Identification and Ranking of Environmental Impacts Associated with the United States Interstate Highway System

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Environmental impacts associated with the development and use of the Interstate highway system are identified, grouped into categories, and ranked by relative significance. The development and use of the Interstate highway system has resulted in several environmental impacts. Although many of these impacts are intuitively recognized, they have not been formally identified or ranked in any systematic way by their relative significance or magnitude. Classification and ranking systems are presented.

Man has traveled since his nomadic beginning when he followed the migratory routes of animals. These travel routes evolved into roads, which we may define as routes of overland communication between established communities (*1*).

A number of significant events have combined to expand the definition of a road beyond being simply a route from one place to another. Industrial advances, increased population, increased disposable income, more leisure time, significant technological accomplishments, and an increasingly complex society have resulted in the development of many roads in the United States. Roads have become an integral part of the landscape and a part of life for virtually every American.

As highway travel in this country increased, the interdependence of utility, safety, beauty, and economics led us to the concept of divided highways. The first such roads were built in the 1930s and the Interstate highway system was begun in 1956. The National System of Interstate and Defense Highways, as it is called in the generic legislation, is to be some 42,500 mi long when it is completed. About 1,000 mi remain to be built (*2*).

According to Hindley (*1*), the Interstate system will represent only 1 percent of the total U.S. road mileage when completed. However, the system will carry at least one-fourth of the nation's total traffic flow. Interstate highways link 43 state capitals and serve 90 percent of all cities with populations greater than 50,000, in addition to about one-half of the rural population.

Although roads have become a natural component of our lives, certain environmental impacts are associated with the system of highways. Those impacts are identified in this paper and it is shown how they can be grouped and ranked.

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PROBLEM STATEMENT

With the invention of the internal combustion engine and mass production of the automobile as catalysts, the proliferation and expansion of the network of highways in the United States have resulted in several environmental impacts. Although these impacts may intuitively be recognized, they have not been formally identified or ranked in any systematic way by their relative significance or magnitude. Additionally, a system for classifying impacts has not been developed.

HYPOTHESIS

Environmental impacts of the Interstate Highway System can be identified and ranked using a scheme of relative importance, significance, or magnitude. It is also possible to place the impacts into definable categories so that relationships can be identified.

DISCUSSION

An attempt is made in this paper to discuss, at least in general terms, the environmental impacts of the Interstate highway system. For the purposes of discussion the term "impact" is treated synonymously with "effect." Put another way, an attempt is made to identify the environmental changes that have occurred as a result of the development and operation of the Interstate highway system.

The following assumptions are made in conducting this study.

1. For the most part, impacts associated with all roads and road systems can be applied to the Interstate highway system. (Some differences in impacts and their relative ranking can be expected because of the differences in location, relative size and volume, and type of traffic use.)
2. Certain impacts are more relevant to the Interstate system than to other roads because of the strategic location of the Interstate highways.
3. Impacts vary in magnitude (scale) and consequence. They can be large or small, beneficial or detrimental.

4. Permanent impacts are more significant than temporary impacts.
5. Impacts can be grouped by function or source.
6. It is possible to identify and describe impacts that are secondary, tertiary, or even further removed, but which have their genesis in the Interstate highway system.

Any alteration of the landscape of the magnitude of the massive highway system obviously causes certain changes or impacts. Some of these impacts are more permanent than others; some are quite significant whereas others are not; and some are generally accepted as beneficial whereas others are considered detrimental.

An additional dimension to the perception of impacts arises when the intended or consequent beneficiary is considered. For example, a section of Interstate highway that connects two major metropolitan areas is of obvious benefit to the people who use that access on a regular basis for commerce and pleasure travel. However, the same stretch of road is probably less beneficial, and perhaps detrimental, to the individual who resides in another region of the country and seldom or never uses the road but contributes to its construction and maintenance through taxes. The same might be true of the individual who owned or was employed by a restaurant or other service type of business located on a previously busy highway that was bypassed by the development of the new Interstate highway.

The Interstate system of highways, although quite small relative to the extent of roadways in the nation, is strategically located so that special impacts can be associated with that system.

Certain impacts are readily apparent when the Interstate system of highways is visualized crisscrossing the nation in north–south and east–west grids. Visual impacts of the long ribbons of roads and their attendant strip developments in and near population centers are immediately evident. Further, the rather permanent nature of the physical presence of the roads and their associated developments are obvious. The highway commercial strip environment will be around as long as the automobile persists as a major transportation mode (*3*).

We have lost the night. Illumination by vehicles on the nation's roads, and the communities and strip developments they serve, has changed the visual quality of our once-dark continent to one splashed with light. Certain areas are now lighted virtually 24 hours a day. The significance of illumination of our landscape is particularly evident to travelers who cross the country at night by air.

Another conspicuous impact is the noise caused by the large volume of traffic pounding the pavement at high speeds. Interstate highways, with their facility for commercial transportation in the form of large trucks and buses coupled with maximum allowable speed limits, are particular sources of noise pollution. Construction and maintenance equipment and activities provide additional sources.

Cook and Van Haverbeke (*4*) have found that proper placement of certain species of shrubs and trees can result in significant reductions in noise pollution. Other mitigating features have been incorporated into high-volume traffic areas in congested regions to reduce noise levels adjacent to the highway. On I-495 around Washington, D.C., for example, sound barriers that resemble fences about 15 ft high have been erected on either side of the highway. These barriers are made of a variety of materials including wood and steel and appear to be fairly effective in containing noise in the highway corridor.

The alteration of vegetation brings with it a host of additional impacts. Vegetative communities form important building blocks for a vast array of environmental processes, functions, and situations. Among them are wildlife habitat values, soil erosion control, and uptake of pollutants and contaminants. The search for low-maintenance plant species that are effective as soil erosion control agents has led to the importation of exotic species such as kudzu (***Pueraria thunbergiana***) and the genetic development of new varieties such as crown vetch (*Coronilla varia*).

Indiana researchers are experimenting with planting shrubs on highway rights-of-way to offset wildlife habitat losses caused by intensive farming, urbanization, industrialization, and other land use practices associated with a rapidly urbanizing society. Roach and Kirkpatrick (*5*) discovered that the planting of shrubs along Indianan four-lane highways provided a habitat that attracts a greater number and diversity of wildlife, primarily birds. Use of these areas by rabbits was more than that of grassed areas. Road-kill data indicate that highway rights-of-way can be developed to increase wildlife productivity without attendant increases in mortality. Maintenance costs associated with mowing are greatly reduced when the grassy areas are converted to shrubs or other vegetation that does not require that treatment.

Formation of borrow pits as a result of the removal of sand, gravel, and fill material for use in highway construction results in wildlife habitat modification. Existing or preconstruction habitat is destroyed or altered and additional habitat is created. Specific management prescriptions can enhance these habitats significantly (*6*).

The extent of the effects of habitat loss because of the construction of I-95 in northern Maine is not fully understood. However, some species have adapted to the new habitats created by this highway development. Other species that are naturally adapted to forest habitat are avoiding the I-95 corridor (*7*).

Yellow sweet clover (***Melilotus officinalis***) volunteered as a ruderal species along a highway that had been recently relocated in conjunction with the construction of Libby Dam in Montana in 1973. The clover reached heights of approximately 8 ft and was browsed heavily by mule deer (***Odocoileus hemionus***). Increased road kills of mule deer were reported, but the cause was linked closely with the action of the deer crossing the road to gain access to the river on their migration route. Construction of the relocated road had occurred at the base of a mountain and the deer traveled from the higher elevations to the river, returning daily.

When the U.S. highway system was composed primarily of gravel roads, the width of the right-of-way—owned, easement, or both—was usually one chain or four rods (66 ft). The advent of the Interstate highway system in the 1950s resulted in expansion of those rights-of-way to a minimum of 300 ft with a median strip of variable widths. Grass was almost always used on the unpaved portions for soil erosion control. Later concerns for overall aesthetic appearance and reduction in maintenance costs led to the planting of perennial woody shrubs and trees to supplement natural vegetation.

Several studies have concluded that significant savings in costs of maintaining the rights-of-way can be achieved, and, indeed, potential profits can be realized by converting these areas to commercial forestry operations (*8*).

Impacts on the environment result from both the construction and operation of the highway system and from the vehicular traffic that uses the roads. Noise pollution has already been discussed. Another impact occurs in the form of chemical emissions from all vehicles.

Traffic on the highways introduces a number of contaminants and pollutants into the immediate area. Runoff from the highway surface carries these potentially harmful pollutant loads to nearby surface waters. Constituents typically include boron, lead, zinc, nitrogen, phosphorus, and ammonia (*9*).

Concentrations of heavy metals and other pollutants from vehicles on Interstate highways have been the object of considerable concern and, consequently, a great deal of research over the past several years. Yousef et al. (*10*) report that the use of detention or retention ponds was quite successful in locking up these noxious elements in the upper layer (approximately 5 to 6.8 cm) of the bottom sediments. Their work was conducted at sites on I-4 and US 17-92 in central Florida. Additional work in central Florida on I-4 showed that grassy swales were effective in reducing concentrations of heavy metals (*11*). Water quality changes caused by highway construction were found to be temporary, and, once the construction was completed, the water quality tended to return to its preconstruction conditions (*12*).

These findings partially coincide with similar observations by the author of several major Corps of Engineers construction projects throughout the nation. Terrestrial scars with their attendant soil erosion and vegetative losses occur during major construction activities. However, with proper care, the scars quickly heal and adverse ecological impacts are mitigated. Obvious visual impacts and effects on certain vegetative and wildlife communities are more permanent.

The literature appears to concentrate on the forms of impacts that have been discussed here. There are, however, other impacts that have received only limited or no attention from the scientific community. The identification of impacts becomes quite complicated when one considers the far reaching consequences of some of the actions that result from development of a means of transporting people and things from one point to another are considered.

Land has been lost from agriculture and other productive uses to the highway system. The total amount of land is probably not as significant as are its location and function and the impacts of the linear corridors created by road construction.

The significance of an Interstate highway route is often more related to its location than to how much land will be taken. The values of archaeological sites, minerals, critical habitats for wildlife species, and other important features associated with a proposed highway route can outweigh the use of the corridor as a road, resulting in a change of the planned route. The relocation of the planned route for I-29 in Louisiana, for instance, allowed continued access to mine extensive lignite deposits. The location of I-85 across Georgia and South Carolina permitted easy access so that millions of Americans could enjoy recreational opportunities at Lake Sidney Lanier and Hartwell Lake.

Population concentrations in the urban areas linked and serviced by the road system open a vast array of secondary and induced impacts. Los Angeles, California, represents the classic example of a modern urban area built around the automobile. It has been estimated that one-third of the metropolitan area is taken up by road surface, one-third by parking facilities, and one-third by living space (*1*). Regardless of the statistical validity of these data, the fact remains that significant land resources are devoted, either directly or indirectly, to the use of motor vehicles in Southern California and the rest of the country.

The concept of neighborhoods has changed with easy access to friends living several miles distant now possible. Distances once considered major journeys are now routinely traveled. Our mobile society has a different set of socioeconomic, cultural, and political values compared with those of previous generations, due in large part to the ease of transportation caused by the highway system. The migration from the inner cities to suburbia following World War II was accelerated by a growing population and great advances in technology. The explosion of the automobile market and improved highways were certainly important aspects of this major cultural change.

The morphology of cities has been altered dramatically by the Interstate system. Traditional neighborhoods have been split. Pedestrian access to, from, or across the multilane roads is limited or nonexistent. The result is fragmentation and isolation of once integral areas in many major cities.

With the advent of the Interstate system and the expansion of the commercial trucking and busing industries, alternative means of travel and shipping provided competition for commercial airlines, railroads, and barges. Economic and environmental impacts in all of these areas could be attributed, at least in part, to improved roads. This unprecedented mobility has permitted, paradoxically, both a decentralization and a recentralization of social activities. Metropolitan life-style has spread into the countryside because of easy access to areas beyond the city limits. The development of suburban areas with shopping centers that have ample parking space, larger centralized schools and hospitals, and other automobile-oriented features has resulted in the decentralization of activities from the metropolis to the suburb (*13*). Each of these new directions comes equipped with a myriad of environmental, economic, and social consequences.

Secondary and induced impacts in the form of sand, gravel, and limestone mining for road construction and the mining of iron ore and other raw materials for the manufacture of vehicles, construction equipment, and other supplies continue to result in environmental impacts on the landscape. Additionally, these activities have produced impacts on the national economy and employment rates.

RELATIVE RANKING OF IMPACTS

The foregoing discussion has established that our system of Interstate highways continues to create a variety of changes in our environment. These changes vary extensively in their relative permanence, magnitude, and importance. Individual impacts can be considered beneficial or detrimental, depending on perspective and whether the action that causes the impact results in a gain or a loss.

The major environmental impacts of the Interstate highway system are shown in the following list. Because of the complexity of the subject, the list can be expanded to capture the level of detail desired. An attempt is made to categorize several impacts under activities that are descriptive of those impacts as a group. These 18 major group headings are used in further analysis in the interest of simplicity, brevity, and consistency.

Direct Impacts

1. Visual
   (a) General aesthetics
   (b) Illumination at night
2. Noise level increase
   (a) Construction and maintenance
   (b) Public use
   (c) Impacts on man
   (d) Impacts on wildlife
3. Air pollution
   (a) Construction and maintenance
   (b) Public use
4. Water pollution
   (a) Construction and maintenance
   (b) Public use
   (c) Surface water runoff
5. Land loss from other use
   (a) Road corridor
   (b) Shoreline at bridge crossings
   (c) Support activities (e.g., maintenance yards, and so on)
   (d) Acquisition, storage, and transportation of materials
   (e) Manufacture, storage, and sales of equipment
6. Land alteration
   (a) Borrow pits
   (b) Cuts and fills
   (c) Soil profile mixing
7. Vegetative modification
   (a) Erosion control
   (b) Wildlife habitat impacts
   (c) Mowing
   (d) Development of new varieties
   (e) Introduction of exotic species
   (f) Use of herbicides
8. Soil erosion
   (a) Increased erosion
   (b) Decreased erosion
9. Wildlife
   (a) Habitat loss
   (b) Habitat creation
   (c) Alteration of habitat for indigenous species
   (d) Interference with migration routes
   (e) Interference with access to water or other nearby habitats
   (f) Road kills
   (g) Interruption in travel routes
   (h) Improved access to wildlife by man
   (i) Isolation of populations and communities
10. Wetlands loss or alteration
    (a) Dredging and filling
    (b) Drainage
    (c) Encroachment because of improved agriculture and development
11. Cultural resources
    (a) Archaeological sites
    (b) Historical sites
    (c) Site destruction
    (d) Site discovery

Indirect Impacts

1. Litter and other solid wastes
   (a) Landfill requirements
   (b) Recycle
2. Strip mines
   (a) Sand and gravel
   (b) Limestone
   (c) Iron ore and other raw materials
   (d) Soil disturbance
   (e) Vegetation loss
   (f) Reclamation
   (g) Water pollution

Induced Impacts

1. Strip development
   (a) Commercial
   (b) Residential
2. Urban development alteration
   (a) Decentralization
   (b) Recentralization
3. Auto manufacture
   (a) Manufacturing plants
   (b) Dealerships
   (c) Repair shops
   (d) Supply of raw materials
   (e) Other support facilities
4. Junk cars
   (a) Storage
   (b) Transportation
   (c) Recycling
   (d) Other disposal (incineration, landfill, and so on)
5. Petroleum production
   (a) Production
   (b) Processing
   (c) Delivery
   (d) Use
   (e) Disposal

In order to assess the overall, generic environmental impact of the highway system, it is important to first assess the individual impacts. Once the individual pieces of the puzzle are identified and placed into logical groupings, the puzzle itself will begin to take form. Two alternative approaches for accomplishing this process are presented.

The first logical step in this process is to combine similar impacts into functional groups (see Table 1). In this display (Alternative 1), the impacts that were broadly identified in the list previously shown are associated with one or more classes. These classes, which represent a further refinement of the list, are defined as follows:

- Class I: Physical impacts are physical alterations to the environment such as vegetative changes and soil movement.
- Class II: Sensual impacts are those that affect the five human senses, but are primarily concerned with visual and auditory perceptions.
- Class III: Conceptual impacts directly alter the life-styles and sociological make-up of our society. Time and space have different conceptual values for the current generation from those they had for generations that did not have the relatively easy transportation associated with our system of four-lane roads. This class is intended to identify those impacts that have had an effect on our conceptual values.

In Table 1, direct, indirect, and induced impacts are shown that are the result of highway construction and operation and the movement of vehicles on the highways. These types of impacts are defined as follows:

- Direct impacts are the direct result of construction and operation of the roads. The use of the highways by motor vehicles is also a source of direct impacts.
- Indirect impacts are caused by the acquisition, storage, and transportation of materials used in the construction and operation of the Interstate highway system.
- Induced impacts result from accelerated activities caused by the operation and use of the Interstate highway system.

Some impacts can be placed in more than one class, illustrating the complex nature of the impacts of the highway system and their interrelationships.

Also identified in Table 1 is a classification of each impact as permanent or temporary. For this study, permanent impacts are those that extend from one generation to another. Temporary impacts may also be long-lived, but it is reasonable to expect that they could be neutralized under normal conditions of national priorities and adequate funding. Temporary impacts may also be those that are short-lived on a site-specific basis. For example, erosion is constant nationwide, but it is normally controlled at a given site in a short time.

Those impacts that are considered to be permanent and classified as having the characteristics of all three classes of impacts under Alternative 1 are

- Strip development,
- Urban alteration,
- Auto manufacture, and
- Petroleum manufacture.

Permanent impacts that appear in two classes are

- Visual,
- Vegetative modification,
- Strip mines,
- Land loss, and
- Land alteration.

Numerical values can be assigned to the impacts that have been identified using the scheme shown in Table 2. Under this

TABLE 1 CLASSES AND TYPES OF IMPACTS: ALTERNATIVE 1

	Class				
			III		
Impact	I Physical	II Sensual	Conceptual	Permanent	Temporary
Direct					
Visual		X	X	X	
Noise level increase		X		X	
Wildlife	X				X
Wetlands	X				X
Land loss	X	X		X	
Soil erosion	X	X			X
Vegetative modification	X	X		X	
Air pollution	X	X			X
Water pollution	X	X			X
Land alteration	X	X		X	
Cultural resources			X	X	
Indirect					
Litter	X	X	X		
Strip mines	X	X		X	
Induced					
Strip development	X	X	X	X	
Urban alteration	X	X	X	X	
Auto manufacture	X	X	X	X	
Petroleum production	X	X	X	X	
Junk cars	X	X			X

TABLE 2 A SYSTEM FOR RANKING IMPACTS: ALTERNATIVE 1

Rank	Permanent	Temporary	Three Classes	Any Two Classes	Any One Class
1	X		X		
2	X			X	
3	X				X
4		X	X		
5		X		X	
6		X			X

TABLE 3 RELATIVE RANKING OF IMPACTS: ALTERNATIVE 1

Rank Number	Impact
1	Strip development
	Urban alteration
	Auto manufacture
	Petroleum production
2	Visual
	Land loss
	Vegetative alteration
	Land alteration
	Strip mines
3	Noise level increase
	Cultural resources
4	Litter
5	Soil erosion
	Air pollution
	Water pollution
	Junk cars
6	Wildlife
	Wetlands

ranking system, the results shown in Table 3 would be achieved. One conclusion from this analysis might be that those impacts with lower rank numbers are more significant and should, therefore, receive attention before the higher-ranked impacts.

The identification and classification scheme is applied to the entire Interstate highway system in a broad, general sense and does not account for regional or local circumstances. Ecological, cultural, socioeconomic, and political variations occur across the nation and the significance of impacts depends heavily on these considerations.

No priorities or values were assigned to the three classes of impacts. This could be done, but, in this instance, the judgment was made that all three classes should receive equal weight. Also, emphasis was given to permanent impacts. The implementation of such a classification and ranking scheme so that priorities of research efforts could be assigned to problem areas must include decision points at which the determination should be made to attack a problem area of a permanent or temporary nature. The methodology should also be appropriately tested before implementation.

The foregoing is an example of how impacts can be grouped and ranked. It is also possible to organize the impacts in other ways. Alternative 2, depicted in Table 4, presents an additional scheme that could be used to arrange impacts in groups of functions that include the construction, maintenance, and use of the roads. A final group in this scheme includes impacts resulting from development adjacent to the Interstate roads.

This alternative method is further refined to identify those impacts that are permanent and those that are more temporary. In this example, air and water pollution resulting from construction lasts only through and, perhaps, until shortly after the construction activity. Strip mines and land and urban alteration are permanent results of the construction activity.

It is possible to rank the relative impacts under the criteria established in Alternative 2 by using the assumption that permanent impacts that meet the most criteria are the most significant. The results of such an analysis are displayed in Table 5.

RESULTS

A review of the literature did not reveal that all environmental impacts associated with the Interstate highway system have been identified and grouped into logical categories. No system of ranking or assignment of significance to individual or groups of impacts was discovered.

Two alternative systems have been devised to group and rank the impacts. Under Alternative 1, impacts are identified and grouped into categories based on functions. Impacts are identified that are direct, indirect, or induced and are further categorized based on their physical, sensual, or conceptual functions. They are also judged to be either permanent or temporary.

A quantitative scoring system was devised based on the permanent or temporary nature of the impact and the number of functional qualities each possesses. Permanent impacts with all three functional classes receive a rank score of 1. Temporary impacts with only one class assignment are ranked as 6. The lower the rank score under Alternative 1, the greater the significance of the impact.

Under this ranking system, impacts associated with urban development, population concentration, and the induced impacts of building more vehicles and developing petroleum products to power them are the most significant of all those that were identified. Temporarily disrupted wetlands and wildlife are the least significant.

Alternative 2 arranges impacts in groups of activities associated with the highway system itself. They are construction, maintenance, public use, and adjacent development. These impacts are also identified on their relative permanency. The scoring system used for Alternative 1 is also applied in Alternative 2.

The results of the analysis under Alternative 2 differ somewhat from those of Alternative 1. This variation is due to the consideration of the source of the environmental impact in Alternative 2 as opposed to the class of impact in Alternative 1.

Results of the analysis in Alternative 1 would be of use in attacking problems that could be associated with physical alteration of the natural resources or perceptual or socioeconomic problems. Alternative 2 could be helpful in identifying the source of impacts so that appropriate corrective action could be taken.

TABLE 4 IMPACTS GROUPED BY SOURCE: ALTERNATIVE 2

	Source of Impact							
	Road Construction		Road Maintenance		Road Use		Development of Adjacent Lands	
Impact	P	T	P	T	P	T	P	T
Direct								
Visual	X				X		X	
Noise level increase		X		X	X		X	
Wildlife		X		X	X		X	
Wetlands		X					X	
Land loss	X						X	
Soil erosion		X						X
Vegetative modification	X		X				X	
Air pollution		X		X	X		X	
Water pollution		X		X	X		X	
Land alteration	X						X	
Cultural resources	X						X	
Indirect								
Litter		X		X	X		X	
Strip mines	X		X					
Induced								
Strip development	X						X	
Urban alteration	X				X		X	
Auto manufacture					X			
Petroleum production		X		X	X			
Junk cars					X			

NOTE: P = permanent, T = temporary.

TABLE 5 RELATIVE RANKING OF IMPACTS: ALTERNATIVE 2

Rank Number	Criteria	Impact
1	Permanent impact of 4 sources	None
2	Permanent impact of 3 sources	Urban alteration
		Visual
		Vegetative modification
3	Permanent impact of 2 sources	Land loss
		Land alteration
		Noise level increase
		Litter
		Air pollution
		Water pollution
		Wildlife
		Strip development
		Strip mines
		Cultural resources
4	Permanent impact of 1 source	Auto manufacture
		Petroleum
		Junk cars
		Wetlands
5	Permanent impact of 0 source	Soil erosion

CONCLUSIONS

Some environmental impacts associated with the system of Interstate highways have been identified by previous studies, but a comprehensive list that has been grouped and ranked has not been found. Research emphasis has been placed on problems associated with air and water pollution resulting from vehicular emissions and vegetative modifications along with soil erosion and wildlife changes and their effects on plant communities. Some attention has been given to visual and noise problems. These areas are generally the most noticeable and are thus the most likely to be funded for research.

Additional impacts, some of which appear to be significant, are caused by construction and maintenance activities as well as public use of the four-lane roads. These impacts have been identified and arranged into more generic groups in the interest of simplicity.

This action, combined with the application of the ranking system to those impacts, allows problems and opportunities associated with the construction and operation of the highways to be identified. By using two analysis schemes (Alternatives 1 and 2), this information can be effectively used in the identification and investigation of problems in a logical and systematic way.

It was not the intent of this study to assign positive or negative values to the impacts. It is noted that a given impact could be viewed either way by different individuals or groups. It is now possible, however, to begin work to identify the benefits of and detriments to the highway system and to formulate problem statements.

In summary, environmental impacts associated with the development, maintenance, and use of the Interstate highway system have been identified. These impacts have been grouped in several different ways, each having a specific application, and they have been ranked by their relative significance in accordance with a system that has been devised. It is possible to group the impacts in a variety of categories as an aid to problem identification and development of strategies for problem solution, mitigation, or other management applications.

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