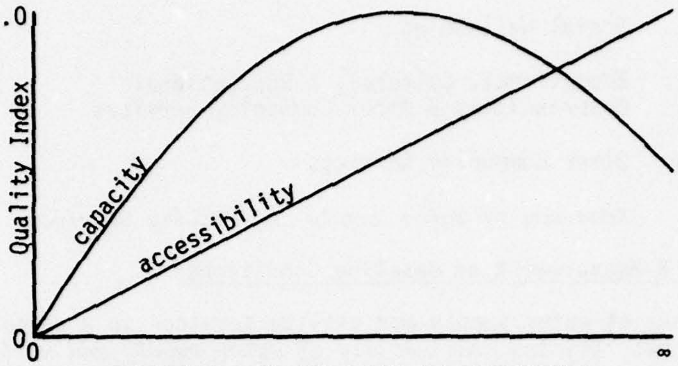
Measurement of accessibility of recreational areas and cultural facilities includes: (a) locational accessibility--distance of areas and facilities from densely population areas of the community and availability of transportation to these areas and facilities; (b) economic accessibility--the costs of using the recreational areas and cultural facilities and the abilities of all viable population groupings to meet these costs; and (c) social accessibility--whether the recreational areas and cultural facilities are open to all races and ethnic groups, religions, etc. These aspects of accessibility could be determined by field observation and the interviewing of users and facility personnel. Social accessibility, however, is difficult to determine.

Prediction of Impacts

Many water resource projects and adjacent park areas that might be provided by them would obviously add to the recreational areas available to a community. Whether adequacy of recreational areas and cultural facilities as a whole would improve, however, will depend on the population influx that the project precipitates and the recreational and cultural desires of the projected population segments. It is possible that some projects could destroy existing recreational facilities. In addition, the project can affect the adequacy of recreational areas and cultural facilities by its impact on the community's tax bases and, consequently, the revenues available for recreational and cultural funding.

Hypothesized Functional Curve & Rationale

Optimum impacts are identified as sufficient capacities of recreational areas and cultural facilities to accommodate most potential users but not excessive capacities that would incur unnecessary costs. In general, the more accessible recreational areas and cultural facilities are to all population segments, the more beneficial the impact is assumed to be. It is hypothesized, however, that after a moderately high degree of accessibility is reached, benefits increase more rapidly.



INDICATORS OF ADEQUACY OF RECREATION
AREAS & CULTURAL FACILITIES

Remarks

The population influx precipitated by the construction of a water project might strain existing recreational areas and cultural facilities of a community. This strain might be alleviated after construction has ended if the project provides additional opportunities for recreation.

Data Sources

Field observation; local recreational and cultural agencies; surveys of the population.

References

Brown, Robert, and Donald Fisk, *Recreation Planning and Analysis in Local Government.* Washington, D.C.: The Urban Institute, 1973.

Fitzsimmons, Stephen J., Lorrie I. Stuart, and Peter C. Wolff, *Social Assessment Manual: A Guide to the Preparation of the Social Well-Being Account,* report for the Bureau of Reclamation, U.S. Department of the Interior, Cambridge, Mass.: Abt Associates, 1975, Pp. 221-23.

Hatry, Harry P., and Diana R. Dunn, *Measuring the Effectiveness of Local Government Services: Recreation.* Washington, D.C.: The Urban Institute, 1971.

<u>Account</u>: Social Well-Being

<u>Category</u>: Educational, Cultural, & Recreational Opportunities & Other Community Services

<u>Subcategory</u>: Other Community Services

<u>Variable</u>: *Adequacy of Water Supply and Utility Services*

Definition & Measurement of Baseline Conditions

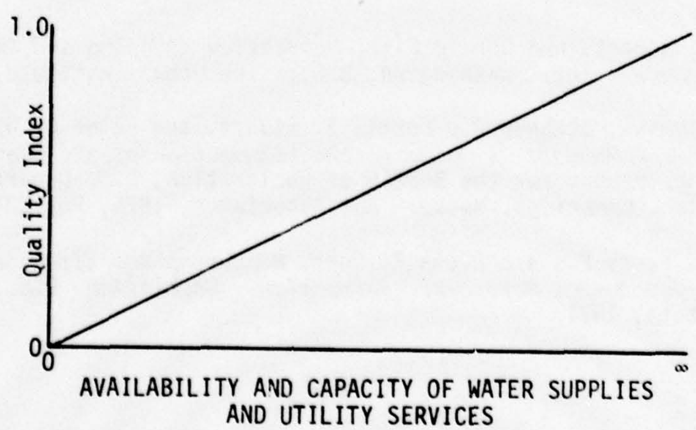
Adequacy of water supply and utility services in a community can be determined by: (1) *the availability of water supply and utility service for all desired users;* and (2) *the capacity of available water supply and utility services to satisfy the needs of the populations.* These data can be obtained by a representative survey of the population.

Measurement of availability of utility services should include questions regarding the diversity of types of utility services that are available to the population (e.g., electricity, gas, etc.). The capacity of available water supply and utility services to satisfy needs can be elicited by a direct question to that effect.

Prediction of Impacts

The water and energy resources which might be provided by a water project might improve the adequacy of water supply and utility services, depending on the population influx and, thus, the increased needs that the project precipitates.

Hypothesized Functional Curve & Rationale



Beneficial impacts are identified as water supplies and utility services being available to all desired users and of sufficient capacity to satisfy the needs of the population and to provide for industrial development.

Remarks

During the construction phase of a water project, the utility services of a community may be strained by the population influx associated with the construction and by the construction process itself. These short-term impacts should be distinguished from the long-term impacts which will occur after a project is operational.

Data Sources

Surveys of the population; Bureau of Labor Statistics, *Expenditures and Income;* Bureau of Economic Analysis, *Survey of Current Business;* U.S. Federal Power Commission; American Gas Association, *Gas Facts;* Edison Electric Institute, *Statistical Yearbook;* U.S. Rural Electrification Administration.

References

U.S. Bureau of the Census, *The U.S. Fact Book, The Statistical Abstract of the U.S.* New York: Grosset and Dunlap, 1977, P. 635.

<u>Account</u>: Social Well-Being

<u>Category</u>: Educational, Cultural, & Recreational Opportunities & Other Community Services

<u>Subcategory</u>: Other Community Services

<u>Variable</u>: *Adequacy of Public Transportation*

Definition & Measurement of Baseline Conditions

Adequacy of transportation facilities and services is generally determined by: (1) *the accessibility of diverse areas of a community by public transportation;* and (2) *quality of available transportation services.*

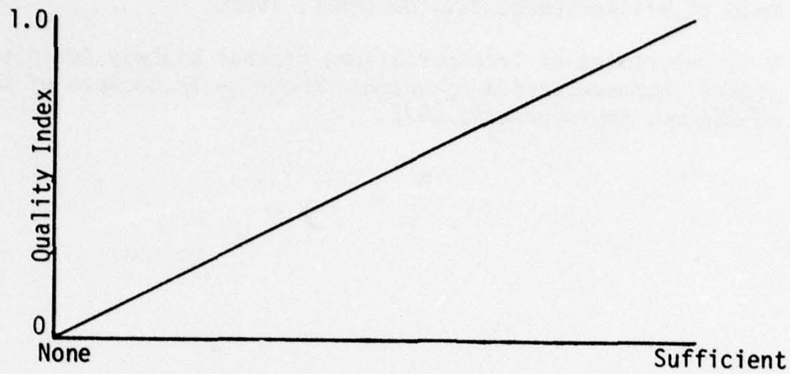
The major concerns with reference to public transportation accessibility vis-a-vis water resource projects are: (a) that all neighborhoods be within reasonable distance of public transportation pick-up and departure points; (b) that public transportation be available from all reasonably dense population areas to major activity centers within or adjacent to the community. Public transportation accessibility with respect to both of these concerns should be measured in terms of geographical accessibility (distance to transportation pick-up points) and economic accessibility (the abilities of all population segments to afford the costs of using the transportation services).

Quality of available transportation services can be measured in terms of: (a) the capacity of the transportation facilities and services to accommodate desired users without overcrowding; (b) comfort of transportation vehicles and facilities; and (c) speed of travel.

Prediction of Impacts

Prediction of the impacts of a water project on adequacy of transportation facilities and services requires projections of: (1) population size, dispersion, and composition and the needs for transportation facilities and services that these population changes imply; (2) waterway transportation which the water project might make possible; (3) needed transportation facilities and services to recreational areas which the water project might provide; and (4) the disruption of highways or other transportation routes by a water project. In addition, estimates should be made of a project's impact on tax bases and, consequently, on the monies available to fund or subsidize increased demands for transportation services.

Hypothesized Functional Curve & Rationale



ACCESSIBILITY AND QUALITY OF TRANSPORTATION FACILITIES AND SERVICE

Benficial impacts are assumed to accrue from transportation facilities and services that are sufficient to meet the needs of the population.

Remarks

The construction phase of a water project may create short-term demands for transportation facilities and services, because of temporary disruption of highways or other transportation routes and/or because of a temporary influx of workers and their families. These short-term impacts should be distinguished from longer term impacts on adequacy of transportation facilities and services after the water project is operational.

Data Sources

Field observation; local public transportation agencies; surveys of the population; *Transport Economics*.

References

Gale, James E., *Transportation Policy Alternatives and the Socioeconomic Reactions: A Case Study of the Washington Metropolitan Area,* report prepared for Urban Mass Transportation Administration, Springfield, Va.: U.S. Department of Commerce, 1973.

Guseman, Patricia K., J. M. Hall, T. K. Fuller, and D. Burke, *Social Impacts: Evaluation of Highway Project Development in Urban Residential Areas,* Research Report 190-1. College Station, Texas: Texas Transportation Institute, Texas A&M University, 1976.

Highway Research Board, National Academy of Sciences, *Urban Travel Demand Forecasting*, Special Report 143, Proceedings of a Conference held at Williamsburg, Va., December, 1972.

U.S. Department of Transportation, Federal Highway Administration, *Social Characteristics of Neighborhoods as Indicators of the Effects of Highway Improvements*, 1972.

EMERGENCY PREPAREDNESS

This report has included all of the variables in the emergency preparedness category that were specified in the mandate of the Water Resources Council (1973). To determine the most salient variables for social well-being impact assessment of water projects, experts working in emergency preparedness for water resource planning were consulted. Their opinion was that water transportation was of primary concern to water resource planning; consequently, these were the emergency preparedness variables chosen for detailed description (see Figure 5).

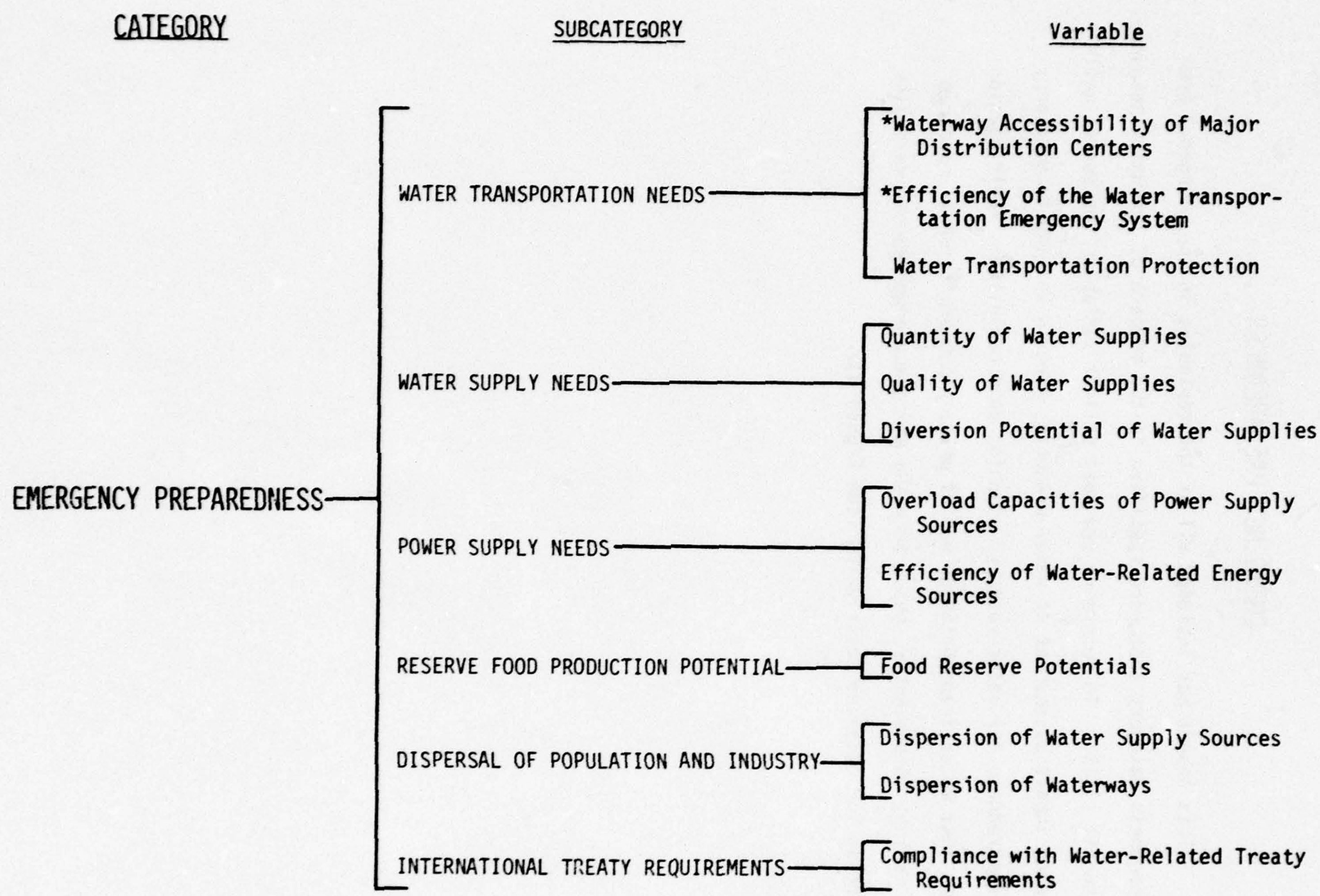


Figure 5

Structure of the Emergency Preparedness Category

<u>Account</u>: Social Well-Being

<u>Category</u>: Emergency Preparedness

<u>Subcategory</u>: Water Transportation Needs

<u>Variable</u>: *Waterway Accessibility of Major Distribution Centers*

Definition & Measurement of Baseline Conditions

This variable refers to whether major centers for the distribution of goods and services are sufficiently accessible by the types and capacities of water transportation which might be required in times of national emergency. Two major concerns for emergency preparedness are: (1) *geographic accessibility of major distribution centers by waterways;* and (2) *the overload capacities of these waterways and ports.*

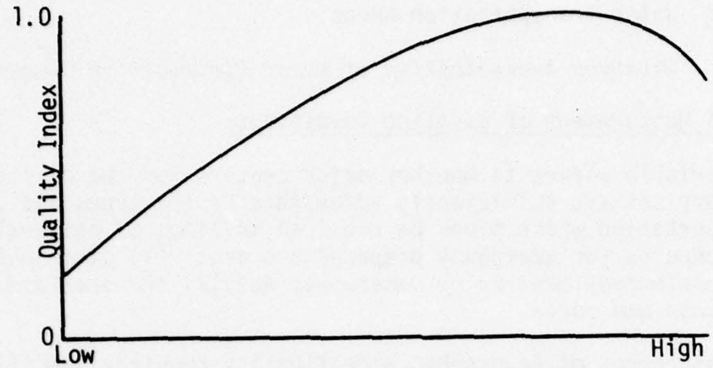
The measurement of geographic accessibility requires specification of: (a) the major centers for the distribution of goods and services; (b) the distance of these centers from waterway ports; and (c) means and capacities of transportation to these waterway ports.

Measurement of the overload capacities of these waterways and ports includes: (a) the amount of traffic and tonnage support capacities of the waterways and ports; (b) operational procedures for the regulation of water traffic; (c) the types of water transport suitable for the waterway and port; (d) commodity loading, unloading, and storage capacity of port facilities; and (e) identification and assessment of other factors that affect the servicing of water transport.

Prediction of Impacts

The effects a water project will have on waterway accessibility and capacity will depend, of course, on the type of waterway project. For example, new waterways and ports can improve geographic accessibility of major distribution centers. Improved waterways and port facilities might also increase such accessibility by increasing the types of transport and the transport capacity to the distribution centers. Plans for expansion and other improvements of waterways and port facilities should be evaluated in terms of whether they will increase transport capacities beyond that needed for normal use. Both new and improved facilities ultimately should be evaluated in terms of how much they will aid in providing for an uninterrupted flow of essential goods and services in the event of breakdown or diversion of other transportation sectors (e.g., air, rail) and in the event of breakdown or diversion of other parts of the water transportation system. Such evaluation should consider the need to provide essential consumer, industrial, and national security needs. Special consideration should be given to waterway networks that are likely to require heavy use in order to meet these needs during emergencies.

Hypothesized Functional Curve & Rationale



GEOGRAPHIC ACCESSIBILITY OF DISTRIBUTION CENTERS AND OVERLOAD CAPACITIES OF WATERWAYS AND PORTS

The impacts of a water project are assumed to be beneficial if the project provides for waterway accessibility of a previously unaccessible major distribution center and/or if the project improves the waterway and port capacity so that it is greater than needed to meet ordinary, non-emergency needs. The idealized curve assumes that there is a moderately high point of accessibility and capacity which can be deemed sufficient to provide for emergencies and that the costs of providing for greater accessibility would reduce overall benefits.

Data Sources

Field observation; U.S. Army Corps of Engineers, *Waterborne Commerce of the United States;* U.S. Maritime Administration; district and state water and transportation agencies.

References

Doyle, John P., and William D. Franklin, *National Transportation Preparedness,* report prepared for the Office of Emergency Transportation. College Station, Texas: Texas Transportation Institute, Texas A&M University, 1968.

Fitzsimmons, Stephen J., Lorrie I. Stuart, and Peter C. Wolff, *Social Assessment Manual: A Guide to the Preparation of the Social Well-Being Account,* report for the Bureau of Reclamation, U.S. Department of the Interior. Cambridge, Mass.: Abt Associates, 1975. Pp. 180, 273.

U.S. Bureau of the Census, *The U.S. Fact Book, The Statistical Abstract of the U.S.* New York: Grosset and Dunlap, 1977, Pp. 619-27.

<u>Account</u>: Social Well-Being

<u>Category</u>: Emergency Preparedness

<u>Subcategory</u>: Water Transportation Needs

<u>Variable</u>: *Efficiency of the Water Transportation Emergency System*

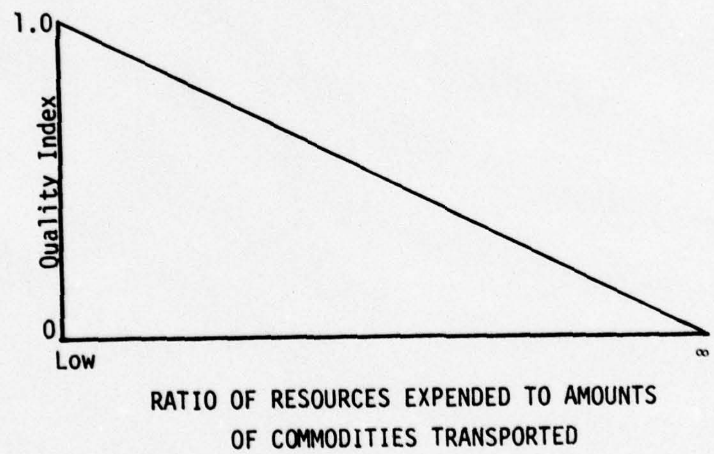
<u>Definition & Measurement of Baseline Conditions</u>

The concern here is with how efficient a water transportation system would be in the event of an emergency. Efficiency is measured in terms of the amounts of manpower, time, and other resources expended in waterway and port maintenance and operations in relation to the amounts of commodities distributed via waterways.

<u>Prediction of Impacts</u>

A water project should be evaluated with reference to its ability to minimize those resources that must be expended in order for a waterway and port to accommodate emergency overload capacities. Alternative plans for new or improved waterway and port facilities should be compared according to the amounts of resources that must be expended for construction as well as operation of the project.

Hypothesized Functional Curve & Rationale



Beneficial impacts are assumed to accrue from transportation systems that minimize the amount of resources expended to transport a given amount of commodities.

<u>Data Sources</u>

Field observation; U.S. Army Corps of Engineers, *Statement of Costs; Waterborne Commerce of the United States;* U.S. Maritime Administration; district and state water and transportation agencies.

References

Doyle, John P., and William D. Franklin, *National Transportation Preparedness*, report prepared for the Office of Emergency Transportation. College Station, Texas: Texas Transportation Institute, Texas A&M University, 1968.

Fitzsimmons, Stephen J., Lorrie I. Stuart, and Peter C. Wolff, *Social Assessment Manual: A Guide to the Preparation of the Social Well-Being Account*, report for the Bureau of Reclamation, U.S. Department of the Interior. Cambridge, Mass.: Abt Associates, 1975, p. 180.

U.S. Bureau of the Census, *The U.S. Fact Book, The Statistical Abstract of the U.S.* New York: Grosset and Dunlap, 1977, Pp. 619-27.

COMMUNITY COHESION

This category of the Social Well-Being account refers primarily to the sociopsychological characteristics of area residents most affected by a planned waterway facility (see Figure 6). Means of measuring variables that point to community solidarity can be direct or indirect. In the first case, surveys of a random sample of residents or interviews with knowledgeable informants will provide a means of assessing strength of community identification, community participation practices, and community values.

Indirect techniques for measuring community cohesion revolve around the use of demographic data, primarily decennial census information or data from periodic *Current Population Surveys*. Thus, specific procedures for determining the socioeconomic diversity and ethnic diversity elicit indirect indications of the social similarity and, thereby, the homogeneity and cohesion of the project site(s). The proportion of older persons in the proposed project area also can provide an indirect indicator of social cohesion.

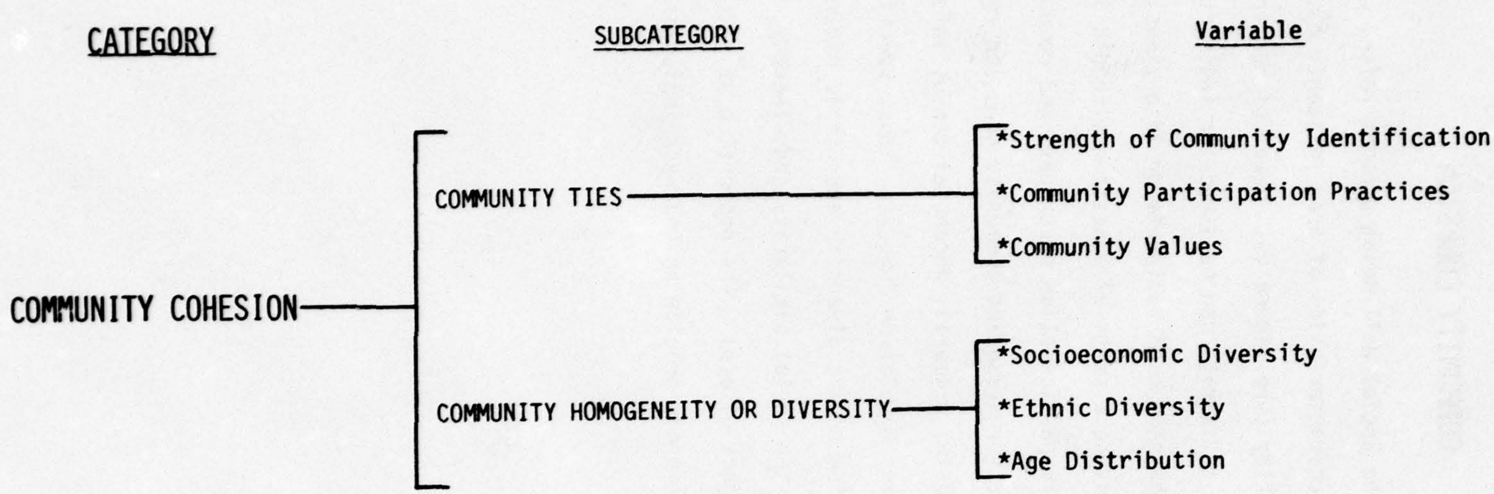


Figure 6

Structure of the Community Cohesion Category

Account: Social Well-Being

Category: Community Cohesion

Subcategory: Community Ties

Variable: *Strength of Community Identification*

Definition & Measurement of Baseline Conditions

Strength of community identification refers to both a psychological unity among people who feel that they belong together and to a locality consciousness based on geographic boundaries (Keller, 1968). The areal unit utilized for a project feasibility study normally will not be coterminous with a community or a neighborhood. The study area may contain no viable residential neighborhoods, only a portion of a residential area, or one and perhaps more viable neighborhoods.

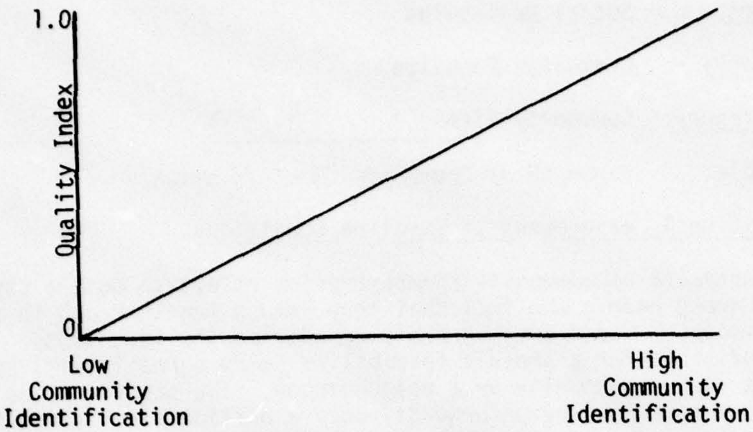
The criteria for determining the strength of community identification should be based on survey questions revolving around the following components: (1) *congruency in identification of community boundaries;* (2) *extent of residents' positive evaluation of the area;* (3) *extent of ties to friends and relatives within the area;* (4) *use of localized facilities;* (5) *residents' emphasis on historical objects or events in the area;* (6) *participation in area associations.* The first factor, "congruency in identification of community boundaries," as well as the other five components, can be determined through the subjective responses of a representative sample of project study area residents, as outlined in Guseman, et al.(1976). Additionally, knowledgeable community members, such as city planners or other city officials, ministers, ethnic leaders, businessmen, local newsmen, or other informed persons can provide accurate assessments of the six components described above.

Prediction of Impacts

Prediction of a water project's impact on the foregoing indicators of community identification rests with the baseline condition. Social impact is greatest when community solidarity is high and the project facility is anticipated to cause mobility within the area, residential displacement, economic alterations, or other visible socioeconomic changes.

Hypothesized Functional Curve & Rationale

Whether a waterway improvement will increase or decrease the strength of community solidarity depends on the type of project as well as the baseline conditions. Projects that segment, rather than border, residential communities can be expected to have the greatest amount of social impact. The functional curve points to a higher quality of life in communities or neighborhoods where social solidarity and community identification are pronounced.



STRENGTH OF COMMUNITY IDENTIFICATION

Data Sources

Data can be obtained from surveys within the project area and/or from knowledgeable representatives selected from the community.

References

Guseman, Patricia K., K. J. Hall, T. K. Fuller, and D. Burke. *Social Impacts: Evaluation of Highway Project Development in Urban Residential Areas,* Research Report 190-1. College Station, Texas: Texas Transportation Institute, Texas A&M University, 1976.

Keller, Suzanne, *The Urban Neighborhood: A Sociological Perspective.* New York: Random House, 1968.

Ross, H. Lawrence, "The Local Community: A Survey Approach." Pp. 557-67 in Robert Gutman and David Popenoe (eds.) *Neighborhood, City, and Metropolis.* New York: Random House, 1969.

Warren, Roland L. *Studying Your Community.* New York: The Free Press, 1955.

Account: Social Well-Being

Category: Community Cohesion

Subcategory: Community Ties

Variable: *Community Participation Practices*

Definition & Measurement of Baseline Conditions

With information regarding community participation, the waterway official has a useful basis for determining residential linkages or interaction patterns within a project area. The feasibility of the planned project, in terms of impact on those residents directly affected, can be evaluated objectively from survey data, such as: (1) *use of area facilities;* (2) *presence of close friends or relatives in the area;* (3) *strength of voluntary associations in area issues;* (4) *extent of participation in waterway project, i.e., meetings and attendance at hearings;* and (5) *overall dependency on area.*

Use of area facilities consists of utilization of social institutions, such as churches, medical facilities, and schools, and of commercial establishments for food and nonfood shopping, banking, and for recreational activities (see Foley, 1961). Additionally, residents' places of work may be located within the area directly affected by a waterway improvement, such as farms or industrial sites. Generally in areas where more than 50 percent of all facilities used by a household are locally based, major waterway projects that change the physical configuration of the area may prove undesirable, because of the relative dependence on the area (Keller, 1968; Burke, et al., 1975).

Presence of close friends or relatives in the area engenders a "sense of community." Especially in communities where personal resources are limited, interpersonal ties are extremely important (Bott, 1957). In urban areas where the majority of residents' friends live within walking distance, for example, a major waterway facility could have an adverse effect on area residents (Ross, 1969).

The strength of voluntary associations in an area also indicates the degree of integration among residents. Churches (both rural and urban), civic groups, professional organizations, unions, and homeowner's associations all provide a basis for community cohesion as well as visible centers of power in the community (Riedesel, et al., 1968). Where more than 50 percent of area residents participate in local organizations, social consequences of major physical alterations will likely be more adverse (Litwak, 1970).

Through the participation by citizens in the planned waterway project, a relative evaluation of its effect can be inferred. Citizen involvement may be beneficial, in that it can:

(a) bring residents into the public policy and planning process;
(b) stimulate public discussion to reflect the community's values;
(c) identify the pros and cons of alternative plans;
(d) increase the public's understanding of planning options;
(e) uncover alternative options; and
(f) encourage resolution of public opposition (see U.S. Department of Transportation, 1974).

Waterway project involvement can be assessed by knowledge of (a) the number of actions for or against the proposal, (b) residents' belief that their personal interests are considered, (c) citizens' knowledge of other groups for or against the proposed facility, and (d) residents' knowledge of right-of-way and relocation assistance.

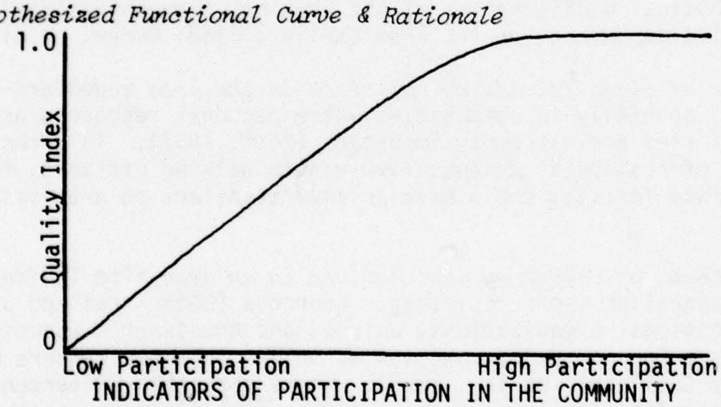
Overall dependency on an area is based on residents' socioeconomic status, ethnic background, age, and lack of transportation to travel beyond local boundaries. For example, lower class and older residents are more dependent on their residential area for carrying out daily activities.

These six forms of participation in the community usually are determined by means of a resident sample. One measurement technique based on survey findings is entitled the "Area Activity Index"; for more information about the application and use of this Index, see Guseman, et al. (1976:78-79).

Prediction of Impacts

The prediction of social impacts on community participation and community cohesion has been described above in the specification of specific indicators. With the use of a representative survey, the waterway planner has: (1) quantitative information about the personal consequences of a proposed project, both beneficial and adverse; and (2) an understanding of existing residential linkages or interaction patterns that aid in determining the final design, and perhaps location, of the facility.

Hypothesized Functional Curve & Rationale



Beneficial impacts are assumed to accrue from baseline conditons, as well as from the intervention of waterway facilities, that stimulate positive community ties and community participation practices among residents.

Data Sources

Surveys of a random population sample; local knowledgeable representatives.

References

Bott, Elizabeth, *Family and Social Network*. London: Favistock, 1957.

Burke, Dock, Patricia K. Guseman, Jesse Buffington, and Dale Schafer, *Evaluation of Residents' Attitudes and Expectations of a Planned Freeway*. College Station, Texas: Texas Transportation Institute, Texas A&M University, Research Report 148-6, 1975.

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Keller, Suzanne, *The Urban Neighborhood: A Sociological Perspective*. New York: Random House, 1968.

Litwak, Eugene, "Voluntary Associations and Neighborhood Cohesion." Pp. 583-600 in Robert Gutman and David Popenoe (eds.), *Neighborhood, City, and Metropolis*. New York: Random House, 1970.

Riedesel, G. A., David M. Scott, Robert Patton, Henry C. Matthews, Harold T. Abbott, Andeas N. Marias van Blauderen, Ned Weaver, and John C. Cook, *A Study of the Social, Economic, and Environmental Impact of Highway Transportation Facilities on Urban Communities*. Pullman, Washington: College of Engineering Research Division, Washington State University, 1968.

Ross, H. Laurence, "The Local Community: A Survey Approach." Pp. 557-567 in Robert Gutman and David Popenoe (eds.), *Neighborhood, City, and Metropolis*. New York: Random House, 1969.

U. S. Department of Transportation, *Social and Economic Effects of Highways*. Washington, D. C.: Federal Highway Administration, 1974.

Account: Social Well-Being

Category: Community Cohesion

Subcategory: Community Ties

Variable: *Community Values*

Definition & Measurement of Baseline Conditions

To a large extent, community values reflect both the needs and interests of various groups. Not only may different population segments possess divergent values, but, conversely, they also may be quite homogeneous in regard to opinions on specific community issues. While attitudes do not mirror actual behavior, they do represent an individual's tendency to act in accord with intensely held values.

It has been established that individuals surveyed concerning large-scale changes in their immediate environment, such as a waterway facility, are both articulate and aware enough of their values to apply them to waterway plan approval or rejection. Various researchers (Schofer, 1969; Colcord, 1971; Weiner and Deak, 1971; and Ylvisaker, 1969) point out several of these salient values, including the:

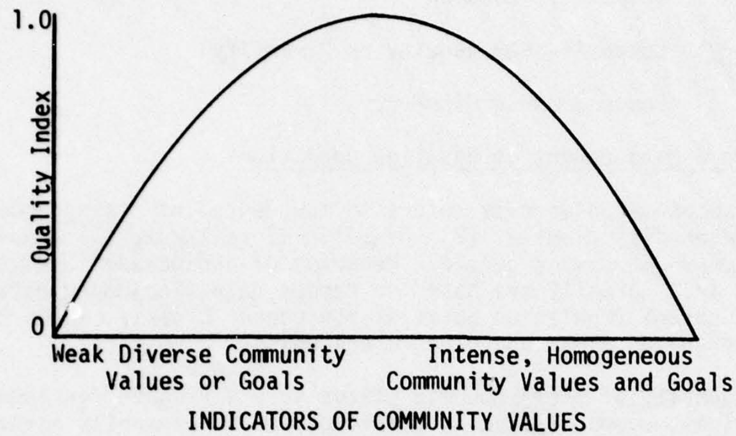
1. *Integrity of neighborhoods;*
2. *High aesthetic quality of the visual environment;*
3. *Preservation of community heritage;*
4. *Stability of residence;*
5. *Protection of property investments;*
6. *Preservation or enhancement of community's cohesion;*
7. *Maintenance of community services;*
8. *Preservation of community safety;*
9. *Provision of adequate housing;* and
10. *Availability of employment.*

In using a survey approach, preference in regard to community values can be ascertained. Further, adequate knowledge of the diversity of opinion among various groups is assessed. The critical factor is that goals or value preferences are ranked by individual residents so that an overall rating can be obtained for each evaluative item.

Prediction of Impacts

Community values become important in enabling the waterway planner to estimate the extent of stress a proposed project will precipitate in an area. A positive baseline evaluation of an area can be an important indication of the extent of impact of large-scale changes. Residents will be favorable to construction of the proposed facility if they assess that the plan has positive benefits, such as: (1) preservation and maintenance of open spaces; (2) reduction of air and water pollution; (3) protection and accommodation of wildlife; (4) attractive landscaping of areas; or (5) preservation of community integrity (see Mason and Moore, 1971).

Hypothesized Functional Curve & Rationale



The goals receiving the highest rating should be measured for consistency among individual residents as well as for intensity. Using these two criteria, the functional curve points to maximum community quality when some diversity of opinion and issue interest exists, but not to the degree that discensus is evidenced for all community issues.

Data Sources

Community values assessment is normally based on the availability of resident-survey data, but public officials or knowledgeable community leaders may also act as respondents.

References

Colcord, Frank C., "Transportation and the Political Culture," *Highway Research Record* 356 (1971): Pp. 32-42.

Mason, Joseph Barry and Charles Thomas Moore, "Development of Guides for Community Acceptance of Highway Location, Development, and Construction," *Highway Research Record* 356 (1971): Pp. 43-54.

Schofer, Joseph, "First Workshop Reports," *Highway Research Board Special Report* 105 (1969): Pp. 67-8.

Weiner, Paul and Edward J. Deak, "Nonuser Effects in Highway Planning," *Highway Research Record* 356 (1971): Pp. 55-68.

Ylvisaker, Paul N., "The Resident Looks at Community Values," *Highway Research Board Special Report* 105 (1969); Pp. 49-55.

Account: Social Well-Being

Category: Community Cohesion

Subcategory: Community Homogeneity or Diversity

Variable: *Socioeconomic Diversity*

Definition & Measurement of Baseline Conditions

Socioeconomic diversity refers to the degree of mixing among residents with different (1) *incomes*, (2) *occupational rankings*, (3) *educational levels*, and (4) *owner and rental values*. Measures of socioeconomic diversity within a project area normally are based on census data, including data from periodic Current Population Surveys, for census blocks, census tracts, urban places, urbanized areas and other areal units.

Homogeneity of socioeconomic status is a surrogate for homogeneity of social values, community goals, participation in community activities, use of local facilities, and community solidarity. Areas containing residents with disparate socioeconomic characteristics usually reflect a lowered "sense of community." For these reasons, the Coefficient of Variation (CV) is suggested for the purpose of depicting an area's socioeconomic homogeneity or diversity. The CV can be used to describe the diversity/homogeneity of owner values, rental values, educational levels, occupational ranking or family incomes within an area (such as a census tract). The CV is formulated for measuring diversity in owner values as

$$CV = \frac{\sum_{i=1}^{n} f_i (X_i - \overline{X})^2 / N-1}{\overline{X}}$$

where $\overline{X}$ = mean or average owner value

X_i = the midpoint for each category of owner values

f_i = the number of owned dwellings in each category

N = the total number of owner units

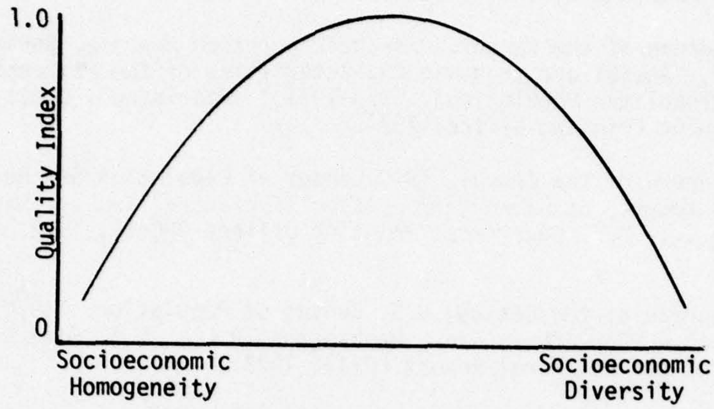
n = the number of owner value categories

The CV can range from 0 to ∞, but usually does not exceed 1.20. A very homogeneous area is one which has a CV of less than 0.30.

Prediction of Impacts

Judgment concerning the degree of social impact and effects on the cohesiveness of residents, especially concensus of opinions in regard to the proposed waterway improvement, should not omit the criterion of socioeconomic homogeneity. Although physical proximity stimulates social interaction, the social similarity of an area--measured by socioeconomic homogeneity--is of primary importance.

Hypothesized Functional Curve & Rationale



INDICATORS OF SOCIOECONOMIC DIVERSITY

In homogeneous residential areas, any large-scale changes are likely to meet with greater, and more organized, opposition, unless the alteration can be of proven benefit to the area. Likewise, in diverse or socioeconomically mixed areas, residents often are less cohesive and may evidence a greater concern about improved property values with the new facility than a concern for community disruption.

Data Sources

Data can be obtained from decennial census information as well as Current Population Surveys, such as *Social and Economic Characteristics of the Population in Metro and Nonmetro Counties, 1970*, and *Social and Economic Characteristics of the Metropolitan and Nonmetropolitan Population: 1974 and 1970*. Since census data provides data aggregated by groups, another source for data at the individual level is the random sample survey of an area.

References

Guseman, Patricia K., J.M. Hall, T.K. Fuller, and D. Burke. *Social Impacts: Evaluation of Highway Project Development in Urban Residential Areas*, Research Report 190-1. College Station, Texas: Texas Transportation Institute, Texas A&M University, 1976.

Hines, Fred K., D.L. Brown, and J.M. Zimmer, *Social and Economic Characteristics of the Population in Metro and Nonmetro Counties, 1970*. Economic Research Service, U.S. Department of Agriculture, Agricultural Economic Report No. 272, 1975.

Keller, Suzanne, "Social Class in Physical Planning." *International Social Science Journal* 18 (1966): Pp. 494-512.

Marrett, Cora B., "Social Class Values and the Balanced Community," *Social Problems* 21 (Fall, 1973): Pp. 259-68.

U.S. Bureau of the Census, *Current Population Reports*, Series P-23, No. 55, "Social and Economic Characteristics of the Metropolitan and Nonmetropolitan Population: 1970-1974." Washington, D.C.: U.S. Government Printing Office, 1975.

U.S. Bureau of the Census, 1970 Census of Population and Housing, *Census Tracts, Standard Metropolitan Statistical Areas.* Washington, D.C.: U.S. Government Printing Office, PHC(1), 1972.

U.S. Bureau of the Census, U.S. Census of Population: 1970. *General Population Characteristics* Washington, D.C.: U.S. Government Printing Office, Final Report PC(1), 1973.

<u>Account</u>: Social Well-Being

<u>Category</u>: Community Cohesion

<u>Subcategory</u>: Community Homogeneity or Diversity

<u>Variable</u>: *Ethnic Diversity*

<u>Definition & Measurement of Baseline Conditions</u>

Ethnic diversity refers to the relative mixing of ethnic groups. If only two ethnic groups reside in an area, such as whites and Negroes, then racial mixing is a more appropriate term. Particularly in Southwestern and Eastern states, however, at least three major ethnic groups predominate, Anglos, Negroes, and Spanish-Americans. Basic community values of ethnic minorities are not noticeably different from those values for Anglos--ability to be involved in local affairs, ability to interact socially and to use localized facilities (Feldt, 1969). On the other hand, ethnic minorities have emphasized a need for more control and influence in decision-making regarding large-scale community alterations and community issues. Stability and security in black and other ethnic minority residential and commercial areas therefore is of special importance.

As with the analysis of socioeconomic diversity described previously, a technique is presented to measure ethnic mixing or ethnic segregation within an area. The relative concentration of Anglos, Negroes, and Mexican-Americans, for example, can be ascertained from census populations and the Index of Qualitative Variation (IQV) applied.

$$IQV = \frac{\Sigma n_i n_j}{\frac{k(k-1)}{2}\left(\frac{N}{k}\right)^2}$$

where n = number in each ethnic category

k = number of ethnic categories being used

N = total population

In the case where 1,500 residents live in one census tract, suppose that 1,000 are Anglo, 400 Mexican-American, and 100 Negro. The observed mix is actually high for this residential area, considering that the majority of tracts will evidence a more homogeneous ethnic composition. The IQV for this tract is:

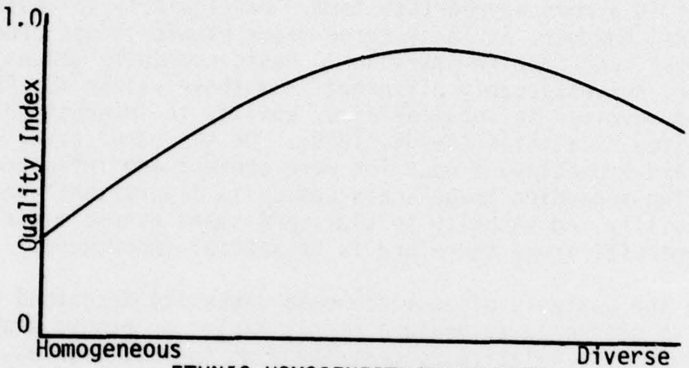
$$\frac{(1{,}000 \times 400) + (1{,}000 \times 100) + (400 \times 100)}{\frac{3(3-1)}{2}\left(\frac{1{,}500}{3}\right)^2} = 0.72$$

The Index will always range between 0 and 1.0, with 1.0 indicating totally balanced mixing among the three ethnic groups (see Mueller, et al., 1970).

Prediction of Impacts

Ethnic groups may stress opposition to a waterway project because of displacement of residents, loss of accessibility, and community segmentation. Conversely, representatives of ethnic groups and other interested individuals have suggested that facilities which "border" ethnic residential areas tend to further isolate them. In the latter case, ethnically balanced or mixed residential development should be a goal of waterway officials planning new facilities. The dilemma remains, however, and further studies need to consider appropriate strategies in this regard.

Hypothesized Functional Curve & Rationale



As noted above, no concensus exists as to the optimum ethnic mix within residential areas. However, ethnic diversity to the extent accepted by residents maximizes the quality index.

Data Sources

Data can be obtained from published census accounts, including Current Population Reports, *"Persons of Spanish Origin in the United States: March, 1975,"* and *"The Social and Economic Status of the Black Population in the United States,"* for specific areal units, such as census blocks, census tracts, urban places, urbanized areas, incorporated places, and SMSA's.* Additionally survey data provide useful information regarding a bifurcation of opinion by ethnic groups of large-scale public projects.

References

Feldt, Allan, "First Workshop Reports," *Highway Research Board Special Report*, 1969, Pp. 65-6.

Guseman, Patricia K., J. M. Hall, T. K. Fuller, and D. Burke, *Social Impacts: Evaluation of Highway Project Development in Urban Residential Areas*, Research Report 190-1. College Station, Texas: Texas Transportation Institute, Texas A&M University, 1976.

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* Standard Metropolitan Statistical Area

Mueller, John H., K. F. Schuessler, H. L. Costner, *Statistical Reasoning in Sociology*. Boston, Massachusetts: Houghton Mifflin, 1970.

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U.S. Bureau of the Census, U.S. Census of Population: 1970. *General Population Characteristics, Texas*. Washington, D.C.: U.S. Government Printing Office, Final Report PC(1), 1973.

<u>Account</u>: Social Well-Being

<u>Category</u>: Community Cohesion

<u>Subcategory</u>: Community Homogeneity or Diversity

<u>Variable</u>: *Age Distribution*

Definition & Measurement of Baseline Conditions

The age distribution and family life cycle of an area provide an important predictor of the degree of identification and ties to the community or specific residential setting. A large proportion of older persons points to a homogeneity of residents, most of whom may have resided within the same vicinity for 30 to 50 years, or perhaps a lifetime. The old and the young are more closely linked to their places of residence than are those individuals between the ages of 20 and 50.

Older age is highly correlated with length of residence and with a desire to remain in current place of residence (Speare, 1974). Nevertheless, the stability of the immediate community is often of as great importance to older persons as is their own dwelling unit (Carp, 1971).

The measurement of age distribution or age dependency from census data can be obtained through use of a Dependency Ratio (see Peterson, 1969).

$$\text{Dependency Ratio} = \frac{\underset{\text{(Residents < 16)}}{\text{Percent of Children}} + \underset{\text{(Residents 60+)}}{\text{Percent of Older Persons}}}{\text{Active Population (Residents 16-59)}} \times 100$$

If the concern is only for older persons, the Ratio is altered and entitled an Aged Dependency Ratio (see Shryock and Siegel, 1975).

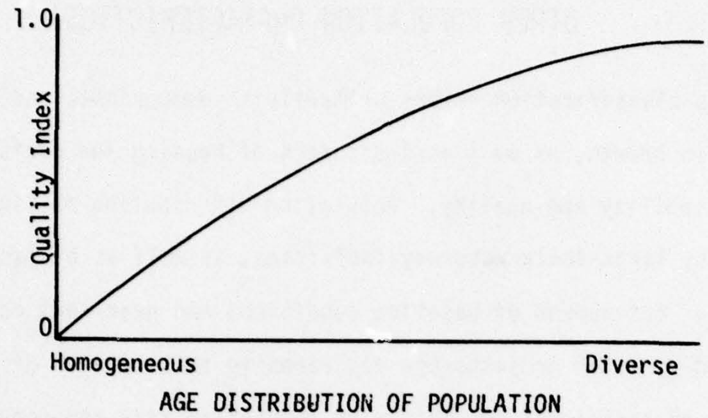
$$\text{Aged Dependency Ratio} = \frac{\text{Percent of Older Persons (Residents 60+)}}{\text{Active Population (Residents 16-59)}} \times 100.$$

Prediction of Impacts

A measure of the predominance of older persons in an area, such as the Aged Dependency Ratio, is very useful for assessing age distribution, particularly when alternative project plans or sites are being evaluated. As can be anticipated, the greater the number of "dependent" residents, the more adverse the consequences of major alterations in a community. If the proportion of older persons is greater than 15 percent, a higher Aged Dependency Ratio and, concomitantly, a greater social impact will be the result of major waterway projects.

Hypothesized Functional Curve & Rationale

Communities diverse along age lines provide an idealized image of the balanced residential area. However, age stratification within residential settings is becoming more pronounced and should be assessed in establishing a full social well-being account.



Data Sources

Census data provide the primary basis for measuring age distribution including decennial publications as well as Current Population Reports such as Series P-23, No. 57, *Social and Economic Characteristics of the Older Population, 1974*. Additionally, survey data may be utilized.

References

Carp, S. M., "Pedestrian Transportation for Retired People, *Highway Research Record* 356, 1971, Pp. 105-118.

Guseman, Patricia K., J. M. Hall, T. K. Fuller, and D. Burke, *Social Impacts: Evaluation of Highway Project Development in Urban Residential Areas*, Research Report 190-1. College Station, Texas: Texas Transportation Institute, Texas A&M University, 1976.

Peterson, William, *Population*. New York: MacMillan, 1969.

Shryock, Henry S., Jacob S. Siegel, and Associates, *The Methods and Materials of Demography*, Washington, D.C.: U.S. Bureau of the Census, 1975.

Speare, Alden, Jr., "Home Ownership, Life Cycle Stage, and Residential Mobility," *Demography* 7 (November, 1974): Pp. 449-58.

U.S. Bureau of the Census, Current Population Reports, Special Studies, Series P-23, No. 57, *Social and Economic Characteristics of the Older Population:* 1974. Washington, D.C.: U.S. Government Printing Office, 1975.

U.S. Bureau of the Census, 1970 Census of Population and Housing, *Census Tracts, Standard Metropolitan Statistical Areas*, Washington, D.C.: U.S. Government Printing Office, PHC(1), 1972.

U.S. Bureau of the Census, U.S. Census of Population: 1970. *General Population Characteristics*, Washington, D.C.: U.S. Government Printing Office, Final Report PC(1), 1973.

OTHER POPULATION CHARACTERISTICS

This classification refers primarily to demographic indicators of population growth, as well as indicators of housing and social institutional stability and quality. Population distribution is likely to be altered by large-scale waterway facilities, as well as by many smaller projects. Assessment of baseline conditions and near-term changes precipitated by water projects are described in this section of the report in terms of techniques for measuring population size and population density. Changes in dispersion of residents around population centers may be generated by some types of waterway projects; in these cases, this indicator should be included in the social well-being evaluation.

Housing and social institutions comprise almost 50 percent of the land use in urban communities. Even in isolated rural areas, catchment areas for social institutions such as school districts must be considered before broad based land use alterations are undertaken. The baseline and predicted changes in housing supply and neighborhood quality should be assayed in planning or implementing waterway projects. Present and near-term alterations in residential mobility and in the stability of viable, salient social institutions must be considered as important social factors for assessment purposes in many types of waterway plans. In addition, housing costs may be included as an evaluative variable in the Social Well-Being account if the waterway facility is anticipated to have a direct impact on property values. The structure of this category is shown in Figure 7.

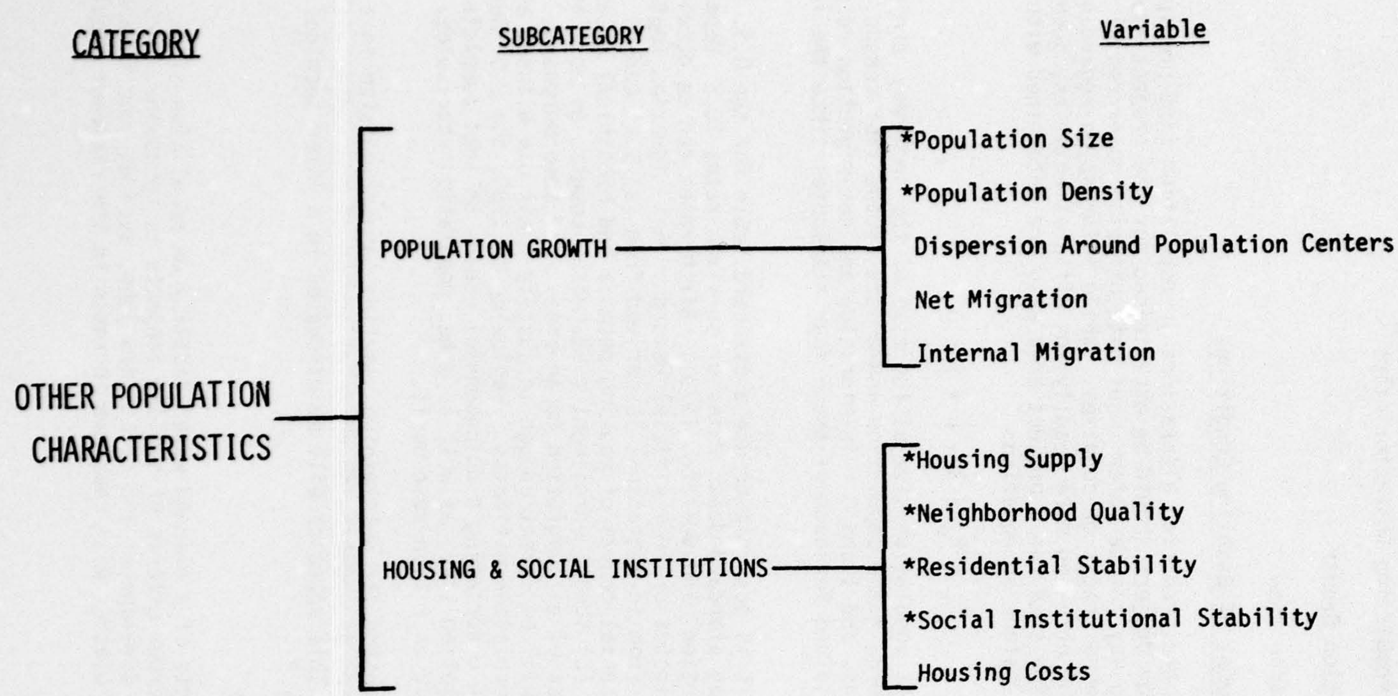


Figure 7

Structure of the Other Population Characteristics Category

<u>Account</u>: Social Well-Being

<u>Category</u>: Other Population Characteristics

<u>Subcategory</u>: Population Growth

<u>Variable</u>: *Population Size*

Definition & Measurement of Baseline Conditions

Population size and predicted alterations in population size precipitated by the waterway project should be ascertained for the project study area. The study site may not be coterminous with official governmental entities, such as census tracts or counties. While information regarding population size can be obtained more readily for official entities, accurate estimates of population size for a project area also are determined with use of the following balancing equation:

$$P_t = P_o + B - D + I - O$$

where P_t = the current population size at the time of the waterway project feasibility study and P_O = the population enumerated at the last census. B = births, D = deaths, and I and O = in-migration and out-migration respectively, with data obtained for each of these four attributes since the last census enumeration.

In many cases, it is possible to use a standard table for the U.S. to estimate deaths, using standard death rates or survival rates (U.S. Department of Health, Education, and Welfare, 1975). Birth rates can be obtained from post-census estimates or from official records. Net migration (out-migration subtracted from in-migration) is derived from (a) post-census estimates, (b) post-censal counts of housing permits and electrical meters or water meters, and (c) school enrollment post-census counts, as well as other visible measures of net migration to an area. For some purposes, census enumerations will be recent enough to justify their use without attempting to derive population estimates. Beginning in 1980, the U.S. Bureau of the Census will be undertaking a quinquennial census so that complete enumerations of population size, as well as other population attributes, will be available regularly on a five-year basis.

A second basic method for determining baseline population size in a project area depends on an enumeration of total number of households within the delimited area. This approach will be discussed in a later section, under *"Housing Supply."*

Prediction of Impacts

To predict impacts of a planned water facility on population size, knowledge of the previous effects of similar projects is necessary. Projects which stimulate land development and create new jobs, such as some inland canals or dredging projects, will cause an increase in the resident population.

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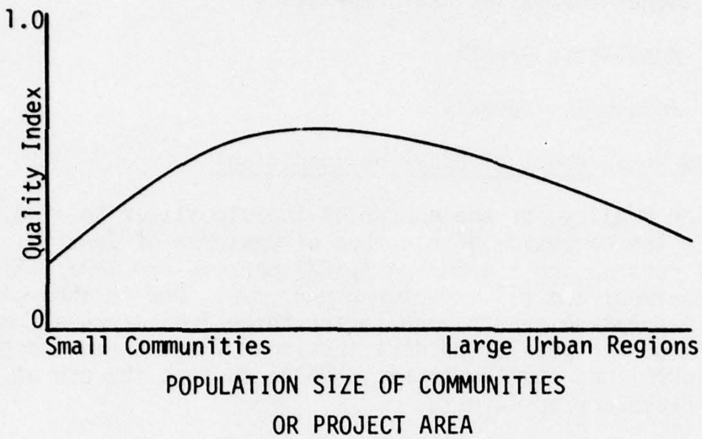
Hypothesized Functional Curve & Rationale



It is difficult to estimate the effects of changes in population size in terms of positive or negative benefits. The functional curve portrays an ideal population size, as assessed by respondents in several nationwide polls. Nevertheless, different individuals, as well as communities in the aggregate, prefer differing population levels for their respective communities. A waterway project which stimulates population growth may be widely accepted in one area and strongly opposed in another location.

Data Sources

Bureau of the Census, Census of the Population, *Characteristics of the Population; Current Population Reports;* County and City Data Book; Statistical Abstract of the U.S.

References

Cosby, Arthur G. and William G. Howard, "Residential Preferences in America: The Growing Desire for Rural Life," paper presented at the Rural Development Seminar Series, Extension Service, U.S. Department of Agriculture, March, 1976.

Fulguitt, Glenn and James J. Zuiches, "Residential Preferences and Population Distribution," *Demography* 12 (August, 1975): Pp. 491-504.

Guseman, Patricia K. and Jesse L. Buffington, "Population Trends and the Future Demands for Transportation Rights-of-Way," paper presented at the American Right-of-Way Association meetings, Region 2, College Station, August, 1976.

U.S. Department of Health, Education, and Welfare, *State Life Tables: 1969-1971*, Rockville, Maryland: National Center for Health Statistics, Health Resources Administration, Public Health Service, 1975, DHEW # (HRA) 75-1151.

Account: Social Well-Being

Category: Other Population Characteristics

Subcategory: Population Growth

Variable: *Population Density*

Definition and Measurement of Baseline Conditions

Population density, or the number of individuals or housing units in a given area, is the composite of a number of measures of density: (1) *persons per room;* (2) *persons per housing unit;* (3) *persons per acre;* (4) *housing units per structure;* and (5) *structures per acre.* Due to the role that waterways play in population growth, the latter three indicators are suggested for looking at changes in population distribution. These three indicators are highly intercorrelated (Galle, et al., 1972), so that the use of any one indicator should prove appropriate.

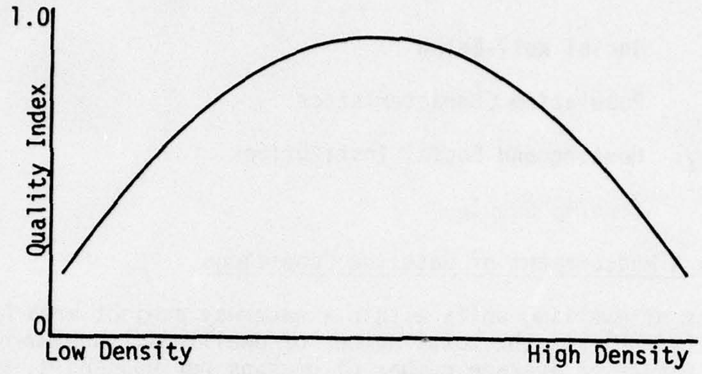
The relationship between density indicators and various attributes seeking to measure "quality of life" has not been fully determined (see Carnahan, et al., 1974). Findings vary based on the empirical data and variables chosen for analysis. Nevertheless, it is recognized that changing levels of population density have far-reaching effects on the quality of life in communities as well as regions. For example, populations in communities undergoing growth in terms of density as well as size have higher wage levels (Hoch, 1972). On the other hand, social institutions are placed under stress situations, as has been noted earlier in several sections of the report. The cost of living also rises with increases in population density, often countering any improvements in wage levels occurring within the community.

Prediction of Impacts

It is difficult to isolate the impact of waterway facilities, including simply the planning of waterway projects on population density and size. Additionally, growth levels are phased, so that net density and population size before construction, during construction, and after completion of the facility should be monitored. Where possible, comparisons with similar sites not affected by a waterway project should provide a basis for comparison of changes in population distribution.

Hypothesized Functional Curve & Rationale

Because no consistent relationship is observed between quality of life measures and population density, the optimum effects of density are portrayed in the idealized functional curve. Changes in density levels caused by waterway projects precede alterations in social institutions, commercial establishments, and general social conditions, thus providing a lagged impact.



Remarks

To be useful, measurements of density across several areal units must be uniform. Special problems arise in measuring persons per acre, for example, if some acreage is included that is primarily commercial or contains other forms of land use that are nonresidential.

Data Sources

Decennial census data, as well as Current Population Reports, provide the primary data base. City planning offices may also furnish relevant information. Mapping of density levels may be undertaken with aerial photography.

References

Carnahan, Douglas, et al., "Urbanization, Population Density, and Overcrowding: Trends in the Quality of Life in Urban America," *Social Forces* 53 (September, 1974): Pp. 62-72.

Galle, Omer R., et al., "Population Density and Pathology: What Are The Relations for Man?" *Science* 176 (April, 1972): Pp. 23-30.

Hoch, Irving, "Urban Scale and Environmental Quality," in Commission on Population Growth and the American Future Research Reports III, *Population, Resources, and the Environment*. Washington, D.C.: U.S. Government Printing Office, 1972, Pp. 235-84.

<u>Account</u>: Social Well-Being

<u>Category</u>: Population Characteristics

<u>Subcategory</u>: Housing and Social Institutions

<u>Variable</u>: *Housing Supply*

<u>Definition & Measurement of Baseline Conditions</u>

Counts of dwelling units within a waterway project area have a threefold utility. First, the total number of dwellings, supplemented with a standard measure of average number of persons per household, provides a means of delineating baseline population size for the area. Second, counts of the number of single-family and multiple-family dwellings provide information regarding baseline population density and stability, so that potential waterway impacts can be assessed. Third, the diversity of dwellings available by owner value categories and gross rental value categories provides a breakdown of household supply for different socioeconomic segments.

For determination of a housing supply count to measure diversity in value of dwellings, the 1970 census data provides an 11-category breakdown for rental values and a 15-category breakdown for owner values. For determination of a household count for the number of single- and multiple-family dwellings, two indicators from the 1970 census provide data on (a) number and percent of dwellings with one, two, and more units in a structure and (b) number and percent of owned, rented, and vacant dwellings. Realtors also can provide post-censal estimates on number of dwellings that are single- and multiple-family, as well as vacant, dwellings.

The first usage delineated above for determining housing supply (a supplement to other measures of baseline population size) can be obtained either through the 1970 census data and supplemental estimates or through the following formula:

$$\text{Population Size Based on Household Count} = (H_o + U) \times \frac{P_o}{H_o}$$

where P_o = the population in all households on the last census date

H_o = occupied housing units on the last census date

U = net increase in occupied housing units between census date and current estimate date

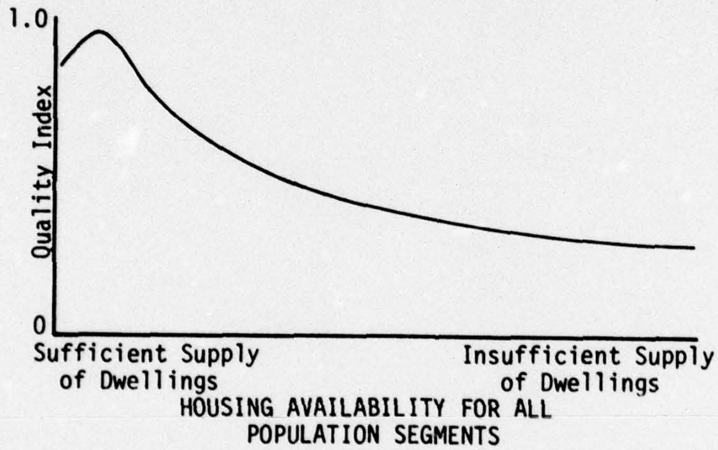
$\frac{P_o}{H_o}$ = average population per occupied unit at the last census (Shryock and Siegel, 1970)

The term U includes any change in the vacancy rate or in the use of housing units as group quarters. Building permit data, utility connections, and aerial photography (including the earth satellite data, Level II, which currently is being incorporated into several Corps of Engineers feasibility studies) can be utilized to measure U, or the post-censal changes.

Prediction of Impacts

To predict the consequences of the proposed waterway facility on a project area, potential housing supply changes should be ascertained. If displacement and residential right-of-way acquisition are anticipated, adequate relocation is possible only when replacement housing exists in the specific owner and rental value categories for those population segments whose dwellings are being acquired. Thus, if the waterway facility is to displace lower valued dwellings, the availability of comparable housing units within close proximity to the original dwellings should be assessed. Additionally, with knowledge of previous impacts of similar projects, the extent to which the proposed facility will bring about population growth can be ascertained. An estimate is needed regarding the housing requirements (including demand for multiple-family and single-family dwellings sought, and actual numbers of new households needed) that will be brought about by the waterway's construction.

Hypothesized Functional Curve & Rationale



An adequate supply of dwellings for all socioeconomic segments is an indicator of a high quality in the communities associated with the proposed project. However, a housing availability which encompasses a high vacancy rating--over seven percent--would not be desirable.

Remarks

If the proposed facility is to displace residents and acquire residential structures, the sufficiency of replacement housing must be ascertained, as well as the potential housing availability, if new residents are attracted to the area because of the waterway project.

Data Sources

Data can be obtained from city planning offices; realtors in the area; Bureau of the Census, *Census of Population and Housing; Current Population Reports;* and *Dualabs Census Tapes.*

References

Anz, Robert, "Dwelling Unit Count from November 22, 1976, Aerial Photography," Technical Memorandum available from City of Waco, Department of City Planning, Waco, Texas, p. 77.

Cagle, Lawrence T. and Irwin Deutscher, "Housing Aspirations and Housing Achievement: The Relocation of Poor Families," *Social Problems* 18 (Fall, 1970): Pp. 243-56.

Shryock, Henry S., Jacob S. Siegel, and Associates, *The Methods and Materials of Demography*, Washington, D.C.: U.S. Bureau of the Census, 1970.

Tessmer, Raymond G. "Estimation of Housing and Population Data from Electric Meter Records," *Public Data Use 4* (Sept., 1976): Pp. 31-6.

U.S. Bureau of the Census, *Census of Population and Housing*, PHC(1) series.

Account: Social Well-Being

Category: Other Population Characteristics

Subcategory: Housing and Social Institutions

Variable: *Neighborhood Quality*

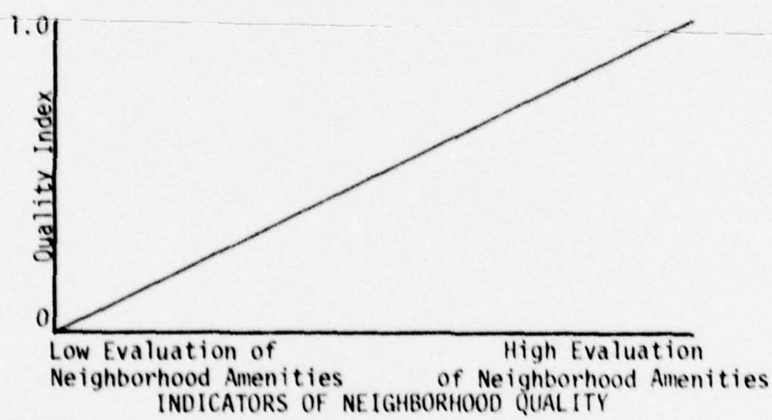
Definition and Measurement of Baseline Conditions

In determining residential satisfaction, as well as the acceptance of broad-scale community alterations, the inhabitant's evaluation of the quality of the neighborhood environment appears to be a primary factor. Whether an area is "well kept up" defines the resident's general contentment with regard to current place of residence (Lansing, et al., 1970). Field observation provides one technique for assessing neighborhood quality. Perhaps more effective, however, is the evaluation by residents of such indicators as: (1) whether the *area is a viable neighborhood;* (2) the *extent of social intimacy;* (3) *stability expectations,* i.e., information regarding residents' desire to remain in the area if they had an opportunity to move; and (4) *overall assessment of the area.*

Prediction of Impacts

Acceptance of a waterway project that will directly affect the general appearance of an area is dependent on the perceived esthetic qualities of the project. In one impact assessment, those who have felt that facility construction would worsen their neighborhood's appearance (even though they were not directly affected), were against the project (Burke, et al., 1975). Similarly, of those who felt that the complexion of the area would be enhanced, 80 percent approved the construction. Clearly, the residents' evaluation of an area significantly influences their reaction to the planned project.

Hypothesized Functional Curve & Rationale



In many cases, improvement in property values and other positive benefits of technological changes, such as waterway projects, can be overshadowed by the need to maintain a high perceived neighborhood quality. If the waterway is viewed as beneficial in terms of area enhancement, then the proposed project is more positively received.

Data Sources

A survey representative of residential opinion in the proposed project site can provide important data input regarding neighborhood quality and perceptions of physical alterations resulting from the project. Knowledgeable informants and "windshield" field observation can provide descriptive information regarding neighborhood quality.

References

Burke, Dock, Patricia K. Guseman, Jesse Buffington, and Dale Schafer, *Evaluation of Residents' Attitudes and Expectations of a Planned Freeway*. College Station, Texas: Texas Transportation Institute, Texas A&M University, Research Report 148-6, 1975.

Lansing, J.B., R.W. Marans, and R.B. Zehner, *Planned Residential Environments*. East Lansing, Michigan: Michigan State University, Institute for Social Research, Survey Research Center, 1970.

Paxton, Edward T., *What People Want When They Buy a House*, Report for the U.S. Department of Commerce, Housing, and Home Finance Agency. Ann Arbor, Mich.: Survey Research Center, University of Michigan, 1955.

Wolf, Eleanor P. and Charles N. Lebeaux, *Change and Renewal in an Urban Community: Five Case Studies of Detroit*. New York: Frederick A. Praeger, 1969.

Account: Social Well-Being

Category: Other Population Characteristics

Subcategory: Housing and Social Institutions

Variable: *Residential Stability*

Definition & Measurement of Baseline Conditions

The average resident moves once every five years (Shryock and Siegel, 1970). Length of residence is often found to be the greatest predictor of social interaction in an area (see Burkhardt, 1971 ; Speare, 1974). In addition, dependency on local facilities and services increases with length of residency, so that adjustments in everyday activity patterns must change if the structure of the area is altered.

To measure the residential mobility levels of an area, a Mobility Index can be used, based on published census data, such as census tract information. The Mobility Index has been tested at several different study sites (see Guseman and McLean, 1970); it is formulated as follows:

$$\text{Mobility Index} = 200 - 2X,$$

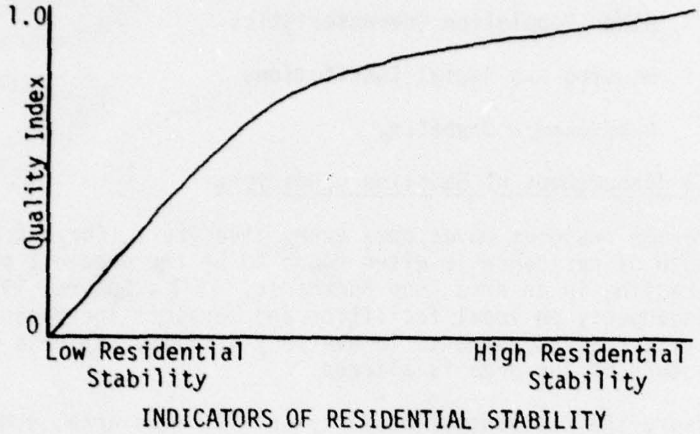
where X = the proportion of residents in the same dwelling over a five-year period.

The Index ranges from 0 to 200, where 200 implies that every person in a census tract has moved within the five-year period. Further residential mobility information can be obtained from two additional census data descriptors: *median year residents moved to their dwelling units* and *percent of dwellings that are owned.*

Prediction of Impacts

The total Social Well-Being account can be viewed through the alteration of existing residential areas in terms of: (1) the displacement of residents who occupy the land acquired; and (2) the alteration of the physical and social environment of those who remain. The success of relocation for those displaced depends largely on two factors: (a) the availability and location of replacement housing which meet the needs of these residents; and (b) characteristics of the relocatees, such as old age, that may create special problems in their relocation. Those who remain are affected by the loss of those displaced; the in-migration of new residents; new residential, commercial, and social institutional development; and the physical alteration of the environment. Attention should be directed toward these short-term impacts of waterway routing, construction, and operation. A review of previous, comparable project impacts provides for the waterway planner an "information base" from which he/she can more adequately assess a proposed facility.

Hypothesized Functional Curve & Rationale



In the idealized functional curve, highly stable areas are those with average residency levels of eight or more years. High residential mobility is average residency of less than four years (Guseman, et al., 1976), or less than two years (Burkhardt, 1971).

Data Sources

The Mobility Index can be used for different areal units, including blocks, census tracts, urban places, and urbanized areas, based on decennial census data or Current Population Reports, such as Series P-20, No. 285, *Mobility of the Population of the United States*. City directory information, city planning accounts, and resident-sample survey can also be used to elicit the data on residential movement.

References

Burkhardt, Jon E., "Impact of Highways on Urban Neighborhoods: A Model of Social Change," *Highway Research Record* 356 (1971): Pp. 85-94.

Guseman, Patricia K. and Edward McLean, "The Impact of Freeways on Urban Neighborhoods," paper presented at the American Sociological Association, Denver, August, 1970.

Guseman, Patricia K., J. M. Hall, T. K. Fuller, and D. Burke, *Social Impacts: Evaluation of Highway Project Development in Urban Residential Areas*, Research Report 190-1. College Station, Texas: Texas Transportation Institute, Texas A&M University, 1976.

Liu, Ben-Chieh, "Differential Net Migration Rates and the Quality of Life," *Review of Economics and Statistics* (August, 1975): Pp. 329-37.

Shryock, Henry S., Jacob S. Siegel, and Associates, *The Methods and Materials of Demography*, Washington, D.C.: U.S. Bureau of the Census, 1970.

Speare, Alden, Jr., "Home Ownership, Life Cycle Stage, and Residential Mobility," *Demography* 7 (November, 1974): Pp. 449-58.

U.S. Bureau of the Census, *Mobility of the Population of the United States*, Series P-20, No. 285, 1975.

Account: Social Well-Being

Category: Other Population Characteristics

Subcategory: Housing and Social Institutions

Variable: *Social Institutional Stability*

Definition & Measurement of Baseline Conditions

Institutional stability refers to the existence of viable:

1. *churches*
2. *public schools*
3. *technical schools*
4. *parochial schools*
5. *labor union facilities*
6. *fraternal and masonic lodges*
7. *cemeteries*
8. *city parks*
9. *public service facilities (fire stations, police stations, public housing authorities, libraries, etc.)*
10. *medical facilities*

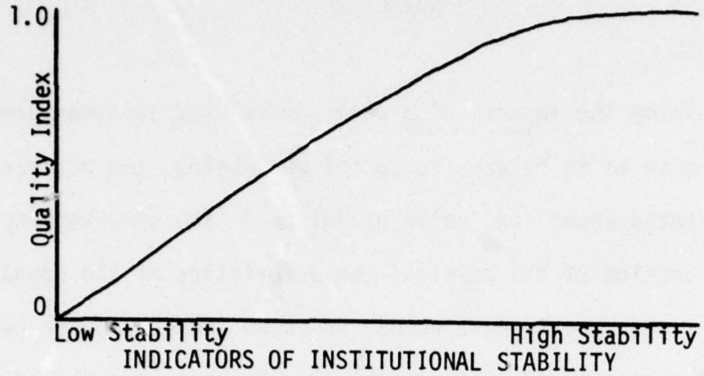
Most social institutions have been designed for accessibility, visibility, optimum maintenance, and existing land use surrounding the facility. Changes in terms of abutting property land use and splitting of the service area, or catchment area, alters service provision.

Measurement of the catchment areas for social institutions is accomplished through field observation and informant interviewing with those officials responsible for the facilities' activities. Second, the boundaries of the social institutional service areas can be plotted on a land use map. Third, a subjective weighting of area dependency on the institution relative to other facilities (a comparative evaluation) is undertaken to assess the saliency of catchment area boundaries. Localized businesses also may be mapped according to service area if segmentation of commercial facility usage is a major concern.

Prediction of Impacts

Community facilities, such as school districts for which use is localized, are often vulnerable to the effects of waterway project implementation. Waterway projects may isolate local facilities, purchase the land on which the facility is built, or acquire surrounding property to the extent that the service is no longer required. Conversely, a population influx precipitates institutional overload in such cases as medical and educational facilities. The two key criteria in designing a waterway within institutional catchment areas are (a) the extent to which these institutional facilities are of salient interest to the public, and (b) the potential degree to which service provision will be altered.

Hypothesized Functional Curve & Rationale



The idealized functional curve points to high stability as reflective of a higher quality of services. Low stability depicts rapid institutional change or lack of viability of the service organization.

Data Sources

Field observation, such as "windshield surveys", and informant interviewing with knowledgeable officials for specific social institutions provide the major data bases.

References

Guseman, Patricia K., J.M. Hall, T.K. Fuller, and D. Burke, *Social Impacts: Evaluation of Highway Project Development in Urban Residential Areas,* Research Report 190-1. College Station, Texas: Texas Transportation Institute, Texas A&M University, 1976.

U.S. Department of Transportation, *Social and Economic Effects of Highways.* Washington, D.C.: Federal Highway Administration, 1974.

NOISE

In assessing the impacts of a water or related land-management project on noise as it relates to social well-being, the major concern is with "unwanted sound" or "noise pollution." The unwantedness of a sound is a function of the physical characteristics of the sound itself, the attitudes that people have about the sound and its source (which, in turn, are a product of their social experiences), and the effects of the sound on people's health and activities. These three aspects of noise pollution, therefore, can serve as the basis for delineation and organization of variables to be examined in assessing noise impacts (Figure 8).

The noise-related variables that are most germane to social impact assessment are those having to do with people's attitudes about noise and its source (see the subcategory, "Community Annoyance/Acceptability "). Measurement of these variables, especially "attitudinal sensitivity," may suffice for small-scale projects whose budgets do not allow for expensive acoustic monitoring and mapping.

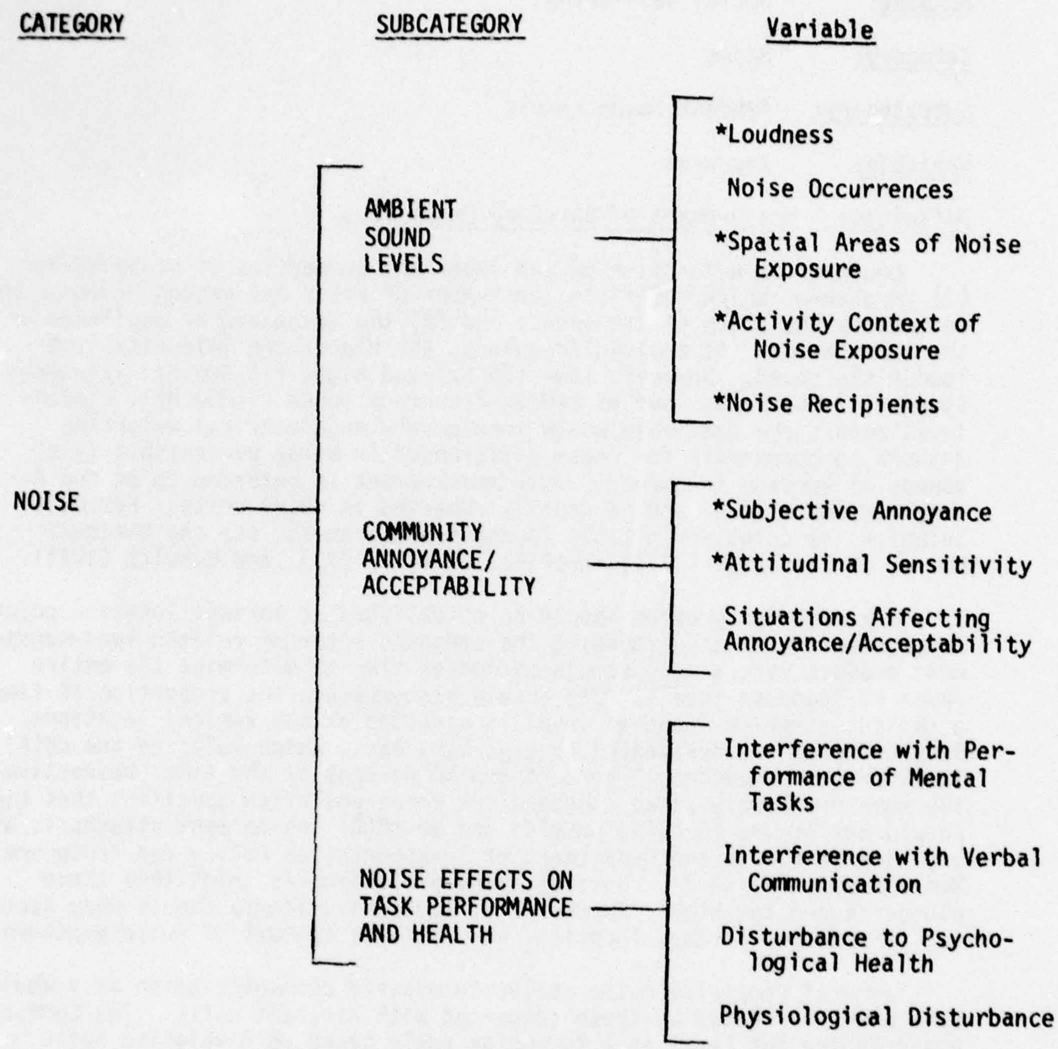


Figure 8

Structure of the Noise Category

NOTE: The variables denoted by an asterisk (*) are operationalized in this report.

Account: Social Well-Being

Category: Noise

Subcategory: Ambient Sound Levels

Variable: *Loudness*

Definition & Measurement of Baseline Conditions

Loudness is a function of two important properties of sound waves: (1) *frequency* which refers to the number of waves per second or Hertz and determines the pitch of the sound; and (2) the *intensity* or amplitude of the sound waves. At a given frequency, the higher the intensity, the louder the sound. However, low- (50 Hz) and high- (15,000 Hz) frequency sound will not be as loud as medium-frequency sound (1,000 Hz). Sound-level meters are available which incorporate an electrical weighting network to compensate for these differences in human perceptibility of sounds of varying frequency. This measurement is referred to as the A-Weighted Sound Level and is usually reported in dB(A) units. For more technical descriptions of this loudness measurement, see the National Bureau of Standards (1971), Hopkins, et al. (1973), and Schultz (1971).

A monitoring program should be established at various location points throughout the area surrounding the proposed water or related land-management project over a long enough period of time to determine the entire range of loudness levels. One should also measure the proportion of time a chosen criterion loudness level is exceeded at the various locations. Such measures are designated as L_{10}, L_{50}, etc., which refer to the dB(A) level that is exceeded 10 percent and 50 percent of the time, respectively. The most frequently cited standard for noise pollution specifies that L_{10} should not exceed 70 dB(A) outside and 50 dB(A) inside most structures at any time (cited in the Department of Transportation Policy and Procedure Memorandum (PPM) 90-2). However, many professionals think that these standards are too high. Furthermore, loudness criteria should vary according to the time of day, location, and activity context of noise exposure.

Several composite noise scales to measure community noise as a whole have been introduced by those concerned with aircraft noise. The Community Noise Equivalent Level is a composite scale based on A-weighted noise levels. See Wyle Laboratories (*Community Noise*, 1971) for technical descriptions of this noise measure.

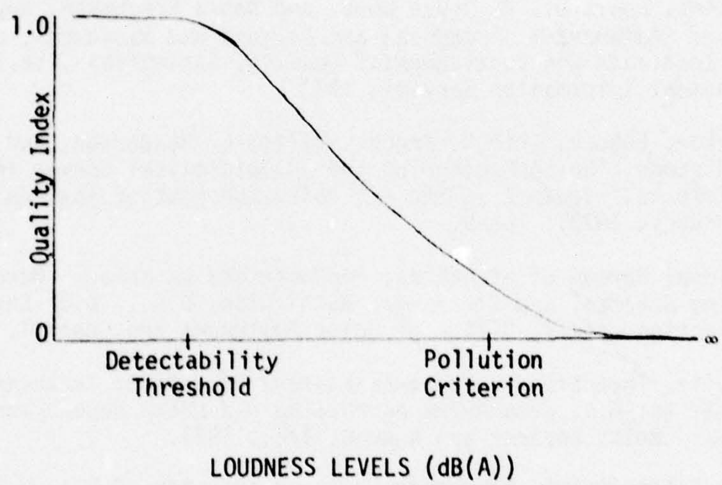
Prediction of Impacts

Short-term impacts on loudness levels will occur during construction of a water-related project. Increases in loudness levels caused by the machinery used, the traffic to and around the project site, and any traffic rerouting necessitated by construction should be estimated. Similar construction projects currently underway or similar past projects can aid in making these estimates.

An empirically based simulation model of the proposed water or related land-management project can be used to predict the long-term impacts that the operational phase of the project will have on loudness levels in the surrounding area. This simulated model should incorporate any aspects of design, machinery, and, in the case of a proposed waterway or port, traffic flow, transport mix, probable velocities of transport, and any other factors that might produce or affect loudness levels emitted by the project. In addition, street traffic rerouting and any land-use changes or other secondary noise sources that might be precipitated by the water project should be considered. For example, a new reservoir or port may increase street traffic in the surrounding area.

In predicting these impacts on loudness levels, separate measures should be made of the increases in the loudness of intruding noises (to which humans are most sensitive) and to residual noise levels (i.e., the all-pervasive and nonspecific background noises) at given times and locations. One should also determine the variability in loudness exposure, which results from combinations of intruding and residual noise levels.

Hypothesized Functional Curve & Rationale



The perceptibility of loudness tends to grow much more rapidly near the threshold of detectability. The idealized functional curve assumes that adverse noise quality does not occur until after the detectability threshold; the noxiousness of the effects grows rapidly within a narrow dB(A) range and then levels off such that further increases in loudness add only slightly to perceived noxiousness or adverse quality.

Remarks

Loudness interacts with other variables to produce noxiousness or adverse effects. The dB(A) criterion for noise pollution, at which point loudness is deemed noxious or adverse, will vary according to time of day or week, location, and activity context (e.g., a much lower level of loudness will be deemed noxious in residential areas at night than in industrial areas during the day). The adversity of loudness will also increase with duration of the noise, the frequency of its occurrences, its contribution to intrusive or background noises, and the quality of intrusive and background noises before the water projects' impact (e.g., when background noise is great, annoyance from intruding noise is less). Further, differing degrees of loudness will seem noxious to people of differing sensitivity and experiences.

Data Sources

Field tests using sound level meters which measure A-Weighted Sound Levels (dB(A)).

References

Hopkins, Lewis D., R. Bruce Wood, and Debra Brochmann, *Environmental Impact Statements: A Handbook for Writers and Reviewers, Report for the Institute for Environmental Quality*, Springfield, Va.: National Technical Information Service, 1973.

Koczkur, Eugene, Eric D. Broger, Valtin L. Henderson, and Alfred D. Lightstone, "Noise Monitoring and a Sociological Survey in the City of Toronto," *Journal of the Air Pollution Control Association* 23 (February, 1973): 105-9.

National Bureau of Standards, *Fundamentals of Noise: Measurement, Rating Schemes, and Standards*, Washington, D.C.: U.S. Environmental Protection Agency, Office of Noise Abatement and Control, 1971.

Schultz, Theodore J., *Noise Assessment Guidelines Technical Background, Report for U.S. Department of Housing and Urban Development*, Cambridge, Mass.: Bolt, Beranek and Newman, Inc., 1971.

Wyle Laboratories, *Community Noise*, Washington, D.C.: U.S. Environmental Protection Agency, Office of Noise Abatement and Control, 1971.

Wyle Laboratories, *Transportation Noise and Noise From Equipment Powered by Internal Combustion Engines*, Washington, D.C.: U.S. Environmental Protection Agency, Office of Noise Abatement and Control, 1971.

<u>Account</u>: Social Well-Being

<u>Category</u>: Noise

<u>Subcategory</u>: Ambient Sound Levels

<u>Variable</u>: *Spatial Areas of Noise Exposure*

Definition & Measurement of Baseline Conditions

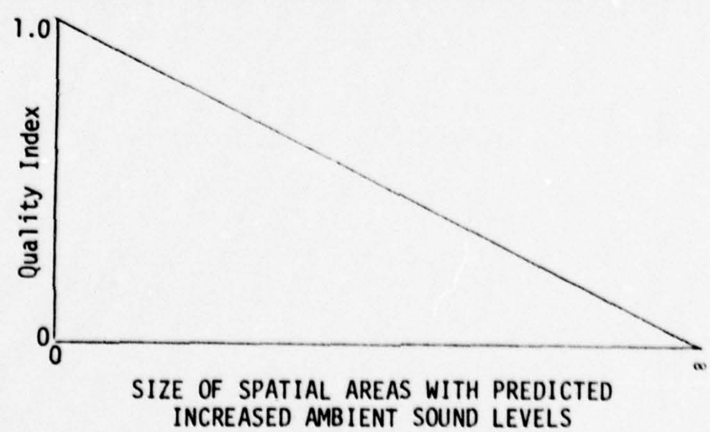
Spatial areas of noise exposure should be defined in terms of *geographical and acoustical characteristics that affect noise-level exposures and the resulting quality of ambient sound levels.* This can be accomplished by superimposing noise contour mapping over maps showing topography and other such environmental characteristics that will affect the ambient sound levels in areas surrounding the water-related project. *The spatial areas can then be zoned according to differing qualities of ambient sound levels.*

Measures of loudness can be used as the primary basis for determining quality of ambient sound levels in the various areas surrounding the water project. Loudness levels in each spatial zone should be specified in terms of maximum-minimum range and frequency, duration, and variability of intruding and residual loudness levels (see discussion of "*Loudness*").

Prediction of Impacts

Geographical and acoustical characteristics of the spatial areas and transmission paths to them can be used to predict the impacts a water-related project will have on the foregoing indicators of ambient sound levels in each area. The geographical and acoustical characteristics to consider include: (1) distance of the spatial area from the water-related project noise source; (2) weather conditions in the spatial area and in transmission paths from the water-related noise source to the spatial area; (3) the reverberant and sound absorption properties of the topography and structures in the spatial area; (4) the reverberant and sound absorption properties of the topography and structures in the transmission paths from the water-related noise source to the spatial area.

Hypothesized Functional Curve & Rationale



The idealized functional curve assumes that the greater the size of spatial areas in which ambient sound levels are predicted to increase because of a water-related project, the more adverse the impact of the project.

Remarks

The determination of spatial area distribution of noise impacts from a water-related project is a necessary preliminary step to determining who will be the recipients of the noise impacts and their activities that are most likely to be affected (see "*Activity Context of Noise Exposure*" and "*Noise Recipients*").

Data Sources

Geographical maps showing topography and structural characteristics of an area can often be obtained from city or county government offices. These maps also can be constructed or modified by field observation and aerial photography. Noise contour mapping can be constructed by field observation using sound-level meters to measure loudness at various location points (see "*Loudness*").

References

Central Institute for the Deaf, *Effects of Noise on People*, Washington, D.C.: U.S. Environmental Protection Agency, Office of Noise Abatement and Control, 1971.

Hopkins, Lewis D., R. Bruce Wood, and Debra Brochmann, *Environmental Impact Statements: A Handbook for Writers and Reviewers, Report for the Institute for Environmental Quality*, Springfield, Va.: National Technical Information Service, 1973.

National Bureau of Standards, *Fundamentals of Noise: Measurement, Rating Schemes, and Standards*, Washington, D.C.: U.S. Environmental Protection Agency, Office of Noise Abatement and Control, 1971.

Peat, Marwick, and Mitchell Company, "New Systems Requirements Analysis Program," *Transportation System Evaluation Indicators Final Report*, Washington, D.C.: U.S. Department of Transportation, May, 1973.

Account: Social Well-Being

Category: Noise

Subcategory: Ambient Sound Levels

Variable: *Activity Context of Noise Exposure*

Definition & Measurement of Baseline Conditions

This variable refers to the activities that people will be engaged in when they are exposed to noises from a water-related project. The adversity of noise impacts and, thus, acceptable noise-level thresholds will differ for different types of activities. The activity context of noise exposure is a function of two factors: (1) *land use;* and (2), *the times of the day, week, and year of noise exposure.*

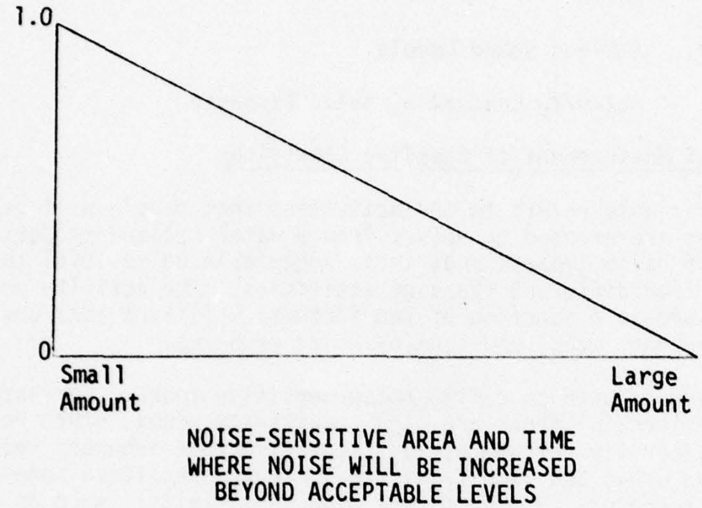
Land use is used to define noise-sensitive zones. For example, suburban residential areas are high sensitivity zones, urban residential areas are generally defined as less sensitive than suburban residential, and downtown urban and industrial areas are low sensitive zones. Critical noise receptors (i.e., of very high sensitivity), such as schools and hospitals, should also be identified. In addition, noise sensitivity will vary by times of the day, week, and year for some types of land use, such as residential and recreation. Times of highest sensitivity are nights, when people are sleeping, and weekends and summer when people are more likely to be outdoors and engaged in recreation.

Ideally, acceptable noise-level thresholds should be designated for different noise-sensitive zones and for different times of the day, week, and year. One can then determine how often and at what areas and times baseline noise conditions exceed these thresholds of acceptability. Unfortunately, there are no standardized noise acceptability standards for activity contexts of noise exposure. The reader is referred to Hopkins, et al. (1973), Kryter (1970), Galloway (1971), and Wyle Laboratories (*Community Noise*, 1971) for suggested guidelines.

Prediction of Impact

A preliminary step to predicting the impacts a water-related project will have on these noise-sensitive activities is the prediction of the project's impacts on noise levels in the various spatial areas surrounding the project (see "*Spatial Areas of Noise Exposure*"). Land-use maps showing noise-sensitive zones and specifying noise-sensitive times for these zones can be superimposed over geographical maps showing predicted ambient sound levels for the various geographical areas. One can then identify those noise-sensitive land-use areas and times where there are predicted increases in ambient sound levels. If noise-level thresholds have been designated for the areas, then one can determine the areas where the project will produce unacceptable noise impacts (i.e., predicted noise levels will exceed the thresholds of acceptability).

Hypothesized Functional Curve & Rationale



High-quality impacts are assumed to accrue in inverse relation to the amount of noise-sensitive area and time where noise from the water-related project will produce excessive increases in ambient sound levels.

Data Sources

Land-use area maps often are available from county and city government offices. If not, these can be produced from field observation and aerial photography. Times of noise sensitivity can also be determined from field observation and from the researcher's own logic and experiences. See "*Spatial Areas of Noise Exposure*" for overlay noise-contour/geographical mapping.

References

Galloway, W. J., C. G. Gordon, B. A. Kuger, and D. L. Nelson, *Highway Noise: A Design Guide for Engineers*, National Cooperative Highway Research Program Report 117, 1971.

Hopkins, Lewis D., R. Bruce Wood, and Debra Brochmann, *Environmental Impact Statements: A Handbood for Writers and Reviewers, Report for the Institute for Environmental Quality*, Springfield, Va.: National Technical Information Service, 1973.

Kryter, K. D., *The Effects of Noise on Man*, New York: Academic Press, 1970.

Peat, Marwick, and Mitchell Company, "New Systems Requirements Analysis Program," *Transportation System Evaluation Indicators Final Report*, Washington, D.C.: U.S. Department of Transportation, May, 1973.

Wyle Laboratories, *Community Noise*, Washington, D.C.: U.S. Environmental Protection Agency, Office of Noise Abatement and Control, 1971.

Wyle Laboratories, *Transportation Noise and Noise From Equipment Powered by Internal Combustion Engines*, Washington, D.C.: U.S. Environmental Protection Agency, Office of Noise Abatement and Control, 1971.

Account: Social Well-Being

Category: Noise

Subcategory: Ambient Sound Levels

Variable: *Noise Recipients*

Definition & Measurement of Baseline Conditions

This variable refers to who will receive noise impacts of a water-related project. Measurement of noise recipients involves two primary concerns: (1) *the size of the population in various noise quality zones* that might be affected by the water-related project; and (2) *the inequality of noise exposure* from the water-related project among population segments.

The size of the population living in the noise quality zones delineated in "Spatial Areas of Noise Exposure" should be estimated. This can be done by obtaining census tract population statistics for the various noise quality areal zones. Although the census tracts and these areal zones will not necessarily be coterminous, field observation and the knowledge of city or county officials can aid in estimating the population of the noise quality zones from the census tract data.

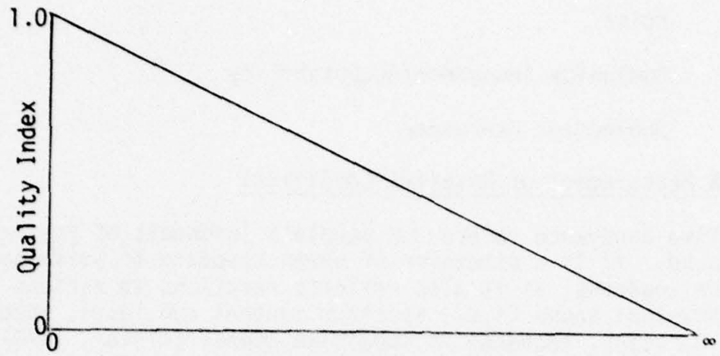
If possible, the size of non-resident populations who spend time in the various noise quality zones should also be estimated--for example, workers employed in downtown or industrial areas, users of recreational areas, shoppers in retail areas, etc. These estimates can be obtained from city or county officials, other people knowledgable of the areas, and field observation. Land-use maps can help identify particular areas of concern in this respect.

Similar procedures can be used to determine the characteristics of the population living within the various noise quality zones and the characteristics of non-resident populations who spend time in these zones. These characteristics should include socioeconomic status, race/ethnicity, and age.

Prediction of Impacts

To predict who will receive noise impacts of the water-related project, population increases should be estimated for the various noise quality zones. (See "Other Population Characteristics" category for methods of determining population increases). Estimates must also be made of the changes in ambient sound levels that will occur in the various noise quality zones. (See "*Loudness*" and "*Spatial Areas of Noise Exposure*" for methods of determining changes in ambient sound levels).

Hypothesized Functional Curve & Rationale



High-quality impacts are assumed to accrue in inverse relation to the size of population subjected to unacceptable loudness levels and to inequality of distribution of such noise exposure among population segments. See "*Loudness*" and "*Activity Context of Noise Exposure*" for determination of unacceptable loudness levels.

Remarks

The variable of noise recipients represents the cumulative interaction of spatial dispersion of noise impacts and population dispersion in geographical areas surrounding the water project.

Data Sources

Decennial census data; *Current Population Reports*; Bureau of the Census, Census of the Population, *Characteristics of the Population;* noise contour/geographical map overlays; land-use maps; field observation; city and county knowledgables.

References

Galloway, W. J., W. E. Clark, and J. S. Kerrick, *Urban Highway Noise: Measurement, Simulation, and Mixed Reactions*, National Cooperative Highway Research Program Report 78, 1969.

National Bureau of Standards, *The Social Impact of Noise*, Washington, D.C.: U.S. Environmental Protection Agency, Office of Noise Abatement and Control, 1971.

Peat, Marwick, and Mitchell Company, "New Systems Requirements Analysis Program," *Transportation System Evaluation Indicators Final Report*, Washington, D.C.: U.S. Department of Transportation, May, 1973.

Account: Social Well-Being

Category: Noise

Subcategory: Community Annoyance/Acceptability

Variable: *Subjective Annoyance*

Definition & Measurement of Baseline Conditions

Subjective annoyance refers to people's judgments of the unwantedness of a sound. It is a dimension of human response to noise that is distinct from loudness, as it also reflects reactions to various other aspects of physical sound (i.e., spectrum content and level, spectrum complexity, duration, increase in impulsive sounds (Kryter, 1970) as well as unpleasant or pleasant feelings towards attributes of the sound source other than the sound per se.

A frequently used measure of subjective annoyance is the Perceived Noise Level (PNL) rating developed by Kryter (1970). This rating is derived from physical measurements of sound which are weighted in such a manner as to enable one to predict people's subjective judgments of noisiness (The Central Institute for the Deaf, 1971: 89). These physical measurements are expressed as PNdB. Calculation of the PNdB is complicated, generally requiring a computer (see Kryter, 1970; Schultz, 1971; the National Bureau of Standards, 1971).

Less complex but also less precise methods of measuring subjective annoyance are subjective judgment tests. These tests can be taken in the laboratory or by social surveys. A direct technique is to ask a person to express his degree of annoyance (ranging from "not annoyed" to "extremely annoyed") with a particular noise or combination of noises.

Measurements of people's subjective annoyance with sounds (either by PNdB or subjective tests) should be taken at various locations throughout the survey area and at various times of the day and week. A composite physical measure of community noise annoyance has also been developed for the aircraft industry and it, or some modification of it, might be relevant for some water-related projects. This measure is the Normalized Community Noise Equivalent Level, which is the CNEL (described under "*Loudness*") corrected for seasonal changes for outdoor residual noise levels in various land-use areas, and for previous exposure and attitudes of people in a community (see Wyle Laboratories, *Community Noise*, Pp. 54 and 55, for these correction factors).

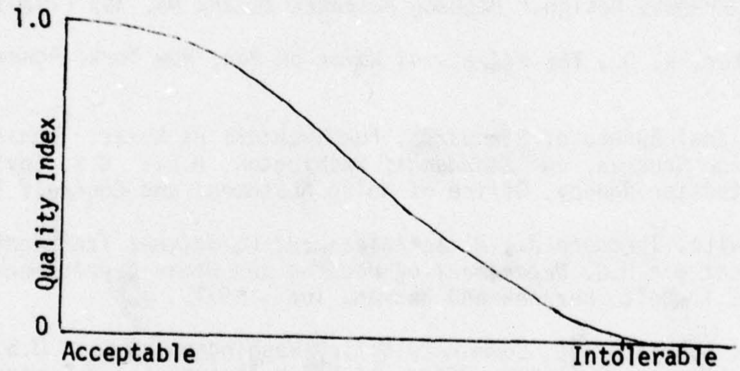
Prediction of Impacts

To predict people's annoyance with the noises that are likely to be emitted by a water-related project, one should simulate the noise that will be emitted during the construction and operational phases of the project.

One should take into account the design layout, the machinery, any traffic or recreational use that might result from the project, and any land-use changes that might be precipitated by the project. PNdB ratings of the particular simulated sounds can be estimated from physical measurements of these simulated sounds, or a panel of citizens representative of the community population can be administered subjective judgment tests to determine their degree of annoyance with the simulated noises.

More important than reactions to these isolated simulated project noises are the increases in subjective annoyance that might occur when the simulated project noises are heard in conjunction with other intruding and residual noises in the community. If possible, PNdB or subjective judgment ratings of these combinations of simulated project and other community noises should be measured at various locations and times throughout the geographical area surrounding the water project; or a measure similar to the normalized CNEL should be calculated for the area as a whole.

Hypothesized Functional Curve & Rationale



PNdB OR JUDGED ANNOYANCE RATING

The idealized functional curve defines people's subjective annoyance with a noise to be adverse. It is assumed that this adversity associated with annoyance grows only slowly at the first evidence of annoyance, then increases rapidly in conjunction with increased degrees of annoyance until annoyance nears the point of intolerance.

Remarks

Subjective annoyance with noise represents the cumulative interaction of physical reactions to noise and "attitudinal sensitivity" to the noise. Subjective annoyance also varies with duration and frequency of the noise occurrence and with the activities engaged in when the noise occurs.

Data Sources

Field tests with sound level meters give the necessary physical measurements of sound to determine PNdB; subjective tests of annoyance in the laboratory or social surveys.

References

Central Institute for the Deaf, *Effects of Noise on People*, Washington, D.C.: U.S. Environmental Protection Agency, Office of Noise Abatement and Control, 1971.

Colony, David C., "Estimating Traffic Noise Levels and Accessibility for Freeway Design," *Highway Research Record No. 305* (1970): 80-98.

Kryter, K. D., *The Effects of Noise on Man*, New York: Academic Press, 1970.

National Bureau of Standards, *Fundamentals of Noise: Measurement, Rating Schemes, and Standards*, Washington, D.C.: U.S. Environmental Protection Agency, Office of Noise Abatement and Control, 1971.

Schultz, Theodore J., *Noise Assessment Guidelines Technical Background, Report for U.S. Department of Housing and Urban Development*, Cambridge, Mass.: Bolt, Beranek and Newman, Inc., 1971.

Wyle Laboratories, *Community Noise*, Washington, D.C.: U.S. Environmental Protection Agency, Office of Noise Abatement and Control, 1971.

Wyle Laboratories, *Transportation Noise and Noise From Equipment Powered by Internal Combustion Engines*, Washington, D.C.: U.S. Environmental Protection Agency, Office of Noise Abatement and Control, 1971.

<u>Account</u>: Social Well-Being

<u>Category</u>: Noise

<u>Subcategory</u>: Community Annoyance/Acceptability

<u>Variable</u>: *Attitudinal Sensitivity*

<u>Definition & Measurement of Baseline Conditions</u>

Previous research has shown that people's acceptability/inacceptability of noise and, thus, their complaints and community action against noise sources are highly related to: (1) *the people's previous exposures to noise;* (2) *their attitudes towards the noise source;* and (3) *other characteristics of the population, such as socioeconomic status and age* which reflect general attitudinal sensitivity to noise (Clark, et al., 1967; Humphrey and Krout, 1975; The Central Institute for the Deaf, 1971; The National Bureau of Standards, 1971).

In determining people's previous exposures to noise, the rural-urban nature of the places where they grew up and of the places where they have lived the past five years should be considered. Rural-urban nature of places should be specified as (a) near industrial, shopping, or other high-activity centers in metropolitan areas, (b) near high-activity centers in other urban areas; (c) suburban areas, (d) small towns, and (e) rural areas.

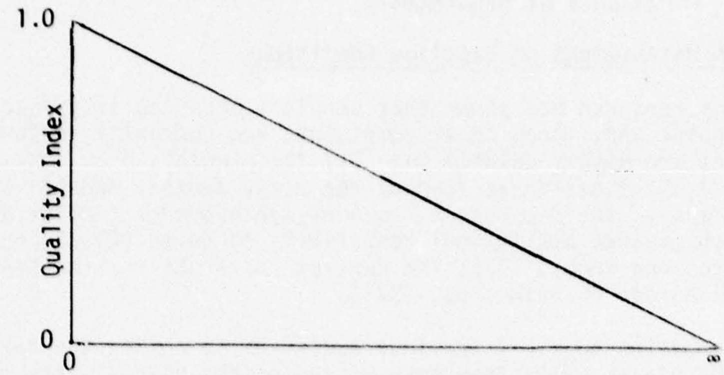
People's attitudes towards the proposed noise source that should be measured are: (a) their feelings about the necessity or preventability of noise from the proposed water-related project; (b) their feelings about the value of the primary functions of the proposed project and its overall importance; (c) their feelings about whether the sponsors and people involved in the proposed project are concerned about their welfare; (d) their feelings about whether they personally will benefit from the project; (e) their fears or apprehensions about the proposed project.

Other characteristics of the population that should be determined are socioeconomic status distributions and ages of the people who are likely to be subjected to noise from the water-related project. (See "Real Income Distribution" category for discussions of measurement of socioeconomic status). People of higher socioeconomic status and older people have been found to be less tolerable of noise (Clark, 1967; McKennell and Hunt, 1960).

<u>Prediction of Impacts</u>

To predict the impacts of a water-related project on attitudinal sensitivity, the researcher must predict the following population characteristics: influx or losses that will be precipitated by the project, ages and socioeconomic status, and previous rural-urban experiences, as discussed previously in this report. Furthermore, one should estimate who will benefit from the project and take into account the probability of attitudes improving once benefits begin to accrue from the project. These effects of similar past projects can help in such predictions. A representative sample of area residents might be transported to a similar project site so that they can directly observe the noise characteristics.

Hypothesized Functional Curve & Rationale



The greater the population's sensitivity to the noise, as determined by the people's previous exposures to noise, their attitudes toward the noise source, and characteristics such as socioeconomic status and age, the more adverse the impacts of noise are assumed to be.

Remarks

Attitudinal sensitivity affects people's annoyance with noise (see "*Subjective Annoyance*") as well as their willingness to accept a certain amount of annoyance.

Data Sources

Social surveys of the population.

References

Central Institute for the Deaf, *Effects of Noise on People*, Washington, D.C.: U.S. Environmental Protection Agency, Office of Noise Abatement and Control, 1971.

Clark, Weldon, et al., *Urban Highway Noise: Measurement, Simulation, and Mixed Reactions*, National Cooperative Highway Research Program, Washington, D.C.: Highway Research Board, 1967.

Humphrey, Craig R., and John A. Krout, "Traffic and the Suburban Highway Neighbor," *Traffic Quarterly* (October, 1975): 593-613.

McKennell, A. C., and F. A. Hunt, *Noise Annoyance in Central London*, The Government Social Survey, London, England: 1960.

National Bureau of Standards, *The Social Impact of Noise*, Washington, D.C.: U.S. Environmental Protection Agency, Office of Noise Abatement and Control, 1971.

AESTHETIC VALUE

The purview of aesthetic value is defined in several different ways in the literature. A broad interpretation of aesthetic value is that it is the valuation of many kinds of sensory responses to environmental stimuli. Included in this interpretation are the sensory responses of touching, smelling, hearing, and seeing. The purview of impact assessment with respect to this interpretation would include air and water quality, noise, biota, and other environmental effects.

Because these various environmental effects have been dealt with elsewhere in the Environmental Quality or Social Well-Being accounts, this category of "Aesthetic Value" deals with the valuation of visual sensory responses. More specifically, aesthetic value is defined here as the valuation of the beauty of a scene (Stalnaker and Arnette, 1976).

The variables relevant to this interpretation of aesthetic value can be grouped into three major subcategories (Figure 9). The first subcategory, "Aesthetic Resource Attributes," concerns attributes of physical resources in the environment that can be perceived and aesthetically evaluated by an observer. The second category, "Social Aesthetic Sensitivity," includes social attitudes and usage which determine aesthetic judgments. The last category, "Visual Perception Sensitivity," concerns physical features of the observers (sensory acuity) and the observers' physical relationships to aesthetic stimuli.

CATEGORY | SUBCATEGORY | Variable

- AESTHETIC VALUE
  - AESTHETIC RESOURCE ATTRIBUTES
    - Intrinsic Quality of Aesthetic Objects
    - *Visual Unity
    - *Visual Complexity
    - Visual Land-Use Compatibility
    - *Fragility of Aesthetic Resources
    - Naturalness
    - Aesthetic Degradation
  - SOCIAL AESTHETIC SENSITIVITY
    - Value Sensitivity
    - *Aesthetic Preferences
    - Activity Context of Aesthetic Observation
  - VISUAL PERCEPTION SENSITIVITY
    - *Viewshed
    - *Aesthetic Exposure
    - Equality of Aesthetic Exposure
    - Visual Acuity

Figure 9

Structure of the Aesthetic Value Category

NOTE: The variables denoted by an asterisk (*) are operationalized in this report.

Account: Social Well-Being

Category: Aesthetic Value

Subcategory: Aesthetic Resource Attributes

Variable: *Visual Unity*

Definition & Measurement of Baseline Conditions

This variable refers to the interrelationships among aesthetic objects or elements and their combination to form a total landscape pattern and image. The concern with respect to this variable for impact assessment is: Can a landscape absorb a water resource or facility without suffering a major change in its pattern or image?

The distribution and interrelationships of the following types of aesthetic objects or elements should be considered: *landform or topography* (the physiographic or geomorphological characteristics of the landscape); *vegetative land cover* (forests, grasslands, marshes, etc.); *waterforms* (lakes, rivers, oceans); *water-land interfaces* (beaches, etc.); *man-made structures* (buildings, dams, bridges, etc.). Characteristics of design, color, complexity, and size of each aesthetic object or element will affect their interrelationships and their combined effect.

Visual unity is frequently referred to as fit, continuity, coherence, and harmony. It concerns the degree of order or redundance of elements, continuity with respect to form and pattern in the landscape, uniformity of textures, and harmonious arrangements of color and shapes. Also of concern is the visual importance of the various aesthetic elements in a landscape view. Importance in this sense means focal points--aesthetic objects to which attention is directed. There may be one strong focal point or secondary and tertiary focal points. Visual importance is a function of spatial composition (the proportional arrangements of elements in a scene), the magnitude of the area from which objects can be seen, the proximity of the viewer to the objects (see "*Aesthetic Exposure*") and the degree of contrast in size, form, complexity, color, and texture among aesthetic objects in the landscape (see "*Visual Complexity*").

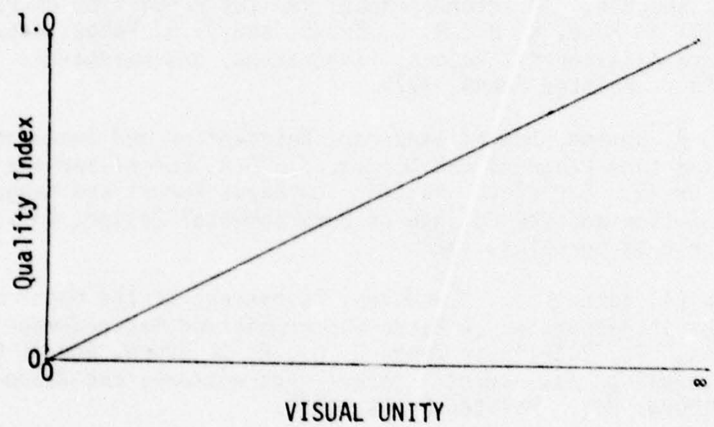
Visual unity should be assessed by an expert or experts who have been trained to be sensitive to these aspects of aesthetic quality (e.g., a landscape architect, planner, or designer; artist; art and landscape historian, etc.). These assessments can be made by on-site observation from frequented or representative vantage points at various seasons of the year or from environmental simulations of typical and outstanding landscape scenes (e.g., photographs or drawings) at the various seasons.

Prediction of Impacts

In predicting the impacts a water or related land-management project will have on visual unity in a landscape, one should consider any man-made structures that the project will introduce (such as a dam) or secondarily precipitate (such as residences, buildings and other construction that will develop around a reservoir) and any effects the project might have on other aesthetic objects or resources. One should estimate how these changes will visually distract from or enhance existing landscape scenes and/or how the project will visually dominate the landscape. These assessments should be made for each season of the year. The effectiveness over time of possible remedial tactics and future land uses that are likely to affect the landscape should be predicted. With respect to the latter, land-use changes and their aesthetic effects without the introduction of the project should be compared with such changes if the project is introduced.

Photograph retouchings or drawings can simulate the changes in the landscape that are likely to occur if the project is introduced. The panel of experts can then assess these effects on visual unity and visual dominance.

Hypothesized Functional Curve & Rationale



Beneficial impacts are assumed to accrue generally from a project that fits orderly and harmoniously within the existing landscape and does not dominate the landscape. However, in some cases a proposed project might benefit a landscape by virture of its domination, whereby it serves as a desirable focal point that makes the landscape visually outstanding or unifies existing landscape elements. An attractive reservoir is an example of the latter.

Data Sources

Panel of experts (e.g., landscape architects, designers, planners, artists, art or landscape historians); photographs; drawings; on-site observation.

References

Cotter, D. J., and D. B. Croft, *Water Application Practices and Landscape Attributes Associated with Residential Water Consumption*, Report for the Office of Water Research and Technology, University Park: New Mexico State University, Water Resources Institute, 1974.

Fabos, J. G., P. N. Procopio, J. H. Spencer, E. H. Zube, and C. Carlozzi, *North Atlantic Regional Water Resources Study*, Appendix N, Visual and Cultural Environment, Amherst, Mass: Research Planning and Design Associates, Inc., May, 1972.

Hendrickson, P. L., R. W. Bahl, B. A. Gray, and W. S. Maynard, *Measuring the Social Attitudes and Aesthetic and Economic Considerations Which Influence Transmission Line Routing*, Richland, Wash.: Battelle-Pacific Northwest Laboratories, 1974.

Kaplan, Stephen, "An Informal Model for the Prediction of Preference," P. 92-101 in Zube, E. H., R. O. Brush, and J. G. Fabos, eds., *Landscape Assessment: Values, Perceptions, and Resources*. Stroudsburg, Pa.: Halsted Press, 1975.

Litton, R. Burton, *Forest Landscape Description and Inventories-- A Basis for Land Planning and Design*, U.S.D.A. Forest Service Research Paper PSW-49. Berkeley: Pacific Southwest Forest and Range Experiment Station and the College of Environmental Design, University of California at Berkeley, 1968.

Polakowski, Kenneth J., "Landscape Assessment of the Upper Great Lakes Basin Resources: A Macro-Geomorphic and Micro-Composition Analysis," Pp. 203-219 in Zube, E. H., R. O. Brush, and J. G. Fabos, eds., *Landscape Assessment: Values, Perceptions, and Resources*. Stroudsburg, Pa.: Halsted Press, 1975.

Redding, M. J., *Aesthetics in Environmental Planning*, Washington, D.C.: Office of Research and Development, EPA, 1973.

Account: Social Well-Being

Category: Aesthetic Value

Subcategory: Aesthetic Resource Attributes

Variable: *Visual Complexity*

Definition & Measurement of Baseline Conditions

Visual complexity consists of two dimensions: (1) *diversity*; and (2) *contrast*.

Diversity refers to variety, the amount of different aesthetic objects in a landscape. Measurement should be made of variety in land use (agricultural, wilderness, commercial, etc.) and of variety among and within the following components of the landscape: landform (topographic differences); geologic surface material (texture, rockforms, etc.); waterform (lakes, rivers, streams); man-made structures (buildings, dams, etc.); vegetation (trees, grasslands, etc.); and fauna (animal life, aquatic life, fowl). Spatial diversity, which relates to external and internal variety in many of these components, is judged by the size and shape of spaces, degrees of enclosure (open vistas versus closed lands, such as forests), and height differentiation. Even views of action created by human or animal use offer variety or diversity in a landscape.

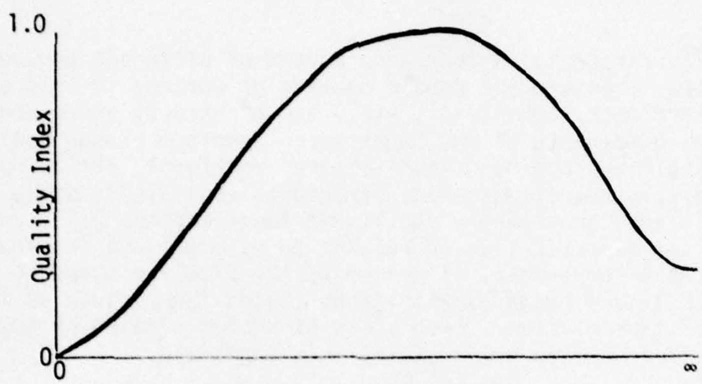
Contrast refers to perceivable edges or interfaces between aesthetic objects which differ by size, form, texture, color, and brightness. Again, these contrasts among and within the various components of the landscape should be considered.

A landscape inventory can aid in the assessment of diversity and contrast. This is a listing and brief descriptions of aesthetic objects within a landscape scene. These inventories can be made on-site or from photographs or drawings of typical and outstanding landscape views at various location points. If time and resources preclude the construction of landscape inventories, experts (landscape architects, designers, artists, etc.) can assess diversity and contrast on-site or from photographs or drawings alone. The on-site observations, photographs, or drawings should be made at various locations, times, and seasons of the year to account for the effects of distance, atmospheric conditions, and seasonal changes on visual contrast. See Fabos, et al. (1975: 325-28) for details regarding the quantification of diversity and contrast.

Prediction of Impacts

In predicting the impacts of a water project on visual complexity, several possible types of effects should be analyzed: (1) increased diversity and contrast in the landscape that will result from the introduction of water bodies, structures, etc., directly or secondarily precipitated by the water project; (2) increased diversity and contrast that will result from the project's control of pollution, flooding, etc. (e.g., resulting in protection of flora and fauna in the area); (3) reduced diversity and contrast in the landscape due to the project's destruction of diversifying and contrasting elements integral to the original landscape. Such destruction might be caused directly by the project (as by a reservoir which causes the removal of trees and fauna in an otherwise monotonous landscape of low biologic interest) or secondarily (as by the destruction of wildlife and forests due to residential and commercial construction surrounding a reservoir).

Hypothesized Functional Curve & Rationale



DEGREE OF CONTRAST AND
DIVERSITY IN A LANDSCAPE

Past research has shown that generally the more diverse or varied the landscape pattern and the greater the contrasts between aesthetic objects, the greater the aesthetic value of a landscape (Fabos, et al., 1972; Hampe, et al., 1974). It is assumed, however, that there is a degree of diversity and contrast that yields the optimum pleasure and stimulation and thereafter aesthetic value declines with increased visual complexity.

Remarks

Visual complexity is integrally related to "dominance." Complexity creates visual importance, focal points, and vividness (memorability) of a landscape. A certain degree of contrast is essential to yield a dominant object.

Data Sources

Landscape inventory; on-site observation; photographs; drawings; panel of experts (landscape architects, designers, artists, etc.).

References

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Account: Social Well-Being

Category: Aesthetic Value

Subcategory: Aesthetic Resource Attributes

Variable: *Fragility of Aesthetic Resources*

Definition & Measurement of Baseline Conditions

Fragile aesthetic resources are defined as *scarce* or *unique* aesthetic resources and other aesthetic objects or landscapes of especially *high aesthetic sensitivity*. Scarce aesthetic resources refers to those aesthetic objects or elements which are unique relative to a given landscape or aesthetic landscape scenes which are unique relative to a given area or region. By "unique" is meant how different an aesthetic object or landscape is in comparison with what is typical. Examples of scarce or unique aesthetic resources are: rare endemic flora or fauna; rare flora of unusually high quality; infrequent but outstanding geomorphological characteristics; other quality aesthetic objects which are unusual by virtue of their form, size, color, or texture; objects of religious significance.

"High-sensitivity" aesthetic objects or landscapes are defined as those producing increased viewer sensitivity or visual awareness. In addition to scarce or unique aesthetic resources (which generally are of high sensitivity by virtue of their uniqueness), the following are considered of high sensitivity:

- boundary edges or interfaces between different landscape types;
- overlooks which allow panoramas of large areas of the landscape;
- natural or cultural (man-made) landmarks which dominate the image of the surrounding area;
- advertised scenic, natural, or historic areas;
- other landmarks of local significance and preference;
- areas of high use or exposure (e.g., major paths, near cities--see "*Aesthetic Exposure*");
- special land-use districts, (i.e., geographic areas having an expected image in the eyes of the public such as recreational areas, wildlife refuges, etc.;
- aesthetic focal points in a landscape and outstanding scenic resources or landscapes in an area.

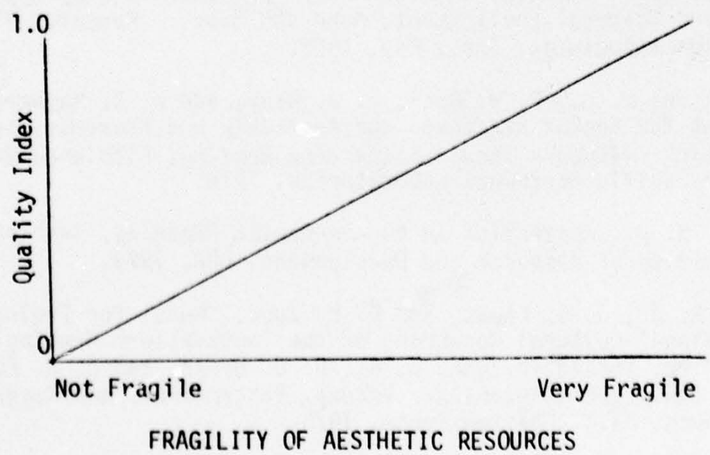
Aesthetic resources not likely to change rapidly as a result of natural processes are also considered to be more "sensitive" or "fragile" with respect to the possibility of man-made alterations than other aesthetic resources.

Landscape inventories can be used to identify scarce or unique landscape resources and other high-sensitivity aesthetic resources as boundary edges, overlooks, landmarks, high-exposure areas, and focal points (for determining the latter, see "*Visual Complexity*"). Surveys of the residents in the area can be used to identify landmarks of especial local significance and preference and geographic areas which have an expected image in the eyes of the public. In addition, the relative importance of landmarks and aesthetic objects to residents, users, and tourists can be assessed by instructing a representative sample of these people to photograph those areas or objects they desire. The views most often photographed would signify those having beauty or interest that they perceive are superior to the typical landscape. Travel guides, natural history books, and park service publications can also be used to help determine significant natural or cultural landmarks.

Prediction of Impacts

In predicting the impacts of a water or related land-management project on fragile aesthetic resources, two types of possible effects should be considered: (1) the uniqueness and sensitivity of the aesthetic resources that will be altered by the project; (2) the uniqueness and sensitivity of the aesthetic resources that will be created by the project relative to the original aesthetic resources in the area. The "viewshed" from various location points throughout the area surrounding the water project should be mapped and fragile resources as defined above should be noted to determine what landscapes and resources will be impacted by the project. These determinations can be made in microscale (within small landscape units) and macroscale (relative to the region).

Hypothesized Functional Curve & Rationale



Fragile aesthetic resources are defined as high-quality resources. If a project is predicted to preserve fragile aesthetic resources, its impacts will be assessed as beneficial.

Remarks

Measurement of other important variables having to do with aesthetic value will be needed to help define fragile aesthetic resources. These are "*Visual Unity*," "*Visual Complexity*," "*Aesthetic Preferences*," and "*Aesthetic Exposure*." How a proposed project will affect fragile aesthetic resources is a more or less cumulative measurement crucial to the assessment of impacts on aesthetic value.

Data Sources

Landscape inventories, surveys of residents, photographs, travel guides, natural history books, park service publications.

References

Cotter, D. J., and D. B. Croft, *Water Application Practices and Landscape Attributes Associated with Residential Water Consumption*, Report for the Office of Water Research and Technology, University Park: New Mexico State University, Water Resources Institute, 1974.

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Account: Social Well-Being

Category: Aesthetic Value

Subcategory: Social Aesthetic Sensitivity

Variable: *Aesthetic Preferences*

Definition & Measurement of Baseline Conditions

Aesthetic preferences or preferential judgments refer to people's personal, subjective appreciation or distaste for aesthetic environments or stimuli. They include people's comparative appraisals whereby the relative quality of aesthetic environments or stimuli are judged against explicit or implicit normative standards. Aesthetic preferences reflect general aesthetic values which differ for different populations and for different segments of the same population. Consequently, aesthetic preferences should be measured for the population as a whole that is likely to be affected by a proposed water project and measured separately for all substantial segments (e.g., socioeconomic status, ethnic, and age groupings) within this population. In addition, aesthetic preferences may vary by activity context of aesthetic observation and by moods, etc. Therefore, aesthetic preferences should be measured separately for representative samples of residents, recreational users, travelers, shoppers, workers, etc., who view landscapes likely to be impacted by the proposed project.

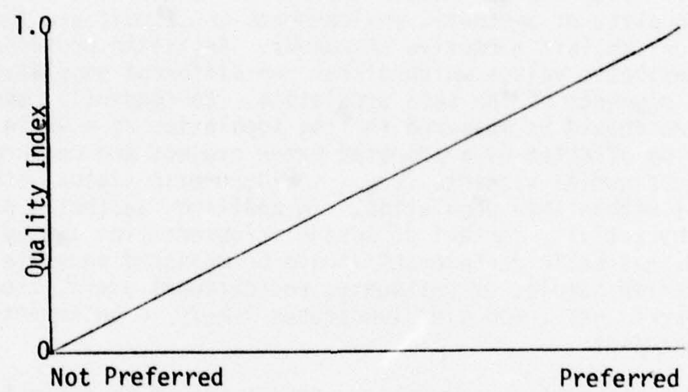
The representative samples of viewers should be asked to give their preferences for or evaluations of the landscape scenes that researchers or experts (landscape architects, designers, etc.) believe to be typical of or outstanding in the area. A pilot survey of the viewers can also be used to determine which scenes are typical or outstanding. The samples' observations of the scenes can be made from photographs, drawings, or on-site at designated location points. Because landscape views vary by distance, photographs which show foreground, middleground, and background views are especially helpful (see "*Viewshed*").

Numerous techniques can be used to measure preferences and evaluations. The Semantic Differential Technique discussed by Carlson, et al. (1976) is frequently used. The respondents also can be asked merely to describe how they feel about the scene, or they can be asked to describe the scene in terms of some of the adjectives in the Landscape Adjective Checklist (Craik, 1975: 138-39). The Likert scaling technique is especially helpful in determining relative degrees of preference for various scenes. See Stalnaker and Arnette, et al. (1976) and Brown (1974) for detailed description and comparisons techniques to qualify aesthetic preferences and evaluations. User-employed photographic studies also can be utilized to determine the relative importance of landscape scenes. In these studies, people in a representative sample are asked to photograph whatever they desire within specified areas. Scenes that are photographed frequently are judged of high quality or visually important.

Prediction of Impacts

Environmental simulations should be made of the alterations in the landscape that will be produced directly or secondarily by the proposed water project. This can be done by retouching photographs or by drawings. The same respondents or a sample drawn by identical techniques should be asked about their preferences for or evaluation of the altered landscape scenes in exactly the same manner as they were asked about the original scenes. Preferences of the altered and original scenes can then be compared.

Hypothesized Functional Curve & Rationale



PREFERENCES FOR AESTHETIC OBJECTS AND SCENES

Aesthetic objects or scenes which are preferred by the residents and users of the area are judged of higher quality than nonpreferred or neutrally evaluated objects or scenes. Beneficial impacts will accrue from the addition and/or preservation of these preferred objects or scenes.

Remarks

Aesthetic preferences are functions of aesthetic values which reflect past experiences, environmental lifestyles, etc. The context of aesthetic observation will also affect preferences, because they affect relative freedom from distraction and opportunity to examine landscapes in detail.

Data Sources

User and resident surveys, photographs, drawings, on-site observations.

References

Brown, Perry J. (ed.), *Toward A Technique for Quantifying Aesthetic Quality of Water Resources*, Report prepared for the U.S. Army Engineer Institute for Water Resources, Logan: Utah State University, 1974.

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Account: Social Well-Being

Category: Aesthetic Value

Subcategory: Visual Perception Sensitivity

Variable: *Viewshed*

Definition & Measurement of Baseline Conditions

Viewshed refers to that area which is physiologically possible for a person to see while located at a given point. Whether an aesthetic object will be within a viewshed and how clearly and vividly that object can be discerned by an observer will depend on the position of the observer--his distance from the object, his elevation with reference to the object, his angle of view--and on the time of day, atmospheric conditions, and visual screening between the observer and the object.

Viewsheds should be measured at various strategic location points of visual access to outstanding and typical landscapes in the area of the proposed water project. The length and area of view at various observer angles at these location points should be measured. Three dimensions of the viewshed, which are a function of distance, should be analyzed separately: (1) foreground, which allows maximum perception of detail at close range; (2) middleground, which is the most critical dimension of the viewshed because it tends to dominate perception or image of the view; (3) background, which is not as sensitive to texture, color, and detail of form, is the least critical dimension of the viewshed unless it offers an outstanding, contrasting panorama to the foreground and middleground views (as of mountains or a lake in relation to urban middle- and foreground views). Grid maps or photographs can be constructed whereby foreground, middleground, and background cells of landscape views are delineated (see Brush and Shafer, 1975). Features within these grids can then be inventoried and described. A computer technique called VIEWIT has also been developed to measure viewsheds (see Iverson, 1975: 283-284 and Redding, 1973: 68-69).

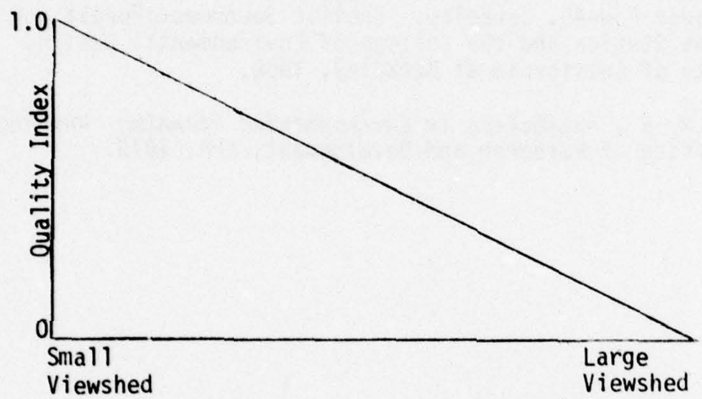
Prediction of Impacts

Two types of viewsheds should be considered in predicting the aesthetic impacts of a proposed water or related land-management project: (1) the predicted visibility of the water resources, structures, or other alterations of the landscape in the viewsheds at all strategic location points; (2) the predicted viewshed from the project's facilities if the project was constructed for recreation or if it otherwise would offer access to aesthetic visual stimulation.

With respect to the first of these considerations, the project's predicted impact on the foreground, middleground, and background dimensions of the viewsheds should be assessed. In addition to providing aesthetically pleasing or degrading foreground detail, any such details increased by a water project might obscure or detract from the original middleground or background views. The effects of the project on middleground views are most crucial, because linkages among landscape components are most apparent in these views; consequently, alterations of the landscape caused by the water project will be especially apparent in these views.

In describing the viewshed from the project's facilities, the elevation of the observers with reference to quality aesthetic objects in the landscape should be considered. Observer position is judged superior if it is above a visual objective; normal, if it is at the same level as a visual objective; and inferior, if it is below a visual objective.

Hypothesized Functional Curve & Rationale



VIEWSHED OF PROJECT
ALTERATIONS ON A LANDSCAPE

In general, the greater the viewshed of a project's alterations on a landscape, the more adverse the predicted impact of the project. There are exceptions to this rule, however, as with respect to an aesthetically pleasing reservoir of which a large viewshed would be more desirable than a small viewshed.

Remarks

In any cumulative index of impact on aesthetic value, quality or degrading alterations of the landscape should be weighted according to the number of strategic viewsheds in which they are visible, the degree of visibility of the alterations within these viewsheds, and the distal dimension of the viewshed where they are visible (i.e., foreground, middleground, or background).

Date Sources

Field observation, photographs.

References

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<u>Account</u>: Social Well-Being

<u>Category</u>: Aesthetic Value

<u>Subcategory</u>: Visual Perception Sensitivity

<u>Variable</u>: *Aesthetic Exposure*

Definition & Measurement of Baseline Conditions

Aesthetic exposure refers to a population's *accessibility to aesthetic resources*. In measuring the baseline conditions with respect to these kinds of exposure, one should determine:

- the number of people presently viewing the site;
- their frequency of viewing the site (average and minimum-maximum range);
- the length of exposure at each viewing (average and minimum-maximum range);
- characteristics of the exposed population (socioeconomic status, age, ethnicity/race, etc.);
- activity context of aesthetic exposure (recreational users, residents, travelers, workers, shoppers, etc.).

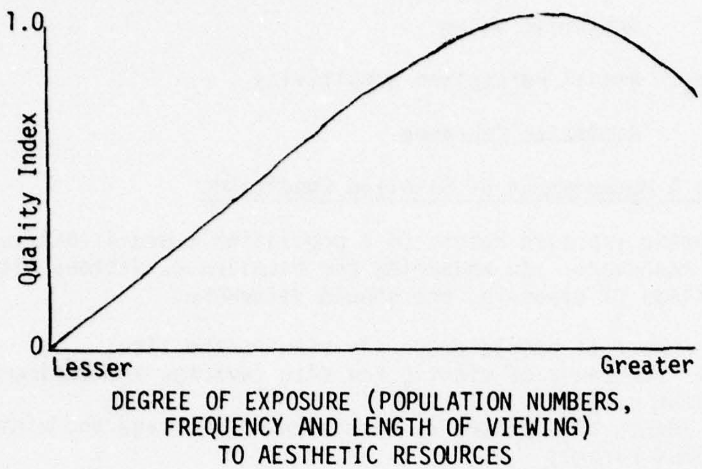
Prediction of Impacts

To predict the impacts of a water or related land-management project on the foregoing aspects of aesthetic exposure, the physical proximity of population concentrations to the water resources or its structures and to other project alterations of the original landscapes should be determined. Alterations directly and secondarily caused by the project should be considered. Delineations of the "viewsheds" at strategic location points in the area surrounding the project will define the sites where project alterations to the landscape can be viewed (see "*Viewshed*"). The population living in or near these location points and travel routes, recreational areas, and industries in or near these locations will affect the number and kinds of people exposed to the views and the amount of their exposure.

For quality aesthetic views that will be improved by the water project, the ease of physical accessibility to the viewing sites also will determine aesthetic exposure. Whether the site can be reached by car, on foot, boat, etc., as well as the distance to the sites from populated areas should be measured.

In making all of the foregoing predictions with respect to aesthetic exposure, one must take into account future population changes (i.e., in size, density, distribution) and future land uses (such as new industry locations, new travel routes, and new residential and commercial developments). Both future population changes and land uses that will be precipitated by the water project and future population changes or land uses that are likely to occur with or without the project are salient.

Hypothesized Functional Curve & Rationale



Generally, the greater the increase in exposure to aesthetic resources (as determined by the number of people exposed and the frequency and length of their exposure), the more beneficial the impact of a project. However, the impact is assumed to peak and to decrease when crowding occurs. Equal exposure of various population segments is also defined as a beneficial impact. Generally, aesthetic exposure is more important for recreational users, residents, and travelers than it is for industrial workers, shoppers, etc.

Remarks

Measurement of aesthetic exposure is essential to the assessment of the visual impact of a proposed project. A cumulative measure of visual impact can be expressed as the product of change in visual quality and the amount of aesthetic exposure.

Data Sources

Field observation, surveys of random samples of viewers at strategic sites.

References

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CONCLUSION

It has not been within the scope of this report to focus on the details and the many caveats that are germane to predicting the impacts of a technological project on social well-being. Briefly addressed below, however, are several basic methodological principles and important criteria that will affect the quality of social well-being impact assessment research and that should be incorporated in future guidelines for water resource planning.

First, the water official is cautioned that this entire report should represent only a beginning effort towards the establishment of guidelines for social well-being impact assessment of water and related land-management projects. Social well-being impact assessment in general is in a primitive stage of development, and resolution of the problems that today can only be acknowledged will have to await future development of the field.

VARIABLE SELECTION

A major problem, acknowledged at the outset of this report, is the selection of variables for study. The social well-being indicators that are meaningful for impact assessment will differ by the type of water project, its location, the population potentially affected, and the phase of operation of the project (i.e., planning, construction, or operation). Furthermore, the researcher should be cognizant that use of a variable listing, such as provided in this report, ". . . can lead to a false sense of security."* Because of the diversity of water projects and the varying conditions under which these projects are planned and implemented, there

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* J. D. Priscoli, personal communication, 1977.

is no guarantee that any one or several variable listings would include all of the indicators that might be significantly impacted upon by a particular project. The variable listing presented in this report is meant to serve only as an aid or guide to the researcher. At this stage of development of social well-being impact assessment, the researcher must in the end rely upon his own intuitive sensitivity and judgment.

There are several additional means of variable selection, however, that are essential to high-quality resource planning. One means of selection is to determine what are the predominant issues of concern to the potentially impacted communities, their leaders, and their citizens.* Do the people themselves perceive income inequality or health to be a problem? Do they anticipate the water project helping or hindering the resolution of this problem? Do the leaders and/or citizens anticipate problems not considered by the researcher?

Another means of variable selection is for the researcher to become familiar with the history of the potentially impacted community--the issues that have been raised before and the peoples' reactions to these issues (Finsterbusch and Wolf, 1977). In addition, the researcher should become familiar with similar types of water projects and the history of issues and impacts associated with them.*

BASELINE MEASUREMENT

The waterway planner is referred to Guseman, et al. (1976:201-38) for detailed descriptions of major data collection techniques. Table 1 summarizes the comparative advantages of these techniques.

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*Ibid.

Table 1

Advantages of Four Data Collection Techniques for Social Well-Being Impact Assessment*

	Data Collection Technique			
Advantages	Survey	Informant Interviews	Field Observation	Secondary Data Sources
Rapid method of data collection	4	3	1**	2
Low-cost approach	4	3	2	1
Variety of data available	1	3	2	4
Currency of available data	3	2	1	4
Provision of quantifiable data	2	4	3	1
Provision of perceptual data	1	3	2	4

*A rating of "1" denotes the most advantageous technique; a rating of "4", the least advantageous technique.

**Field observation can be cursory and rapid, or it can be an in-depth, comprehensive, and, consequently, time-consuming data collection technique.

PREDICTION

Prediction of effects on social well-being is highly problematic compared to prediction of biological and physical effects. Not only is social research in a comparatively early stage of development, "there is a respectable body of opinion that holds a social science will never be predictive in the same sense as physical science" (Wolf, 1976:59). Experimentally controlled conditions, which can seldom be achieved by social scientists anyway, are impossible for predictive social analysis (Wolf, 1976). Moreover, technological and social phenomena often have interactive or reciprocal effects on each other (Baur, 1973; Shields, 1974). To predict the impacts of a technological project on social well-being, the researcher must take into account the fact that the project or even plans for a project affect people's responses to the project. These responses, in turn, may result in alteration of the project or its plans, thereby affecting the impacts the project will ultimately have on the social well-being of residents.

Even after variable selection, specific techniques for prediction of effects on social well-being will differ according to the major goals of impact assessment, the phase of project development, the scope of the potentially impacted population, time, resources, etc. The major goal for impact assessment will be to aid in one or both of the following decisions: (1) the decision of whether to act--whether to have a technological project; and (2) the choice between alternative means to implement a project (Finsterbusch and Wolf, 1977). Essential to the action versus no-action decision is prediction of what changes would occur without implementation of the project compared to the changes that are expected to result from the project (Wolf, 1975). The choice between project alternatives is the less problematic goal for social well-being impact assessment, because it involves instrumentalities rather than ultimate values, the time frame necessary for evaluation of impacts is shorter, the uncertainty of probable impacts is less, and, finally, the outcome of the no-action decision is harder to predict (Finsterbusch and Wolf, 1977).

For both types of impact assessment, predicted effects should be distinguished according to the phase of the project: planning, construction, or operation. Sometimes the techniques of prediction will vary according to timing of effects to be predicted. In addition, the population to be affected will differ by the phase of the project and according to the variable being predicted. The scope of variable effects is generally less the more remote the location of a population from the location of the project. The impacts are usually most drastic on the community or communities nearest the project, hence, the emphasis frequently placed on community research methods (Baur, 1973). The waterway planner is referred to Guseman, et al. (1976:132-65) for detailed description and evaluation of forecasting techniques, such as the Delphi method, scenarios, and cross-impact matrix analysis.

IMPACT EVALUATION AND WEIGHTING OF INDICATORS

The Water Resources Assessment Methodology (WRAM) developed by the Waterways Experiment Station includes four primary components: (1) *importance weighting of variables;* (2) *scaling of impact variables;* (3) *multiplication of scale values by "relative importance coefficients";* and (4) *aggregation and professional interpretation of results.* In order to assign importance weights, it is necessary to make the initial allocation among the broad categories of a given account. For the Social Well-Being account, this would include: (1) Real Income Distribution; (2) Life, Health, and Safety; (3) Educational, Cultural and Recreational Opportunities and Other Community Services; (4) Emergency Preparedness; (5) Community Cohesion; and (6) Other Community Characteristics. A second allocation would be made to the subcategories within each category, for example, "Income opportunities," "Labor-force characteristics" and "Income expenditures" in the Real Income Distribution category. A third level of allocation then applies to individual variables. As the WRAM model gains in acceptance, interaction effects and, most important, the relative weights of input variables should become more specifically explicated.

With progress in social well-being impact assessment, the appropriate population(s) for study, the monitoring of impacts at different project phases, and the relationships between key social factors and particular types of projects should be more carefully assayed. WRAM, as the underlying assessment and predictive model, holds much promise for effective evaluation and thereby for improvement of the quality of living conditions for Americans affected by waterway facilities.

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In accordance with letter from DAEN-RDC, DAEN-ASI dated 22 July 1977, Subject: Facsimile Catalog Cards for Laboratory Technical Publications, a facsimile catalog card in Library of Congress MARC format is reproduced below.

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