Texas Coastal Management Program

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Technical Paper No. 8

A METHODOLOGY TO ASSESS SOCIAL/INFRASTRUCTURAL IMPACTS

ACTIVITY ASSESSMENT ROUTINE SOCIAL AND ECONOMIC COMPONENT

The General Land Office of Texas
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This is one of a series of technical papers, which cover a variety of topics. For information concerning other technical papers in this series, or to order more copies of this paper, contact:

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FOREWORD

This technical paper is one of a series of seven papers in which the background material, models, and data used to develop the social and economic component (SEC) of the activity assessment routine (AAR) are discussed. Together, the papers are reference sources for the SEC user's manual and form a basis for further system development.

Staff members of the Environmental Management Division, Texas General Land Office, in Austin are available to assist interested parties in learning to use the system, and they welcome any questions, comments, and suggestions concerning the SEC.

Many individuals assisted in the production of these technical papers. The principal-in-charge was Ron Luke. Project managers were Dennis Cooper and Ann Orzech. The author of this paper was Ann Orzech. The principal developer of the methodology was Jim Kimmel. Others who assisted in its development were Carolyn Honea, Cassandra Evans Woods, Bob Anderson, and Marta Braiterman. The technical editor was Nancy Grona. Production assistance was provided by Lori Snyder and Joanne Click.

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1. INTRODUCTION

The social and economic component (SEC) of the activity assessment routine (AAR) was developed as part of the Texas Coastal Management Program to provide a systematic, analytical procedure for evaluting certain social and economic effects from a proposed siting or expansion of a major facility.

The SEC considers the effects of a project on six economic factors: employment, income, output, industrial water use, tax revenues and government service costs, and administrative financial capabilities. The methodologies used to estimate these effects are discussed in detail in Technical Papers No. 6 (Input/Output Models of the Texas Coastal Region) and No. 7 (Assessment of Fiscal Impacts).

The effects on 13 social/infrastructural factors are also considered by the SEC:

1. Population
2. Housing
3. Educational services
4. Law enforcement
5. Fire protection
6. Health care facilities
7. Health care personnel
8. Municipal water supply and disposal
9. Wastewater treatment
10. Solid waste disposal
11. Traffic count
12. Road damage
13. Noise

The approaches used to estimate these effects, and the limitations and assumptions of the analysis, are presented in this paper.

2. METHODOLOGICAL DESCRIPTION

OVERVIEW

The process used to determine the impact of a project on certain social/infrastructural factors is shown graphically in Figure 1. First, the number of workers directly employed by the project who are likely to be new residents to the area (that is, those who are likely to relocate to within communting range of the site) is estimated. This estimate is based on discussions with construction contractors with experience in the area for the construction phase, and with company officials for the operations phase.

The new-resident employment is then allocated to specific cities near the project site through a gravity model, and both the expected change in population and new demand for housing are derived.

Finally, current ratios of factor values to population are then used to estimate project-induced demands. For example, the present state ratio of population to public school students is applied to projected population increases to estimate the project-induced increase in student enrollment.

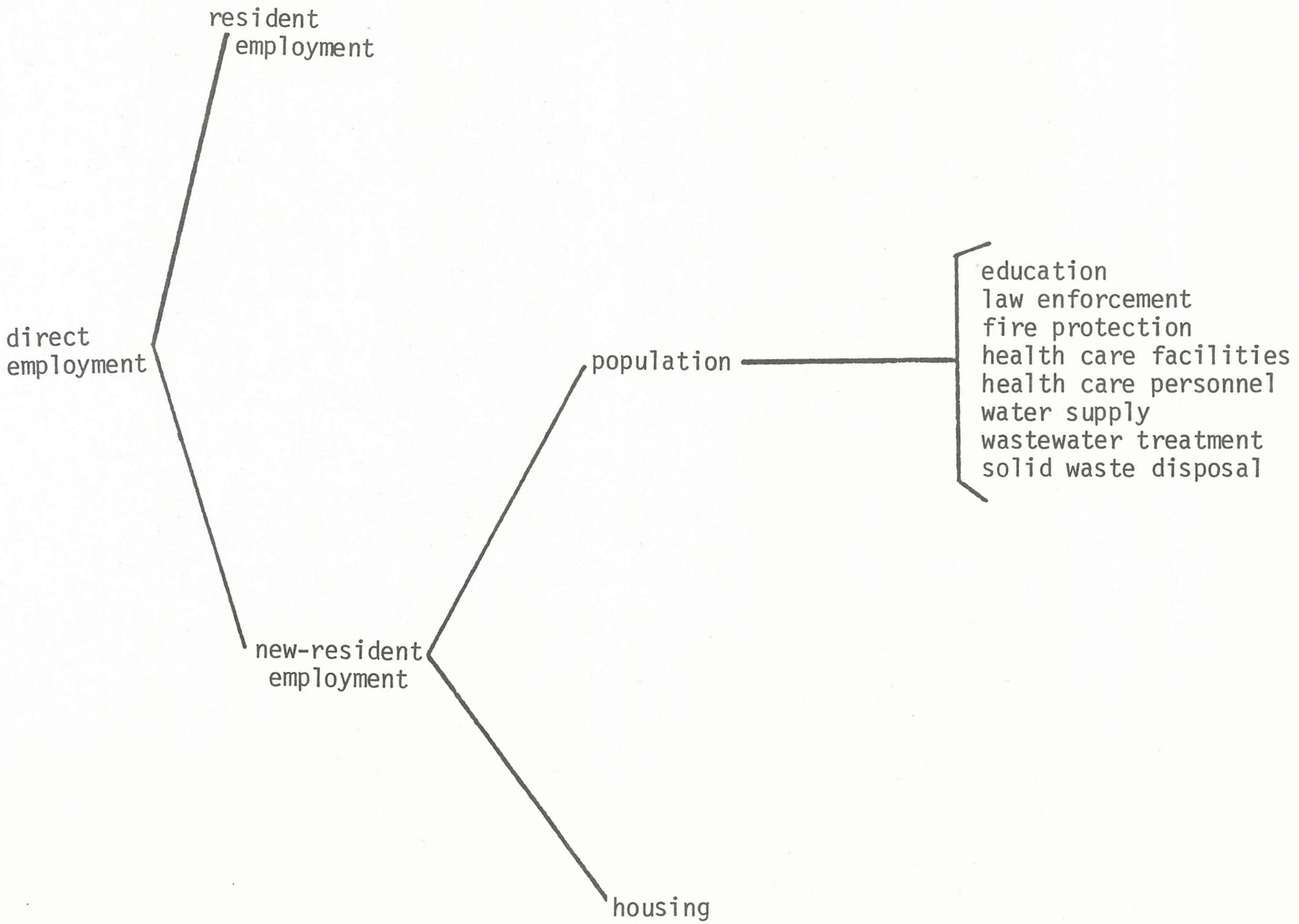
The new levels of demand are compared with existing service levels, and the capability of the impact area to absorb impacts is determined. This is done in one of three ways:

1. Appropriate government officials are asked to assess the impact on a particular factor. When the number of new students is estimated, for instance, the affected superintendents of schools are asked (a) whether the expected increase in enrollment could be absorbed by existing or planned facilities, (b) whether it would strain existing or planned facilities, or (c) whether it will require construction of new facilities.

2. The number of new personnel needed to maintain present ratios of personnel per capita is estimated and serves as an indicator of the impact on law enforcement. For example, the number of new law enforcement personnel required as a result of a project is estimated by applying the present number of officers per capita to the new population projected to result from the project. If relatively few additional personnel are required, it is inferred that the project has little or no effect on the level of police protection.

Figure 1

DERIVATION OF PROJECT-INDUCED DEMANDS



3. The projected increases in demand on facilities are compared to the systems' present reserve capacities. If the new demand is equal to or greater than 100 percent of the current reserve capacity, the system will not be able to meet the increased demand.

Through this process, the social/infrastructural issues which may be problematic are identified so that project proponents and affected government officials are aware of the problem and can take appropriate action.

DETAILED DISCUSSION

The approaches used to determine impacts on each of the social/infrastructural factors are presented in the following paragraphs. To perform a realistic and useful impact assessment, it was necessary to make certain assumptions that serve to limit the possible range of effects to be assessed. The assumptions on which this assessment component are based are thought to be reasonable and consistent with the dynamic nature of society. These assumptions are described in detail below and their implications are discussed in the following section. Because of the assumptions that must be made to create a workable procedure, the level of analysis is straightforward, and extensive derivations are not made unless the additional information provided by them is thought to be worth the added risk of building assumptions on top of assumptions.

ALLOCATION OF NEW-RESIDENT EMPLOYEES

An estimate of the percentage of workers expected to come from within a 60-mile driving distance of the project site is required information for the SEC. This percentage is then multiplied by the total work force; the product is an estimate of the number of workers who will come from the commuting range (that is, resident employees). The product is then subtracted from the total estimated work force for the project; the difference is an estimate of the number of new-resident employees.

The new-resident employment is then allocated to cities and unincorporated communities within commuting range of the site through a "gravity" model. With this model, the percentage of the total population increase moving to a given community varies directly with its present population and inversely with its distance from the site. In essence, present population is used as a proxy value to indicate attractiveness of a city based on the level of services available. In addition, the model assumes that families attempt to locate near the place of employment; as a result, a given city is assumed to be more attractive to new residents than one of equal size farther from the site.

Mathematically,

$$(1) \quad NR_1 = GF_1 \times NR_i$$

$$(2) \quad GF_1 = \frac{\frac{P_1}{D_1}}{\frac{P_i}{D_i}}$$

where NR_1 = new-resident employees allocated to city 1

GF_1 = gravity factor of city 1

P_1 = population of city 1

D_1 = distance of city 1 from site

NR_i = total new-resident employees

P_i = sum of all populations of communities in commuting range

D_i = sum of distance of communities in commuting range

POPULATION

The population increase expected as a result of the new-resident employees and their families moving into the area is estimated for each city and its corresponding school district, as well as the total increase for the counties within which the cities are located and the input-output region within which the project is sited.

In each geographic entity, the new-resident population is estimated by multiplying the number of new-resident employees expected to locate in that geographic area by a "population multiplier." The population multiplier is the ratio of the state's total population to employment. Use of the multiplier assumes that the relationship between population and employment for new-resident employees in the Texas coastal area is the same as for the state as a whole.

Thus, for a given geographic area,

$$\text{new resident population} = \frac{\text{total state population}}{\text{total state employment}} \times \text{new-resident employees located in the geographic area}$$

HOUSING

The new-resident population will need immediate housing. The effects of a strain on housing is not limited to the new residents, for existing residents may face housing cost increases and difficulty in moving to other housing units. The number of units needed is estimated under the assumption that each new-resident employee will require one housing unit.

Officials from either the local city hall or chamber of commerce are asked to assess the ability of the local housing market to absorb the new-resident employees. Specifically, they are asked if the new demand can be absorbed by existing vacant housing units or if it will require the construction of new units.

EDUCATIONAL SERVICES

The number of new public school children expected to enroll in local schools is estimated by applying a "student enrollment multiplier" to the new-resident population in each school district. This multiplier is the ratio of the state's total public school enrollment to population. Use of the multiplier assumes that the percentage of the new-resident population of school age is the same as the percentage of the total state population of school age.

For a given district,

$$\text{new school enrollment} = \frac{\text{total state school enrollment}}{\text{total state population}} \times \text{new-resident population in school district}$$

The judgment of local school superintendents is relied upon to determine the capability of the school districts to handle the new students. Specifically, the superintendents are asked (1) whether the expected increase in enrollment could be absorbed by existing or planned facilities, (2) whether it would strain existing or planned facilities, or (3) whether it will require construction of new facilities.

LAW ENFORCEMENT

The existing ratio of law enforcement officers to population in each city is calculated and becomes the per capita service level standard for that city. The number of new personnel needed as a result of the project to maintain that ratio is then estimated by applying the per capita ratio to the projected new-resident population. Through this process, it is determined whether the city's population growth is great enough to warrant the hiring of additional police officers in order to maintain the existing level of service.

FIRE PROTECTION

As with law enforcement, the present number of fire protection personnel per capita is calculated and used as the per capita service level standard for that city. The number of new personnel needed to maintain that level of service is then estimated; the existence of a volunteer force is noted. As with law enforcement, this approach does not estimate needs for fire protection equipment. It should be understood, however, that increased demand for personnel implies an increased demand for equipment.

HEALTH CARE FACILITIES

Impacts on health care facilities are estimated in total for all those counties within which an impacted city is located (that is, the "impacted county area"). Health care is assessed on a regional basis because patients usually travel for such care.

The impact of a project on facilities is estimated by applying the current number of hospital beds per capita to the new-resident population in the impacted county area. The present per capita ratio represents the per capita service level standard; the number of new beds needed to maintain that level of service is thus estimated.

Hospital beds are used in this approach as a proxy for health care facilities. Obviously, hospital beds are only one feature of health care facilities. Nevertheless, the number of beds is commonly used as an indicator in planning health care delivery.

HEALTH CARE PERSONNEL

As with health care facilities, the impact of a project on health care personnel is estimated for the impacted county area. The present number of practicing medical doctors per capita is multiplied by the projected new-resident population in the area to determine the number of new doctors needed to maintain current service levels.

Medical doctors are used as the proxy for health care personnel. Although there are many other types of health care personnel, the number of physicians is the standard commonly used by health planners.

MUNICIPAL WATER SUPPLY

Project impacts on municipal water supply are estimated by comparing the new-resident population's projected peak daily demand for water with a municipality's present production capacity for reserve drinking water. The reserve capacity is the difference between the system's design capacity and present peak daily demand and is a measure of the system's current slack. The projected peak daily demand of the new-resident population is determined by applying a city's present per capita peak daily demand to the new-resident population. This assumes that the new-resident population will use water at the same rate as existing residents.

If the new demand for water is greater than or equal to 100 percent of the reserve capacity or if no reserve capacity exists, the system cannot meet the added project-related demands projected to be placed on it.

WASTEWATER TREATMENT AND DISPOSAL

A city's wastewater treatment facilities, like its water supply system, have design capacities measurable in gallons of wastewater flow treated per day. Impacts on wastewater treatment and disposal are estimated similarly to impacts on water supply. That is, the new peak daily demand on the system as a result of the project-related population influx is estimated by applying present peak daily use rates per capita to the projected new-resident population. The added daily demand is then compared with the system's present reserve treatment capacity. This method assumes that the peak daily use rate of the new residents is the same as that of current residents.

If the system presently has no reserve capacity, or if the new demand is equal to or exceeds 100 percent of current reserve capacity, then the system cannot meet the increased demand.

SOLID WASTE DISPOSAL

The impact of a project on solid waste disposal is measured by estimating the percentage increase in solid waste generated by the new-resident population, given a city's present per capita solid waste disposal. It is assumed that new residents will generate solid waste at the same rate as existing residents. Waste disposal carried out independently by private industries or individuals, or even by the project itself, are not considered.

TRAFFIC COUNT

Traffic impacts are considered on the highway corridors leading to the site in order to account for increased traffic due to workers commuting to the site and material deliveries to and from the project. General increases in traffic in the cities due to the new-resident population are not assessed.

The estimated number of daily truck trips plus worker commuting trips are added to a road segment's current average daily traffic count to derive a new average daily traffic count; the percentage change in average daily traffic for each road segment and time period is then calculated.

Similarly, the estimated number of project-related truck trips is divided by the new average daily traffic count in order to estimate the new percent of traffic comprised of heavy trucks (heavy truck mix). The percentage change in heavy truck mix as a result of the project is then determined.

ROAD DAMAGE

The frequent use of roads by heavy, loaded trucks making deliveries to or from the project may damage roads. Because the state has a responsibility for maintaining public highways and severe damage to roads can cause major problems for its users, the degree of road damage caused by anticipated truck traffic is estimated. Personnel at the district offices of the Texas Department of Highways and Public Transportation are asked to assess the potential damage in these terms: (1) no damage, (2) some surface damage, (3) major surface damage, (4) some subgrade damage, or (5) major subgrade damage.

NOISE

Acoustical engineering literature provides estimates of the decibel levels normally associated with different land uses. These studies were used to estimate project noise impacts by considering that the change in land use will also change noise levels around the project site. The impact of a project on noise levels is estimated for the immediate project area only; it is measured in terms of the distance in feet from the site needed to reduce noise to the preproject level.

The following mathematical model was used.

Let N_e = noise level in decibels of existing activity on site

N_p = noise level in decibels of proposed activity

DLF = distance noise loss factor, or the distance the noise of the proposed activity must travel through space to equal the noise level of the existing activity

AC = noise absorption capacity of landscape type

AFL = noise absorption factor of landscape

LLF = landscape noise loss factor (a measure of the noise-reducing ability of the landscape in feet)

DFS = distance from site in feet needed to reduce noise to preproject level

Then,

(3) $$DLF = 10^{\left(\frac{N_p - N_e}{20} + 1\right)}$$

(4) $$AFL = \frac{\log \frac{DLF}{10} \times AC}{0.301}$$

(5) $$LLF = 10^{\left(\frac{AFL}{20} + 1\right)}$$

(6) $$DFS = DLF - LLF$$

3. ASSUMPTIONS AND LIMITATIONS OF THE ANALYSIS

ASSUMPTIONS

The underlying assumptions of the approach used to estimate each factor were outlined in Chapter 2; their implications are discussed in this chapter.

The impact assessment procedures for most of the social infrastructural factors are ultimately based on the estimates of direct employment; at this point, a potential source of error exists. Though cost estimation is central to the planning process for a project and cost estimation involves estimates of labor, it must be understood that labor estimates are not necessarily accurate. Labor estimates are made with consideration of normal project delays resulting from weather or material shortages. However, if serious delays occur it may be necessary for the contractor to increase the construction labor force much beyond normal expectations. Thus, short-term impacts may be significantly greater than estimates would indicate. Estimates of the operation work force are generally much more reliable.

When total direct employment has been estimated, it is necessary to determine what portion of these new jobs will be filled by people moving into the area and what portion will be filled by workers within commuting distance of the site. Though there are models that estimate worker availability, it is thought that a more realistic approach is to seek that information from contractors with experience in the area. Contractors are usually willing to provide such information, even when the work has not been let out for bid. However, the information is a general estimate, and must be viewed as such.

The new-resident employees are allocated to cities and unincorporated communities within reasonable driving distance of the site. The model is not sufficiently selective to determine the part of a community in which the new-resident employee and his family will locate.

A population multiplier is then applied to estimates of new-resident workers to derive project-related population increases. Various coefficients have been used in other studies; the SEC uses one thought to be realistic for Texas. It is calculated by dividing the state population by the total number of workers in the state to yield a ratio between population and employment. This ratio may overestimate the number of dependents per worker in that it does not separate households with more than one worker from those with only one worker. It is safer, however, to overestimate impacts than to underestimate. The demand for housing units is estimated by using a coefficient of one unit for each new-resident worker. As with population, this coefficient probably overestimates to some extent. In both cases, alternative coefficients may be derived from local conditions or obtained from other sources.

The expected increase in school enrollment as a result of the project is estimated by applying an education multiplier to the population increase projected for each school district. This mulitplier is derived by dividing the total school enrollment in the state by the total state population. An age distribution of workers and their families which differs significantly from the state as a whole will result in differences between the actual and projected school enrollments.

In estimating demands placed on infrastructural factors such as water, wastewater treatment, solid waste, police and fire protection, and health care, the SEC uses coefficients calculated from existing local per capita levels of service. These local-based coefficients are used rather than "standard" coefficients for the following reasons. First, for some services such as health care, it is not possible to develop a valid per capita standard. This is due to the many variables involved in health care other than ratio of physicians to population. Second, a generalized standard must by definition incorporate a range of circumstances. For example, urban residents usually have a greater demand for fire and police protection services than do residents of small cities. Consequently, to base demands for police and fire protection personnel in a rural area on standards suitable for an urban area assumes levels of services beyond present conditions, and possibly beyond what is reasonably required. The other side of this consideration, however, is the fact that existing conditions may be deficient, and therefore deficient levels of service are being projected. This point is mollified to some degree by the fact that existing levels of service de facto represent conditions which are acceptable to the population in question.

The assessment procedures for a few factors, such as traffic and noise, rely on information specific to the project. As a result, the estimation of these impacts depends almost exclusively on the applicant's description of project activities. Since these estimates come from the applicant's own estimating procedure, they are generally reliable. Such estimates can also be compared with information from previously analyzed projects to check for gross errors in estimation.

LIMITATIONS

DATA LIMITATIONS

The SEC is designed to be used in permitting and for planning and is not an exercise in basic research. In all possible cases, the component makes use of published sources of data. Published information is available for a great range of social factors at the county level, and in some cases, the subcounty level. However, by the time many of these data are collected and published, they are several years old. In addition, such publications seldom are annual, which tends to increase the relative age of the available data, particularly toward the end of the period between collection dates. However, in many cases, these publications are the only source of necessary data regardless of age.

Though the use of published data simplifies the task of using the SEC, it is still necessary, in some cases, to seek data from local sources. These primary data fall into two categories. The first is quantitative information about social factors which is not published for the geographic area under question. For example, if data on educational facilities in a given school district are not published, the local school superintendent will have this information and will usually be cooperative in providing it over the telephone. The second type of primary information is judgmental and must be obtained from specific individuals at specific times and places. Continuing the example of educational facilities, the superintendent will be able to describe the school system's capabilities to absorb the estimated number of new students. This information is judgmental and cannot reasonably be checked; it must simply be relied on.

FACTORS CONSIDERED

The factors considered in the SEC are those which are capable of quantification and examination in a routine manner and for which a governmental responsibility can be determined. It is thought that these factors will be those most directly affected during development, and they are the ones which must be dealt with by public officials. An example is education. The impact of a project on education can be derived through a quantitative estimation of the probable number of new students; the superintendent of schools and the school board are responsible for education in a district. Those factors which are qualitative in nature and which thus must be analyzed by highly trained professionals were excluded from the SEC. Examples are community cohesion, quality of life, and archaeological and cultural resources.

Recreation is not considered in the SEC for precisely those reasons. The only quantified measure of recreation readily available is park acres per capita. This does not measure intensity of use or other kinds of recreation (driving on a highway looking at birds, for example). Acres per capita also says nothing about the quality of access to recreation, use by people from outside the local area, or a host of other factors. The number of park acres available, therefore, may be very misleading.

In addition, the Texas Parks and Wildlife Department has special responsibility to consider the needs of recreation, and the Texas Outdoor Recreation Plan provides information on recreation needs to all state agencies. Recreational planning and permitting policies are the responsibility of the Parks and Wildlife Department; these officials should be contacted concerning the probable impact on recreation.

Special issues, which occur in every study, are also excluded from consideration. These arise because either the underlying assumptions of the SEC do not hold in a particular case, or because the question is beyond the scope of the SEC.

As an example of the former, in certain instances a special analysis of the community patterns of workers and their impacts on infrastructural factors may be necessary. In the SEC, all workers are assumed to reside with their families within reasonable driving distance of the site. Workers are thus of two types: resident workers already living within commuting range of the site, and new-resident workers who move with their families within commuting distance. Certain types of workers do not fit the pattern, however. These include pipeline construction workers who typically do not move with their families into an area but rather rent by themselves or share with others a motel, hotel, or boarding room, and dredge workers who work a schedule of one week on and one week off and who typically return to their normal place of residence during the off week. In these situations, the SEC would overestimate both the population increase associated with a project and its impact on infrastructural issues.

Other issues are beyond the scope of the SEC. These include, for example, the secondary development which might result from a new highway or navigation channel in an area and specific impacts on unincorporated communities.

Although the process does not consider every social factor, it does encompass those issues of greatest concern to local government officials. It identifies potential problem areas worthy of further study for government officials and eliminates from further study those which are insignificant.

4. CONCLUSIONS

The methodology outlined in this paper is an outgrowth of practical experience in gathering data and assessing the social/infrastructural impacts of major projects. During its development, emphasis was placed on creating a workable tool for permitting agencies, local government officials, industrial applicants, and the interested public to be used in estimating social/infrastructural impacts. Like any analytical tool, it is not a replacement for thought and will not make decisions. Proper use of the approach, however, will permit the determination of the effects of industrial development and the identification (or red-flagging) of potential problems in order to provide the responsible government officials with sufficient lead time to plan for the impacts.