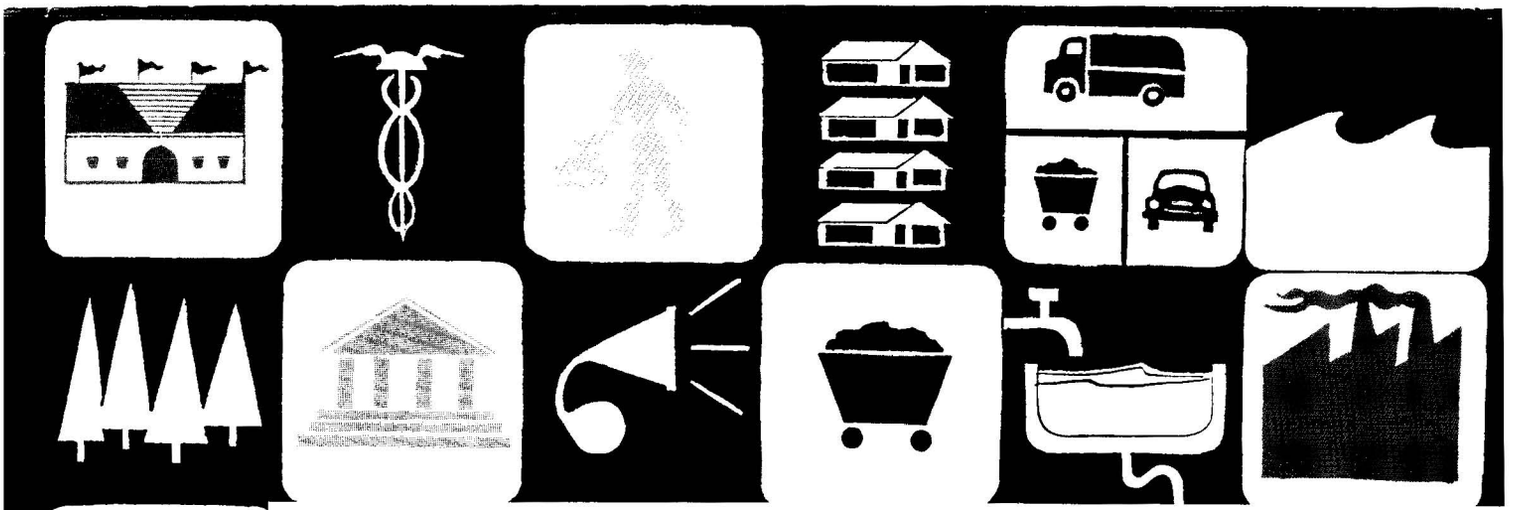
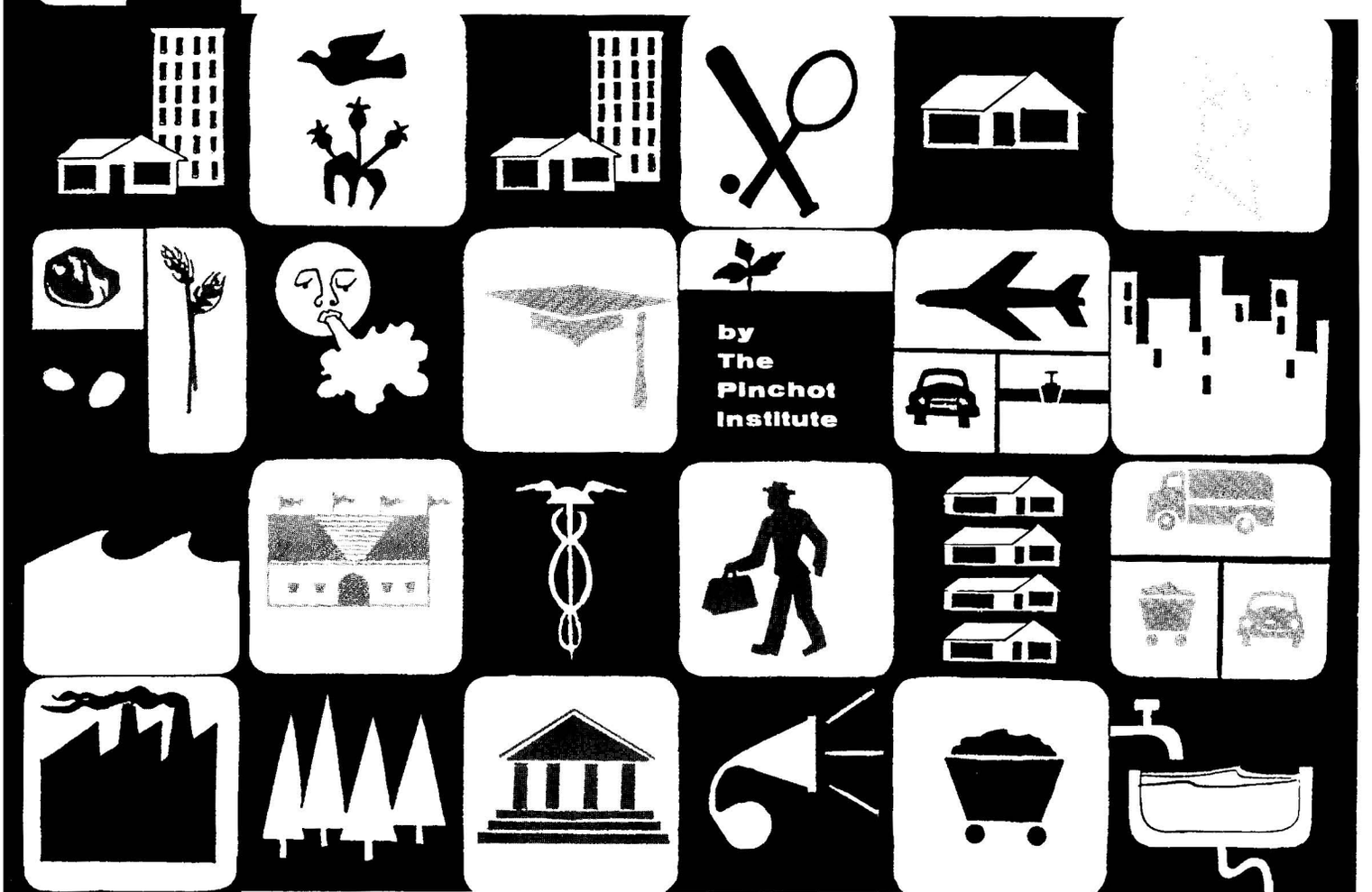


The PINCHOT INSTITUTE SYSTEM for ENVIRONMENTAL FORESTRY STUDIES



by
The
Pinchot
Institute

USDA FOREST SERVICE GENERAL TECHNICAL REPORT NE-2
1973

NORTHEASTERN FOREST EXPERIMENT STATION, UPPER DARBY, PA.
FOREST SERVICE, U.S. DEPARTMENT OF AGRICULTURE
WARREN T. DOOLITTLE, DIRECTOR

"Environment is not an abstract concern, or simply a matter of aesthetics, or of personal taste—although it can and should involve all of these as well. Man is shaped to a great extent by his surroundings. Our physical nature, our mental health, our culture and institutions, our opportunities for challenge and fulfillment, our very survival—all of these are directly related to and affected by the environment in which we live. They depend upon the continued healthy functioning of the natural systems of the Earth."

RICHARD M. NIXON
August 1970

The PINCHOT INSTITUTE SYSTEM for ENVIRONMENTAL FORESTRY STUDIES

by
The Pinchot Institute

ABSTRACT

THIS PAPER describes a prototype system for research planning and administration to meet man's needs for forest vegetation in and around metropolitan areas. The system's components involve social needs or services, technological developments, environmental effects, and the locales where the services, developments, and environmental effects occur. The system is organized from three different perspectives—a social-need viewpoint, a supply-response viewpoint, and an environmental-effect viewpoint. A series of diagrams are presented that show, for each of the three viewpoints, how to formulate and evaluate problems suggested by combinations of various components in the system. Problems that are relevant to the system are those that can be solved by one or more of the following kinds of ecological manipulation procedures of natural forest stands throughout Megalopolis: change or maintain species composition, alter or preserve the density, improve or maintain productivity of an area, and rearrange or hold constant spacial patterns. Examples are provided on how the system can be applied, and various suggestions are made on how to improve it.

MANUSCRIPT SUBMITTED FOR PUBLICATION 8 AUGUST 1972.

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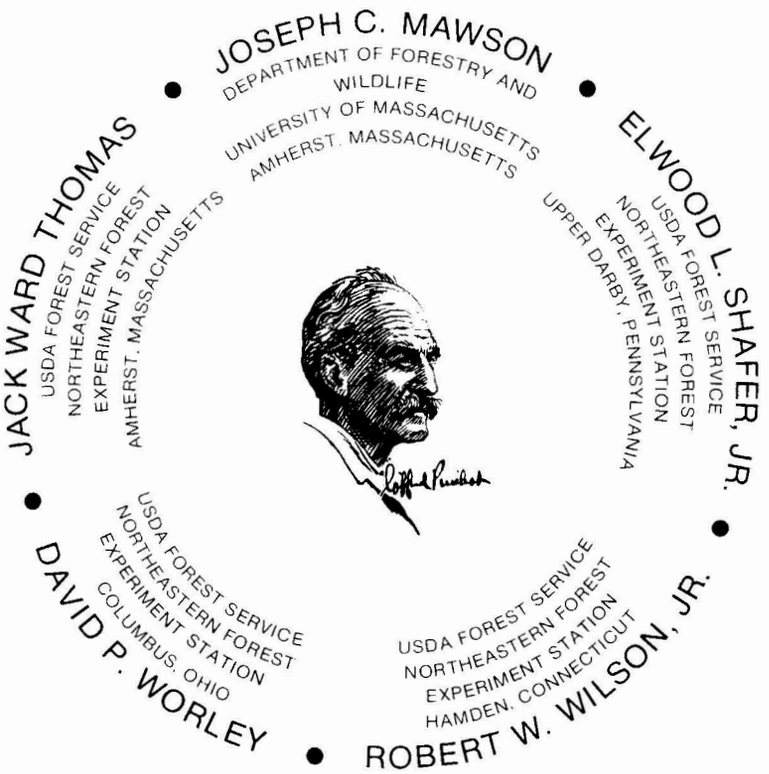
FOREWORD

THE RESEARCH-PROGRAM development and evaluation system described in this report was developed by an interdisciplinary team of the Pinchot Institute for Environmental Forestry Studies. The members feel that environmental research problems are best attacked by a team effort and that such an effort will be increasingly necessary in research efforts dealing with the interaction of man and his environment. This report is a fruition of that team effort. We believe that our prototype system for research planning and administration can be used, following appropriate modifications, by other disciplines and other government and private institutions in the conduct and administration of almost any type of research dealing with man-resource environmental problems.



A CRISIS

LIKE the Four Horsemen of the Apocalypse —harbingers of war, pestilence, famine, and death—four great threats today confront the ecology of the densely populated Megalopolis of the Northeast: water pollution, air pollution, soil erosion, and destruction of flora-fauna relationships.

In responding to this environmental crisis throughout Megalopolis, the most significant challenges to science are:

1. To establish a systematic research strategy for solving the relevant problems.
2. To set associated research priorities to organize scarce research resources.
3. To proceed, as quickly as possible, with the required research.

To do this, an overall systematic approach is needed that is related to social needs, that considers social controls as devices to achieve these needs, and that stabilizes or improves natural ecosystems required to enhance the social wellbeing of man.

Such a system has been developed by the Pinchot Institute.

THE PINCHOT INSTITUTE

The Pinchot Institute for Environmental Forestry Studies, an interdisciplinary research division of the U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station, was created in 1970 to help improve—through environmental forestry research—human environments in the densely populated areas of the Northeast.

Environmental forestry involves those aspects of resource management dealing with man's needs for, and association with, the tangible and intangible values of forest vegetation in and around metropolitan areas. Such forested vegetation involves a wide range of forested conditions—ranging from city park environments to green belts and woodlands in the rural areas that intersperse the huge, sprawling, urban complexes throughout Megalopolis.

Where this forest vegetation exists, it modifies and improves living conditions, furnishes sites for recreation, protects and maintains water supplies, provides sanctuary for wildlife, screens industrial and highway developments, abates noise, reduces temperature, filters dust, fumes, and other atmospheric impurities, and enhances the setting for aesthetic enjoyment.

The concept of *environmental forestry*, like that of *economics*, cuts across the full fabric of our national life on a broad range of resource-allocation decisions involving such diversified social services and needs as transportation, energy production, housing, employment, health and welfare, education, recreation, and technological development.

The Pinchot Institute involves a coordinated effort of university and Forest Service scientists working together to enhance the social wellbeing of man through the proper management of forest-resource values and effects in and around densely populated areas. The charter of the Institute's Consortium for Environmental Forestry Research describes the organizational procedures for accomplishing a coordinated forest Service-university research effort (appendix I). The Institute's objective is to provide information for megalopolitan decision-makers to help them maintain a proper ecological balance between urban man and his surrounding forest environments.

A STRATEGY

Establishing and administering a comprehensive environmental-research program such as that of the Pinchot Institute might be compared to playing three-dimensional chess. The easiest move is to develop individual research studies within a general problem area. This approach, which is common in environmental research, is like knowing no more about the game than one move that an individual chessman can make.

Deciding on how several research studies should be grouped to provide a satisfactory solution to any one overall general problem area of megalopolitan man parallels the chess player's need to understand how a series of moves on the board complement one another and how one move may affect other moves.

Understanding how groups of studies in each of several research-problem areas fit into a comprehensive research program is similar to the chess player's need to develop a strategy that allows him to play the game in several dimensions at the same time.

And finally, insuring that the emphasis of a research program is relevant to the total social needs and technological developments of society parallels a chess player's need to know not only how his own, but also how the past, present, and future moves of other players in the game affect the patterns of play.

Our thesis is that, in environmental forestry research, too much attention has been devoted to planning and carrying out the details of individual research studies or groups of studies before adequate effort has been expended in understanding how such studies fit into an overall research program, and how these same studies are oriented to social needs and technological developments.

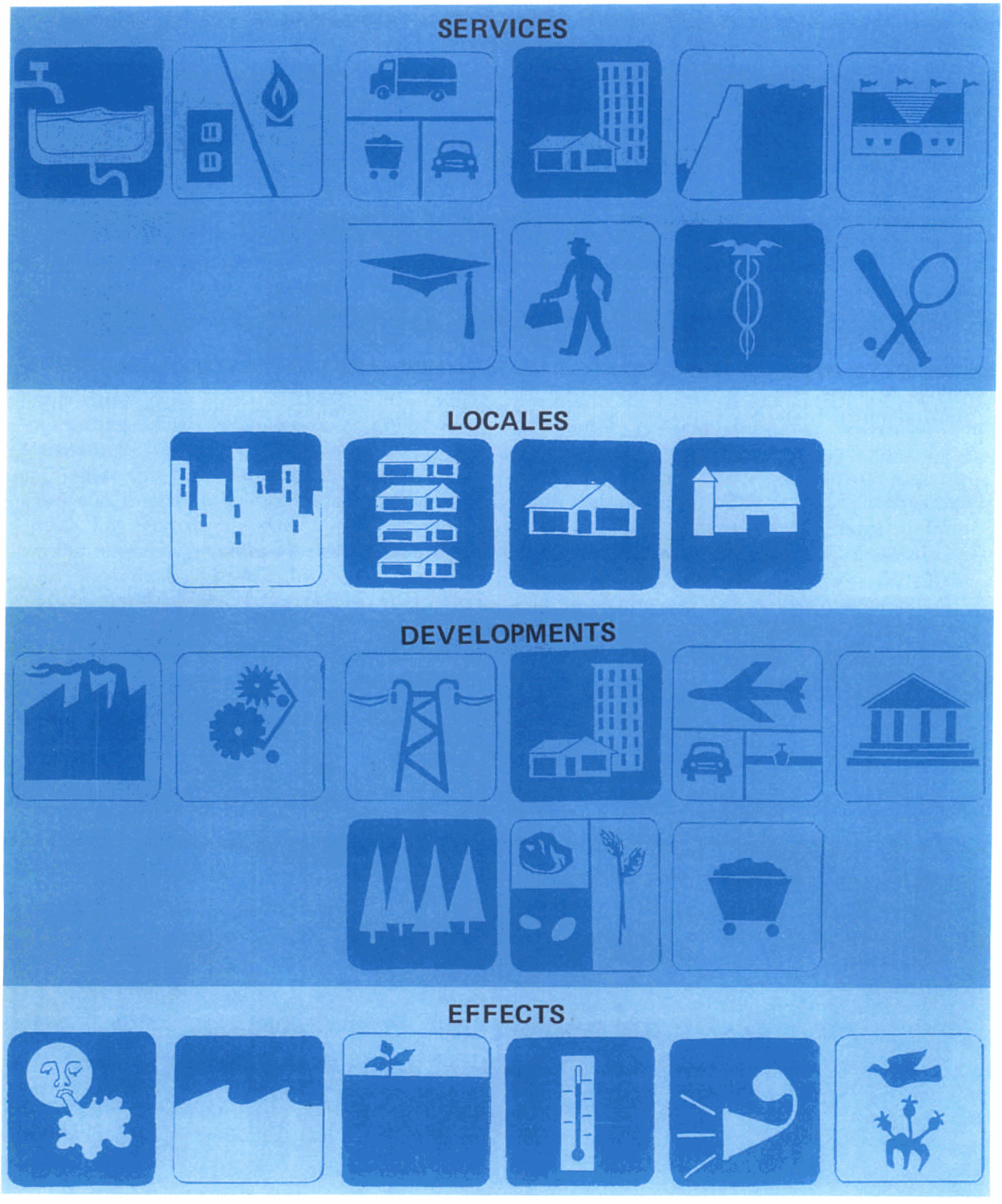
As environmental scientists, we have been playing in a kind of three-dimensional chess game, but we usually have concentrated our

efforts on only one dimension of the playing surface. In a sense, we have identified the capabilities of a few chess pieces and have developed a few moves on a chessboard that resembles the covers of this publication. However, the odds of winning the total game with such a strategy are extremely small. We believe that the odds of winning—meeting the real needs of decision-makers—can be increased by changing our strategy to one that calls for recognizing the interconnectedness of the problems, the ramifications of the solutions, and the need to prescribe comprehensive research approaches.

Our purpose here is to describe a strategy, or system, for either defining research problem areas for investigation, or for evaluating the effects of social services and technologies on natural forest-resource ecosystems in light of the overall objectives of the Pinchot Institute.

This is a first-generation system, like a first-generation computer system containing vacuum tubes that could not handle overloads. It has in it a series of information vacuums that we have purposely passed through in tracing the entire flow of the system. At the same time, we recognize that these information vacuums require considerable research and improvement to define important details and interrelationships within the system.

In much the same way that research on transistors and microminiaturization was required to advance computer technology to second- and third-generation systems, additional research is needed on the Pinchot Institute research system to make it more compatible with the present and future needs of metropolitan planners and managers.


SERVICES
LOCALES
DEVELOPMENTS
EFFECTS

THE SYSTEM

The proposed system for Pinchot Institute research deals with the man-dominated section of a forest environment ecosystem. The system is based on the following assumptions:

> *All changes or status quo conditions in an environmental forestry system can and will be evaluated in terms of services (or needs) required by man. These services are provided in a particular locale through the establishment of technological developments that eliminate or produce certain environmental effects (table 1).*

Thus the primary components of the system are *service, locale, development,* and *environmental effect.* (See appendix II for definitions.)

The key elements listed for each component in the system (table 1) are neither mutually exclusive nor exhaustive of all possibilities, but they serve both to show the scope of the system and to focus on the important elements in each component.

At the outset, it is well to recognize that the system is people-centered and subject to criticism from a purely ecological viewpoint. Any research framework such as this, which deals with environmental problems in the megalopolitan Northeast, could not be otherwise. This intensely human-influenced environment will be a product of man—for either good or ill.

Table 1.—Components of the system for Pinchot Institute research

SERVICES required by man	LOCALES where the services are provided	Technological DEVELOPMENTS used to provide the services	Environmental EFFECTS
Physical infrastructure:			
1. Water supply & waste disposal	1. Urban	1. Heavy industry	1. Air quality
2. Energy provision	2. Suburban	2. Light industry	2. Water
3. Transportation	3. Exurban	3. Power	3. Soil
4. Housing	4. Rural	4. Residences	4. Temperature and humidity
5. Flood control		5. Transportation	5. Noise
6. Recreational structures		6. Cultural and institutional structures	6. Flora & fauna
Institutional infrastructure:		7. Forestry	
7. Education		8. Agriculture	
8. Employment		9. Mining	
9. Health & welfare			
10. Recreational activity			

RESEARCH PACKAGING AND PRIORITY ASSIGNMENTS

The key elements (table 1) were arranged into all possible four-way combinations to contain one key element per component. For example, going from left to right in table 1, the first combination would be:

Service	*Locale*	*Development*	*Effect*
Water supply	Urban	Heavy industry	Air quality

In terms of the numbers that identify these items, this would be designated as a 1-1-1-1 package.

In examining any four-item possibility, we intuitively retained only those packages in which one or more research problems suggested by a package could be solved by one or more of the following four kinds of ecological manipulation procedures:

1. Change or maintain species *composition* of vegetation. Example: The health and welfare (service 9) of youth in urban (locale 2) residences or ghettos (development 4) can be improved in summer by exposing them to maintained *compositions* of water and flora and fauna (environmental effects 2 and 6) in forests near cities.

2. Alter or preserve the *density* of vegetation. Example: The construction of a highway (development 5) in urban areas (locale 1) to provide transportation (service 3) produces noise and air pollution (environmental effects 1 and 5) that can be significantly abated by altering the *density* of vegetation near the higway.

3. Improve or maintain the *productivity* of an area. Example: Disposal of wastes (service 1) from residential areas (development 4) in urban rivers (locale 1) pollutes water quality (environmental effect 2). The problem can be alleviated by transporting treated wastes to nearby forest environments and spraying the affluent on the soil, which in turn filters out the nutrients and improves the *productivity* of the forest so that it can continue to act as a natural filtering agent to purify waste water.

4. Rearrange or hold constant *spacial patterns* of vegetation. Example: *Spacial patterns* of vegetation can be arranged so as to enhance the aesthetic quality of flora and fauna (environmental effect 6) at cultural and institutional structures (development 6) designed for recreational activities (service 10) in urban situations (locale 1).

The four constraints just listed relate a given research package (four-way combination of items in table 1) to man-forest interactions. The four-way packages generated specify man's role in these interactions. We incorporated the forest-related aspect by assigning a forestry-related solution constraint to any given package. In this way we filtered from all total possible packages only those packages in which forest-related variables may help solve problems of megalopolitan man.

This procedure for matching environmental forestry-research solutions to four-way combinations of services, locales, developments, and effects corresponds to the way a computer weeds out all the wrong answers until only the right answers are left. The magnitude of such weeding operations in this case dealt with taking the initial 2,160 possible four-way combinations of items and finally accepting only 321 that were meaningful in terms of Pinchot Institute objectives and constraints.

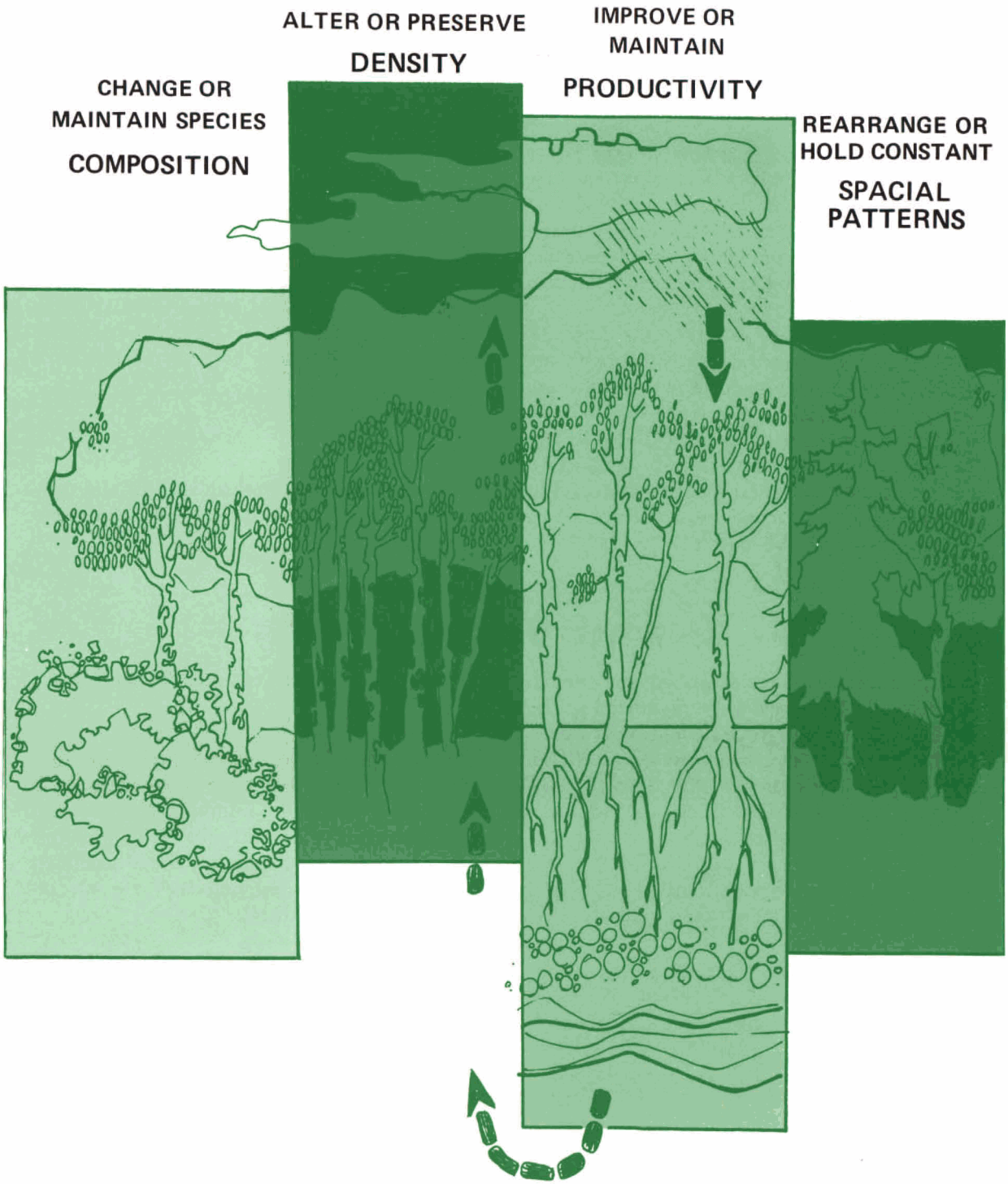
Each of these 321 packages was then assigned either a high or low priority rating, depending on the social-needs urgency for research in that particular package and the research.

To be rated high priority, a package had to meet two criteria:

1. There was an urgent social need for research within the package problem area.
2. There seemed to be a reasonable probability of success for associated research needs.

A low priority was given if a package met only one or none of these two criteria but still was a feasible area for research.

It should be recognized that the decisions made in the weeding and priority assignment were subject to the biases of the multidisciplin-


ALTER OR PRESERVE
DENSITY
IMPROVE OR
MAINTAIN
PRODUCTIVITY
CHANGE OR
MAINTAIN SPECIES
COMPOSITION
REARRANGE OR
HOLD CONSTANT
SPACIAL
PATTERNS

ary team involved. Therefore the packages that were eliminated are not necessarily meaningless, and any user of this system should be prepared to redirect any package that can be rationally proved viable for consideration. However, we believe that it would be rare to find such items in a search of both high- and low-priority items. In fact, low-priority items were retained in the system as a fail-safe insurance against elimination of viable research packages that may be explored in further refinements of the systems.

The procedure for selecting the final 321 packages was conducted partly by hand and partly by programming decision rules in a computer. The output at this stage was a list or catalog of problem packages (table 2). In a computer output display, though we can trace the packages through the entire matrix, it is difficult to see quickly the relationships among large segments of the matrix.

Table 2.—Partial list of acceptable research packages from computer output

Services	Locale	Development	Effect
HEALTH	URBAN	HEAVY	AIR
WATER	URBAN	HEAVY	SOIL
WATER	URBAN	HEAVY	NOISE
RECR	URBAN	HEAVY	NOISE
HEALTH	URBAN	POWER	AIR
ENERGY	URBAN	POWER	NOISE
RECR	URBAN	POWER	NOISE
HOUSING	URBAN	RESID	AIR
HOUSING	URBAN	RESID	NOISE
RECR	URBAN	RESID	NOISE
HOUSING	URBAN	RESID	FLORA
RECR	URBAN	RESID	FLORA
HEALTH	URBAN	RESID	FLORA
RECR	URBAN	RESID	FLORA
HOUSING	URBAN	TRANS	AIR

Our next step was to develop a display system that would enable us to use this information easily.

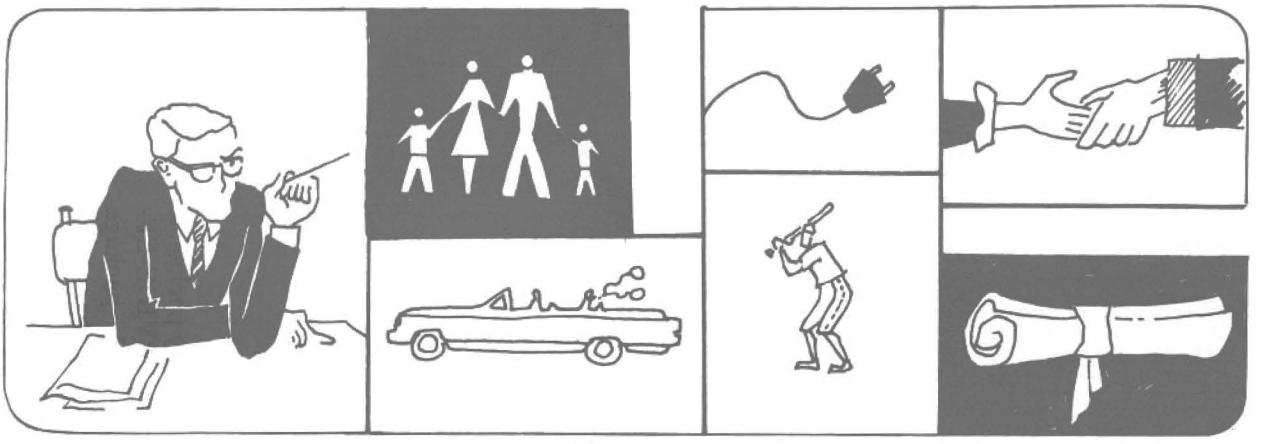
THREE VIEWPOINTS

The system we have described was cumbersome to use. It needed to be organized so that complex research problems could be evaluated comprehensively and examined from different viewpoints. Therefore we arranged the 321 packages in three different ways to reflect the following three viewpoints:

1. A social-need viewpoint
2. A supply-response viewpoint
3. An environmental-effect viewpoint

These three perspectives of the system contain exactly the same research packages, both in makeup and in total number, but the packages are grouped differently for each viewpoint. From here on, it is not the individual packages that are important, but how they are interrelated and conceptualized.

SOCIAL — NEEDS VIEWPOINT



First, we can view the system from the standpoint of the policy-maker, decision-maker, or administrator whose primary responsibility is to provide services for urban man's needs. Here our major concern is policy formulation and decision-making about man-environment interactions. Indications of social needs within one or more of the services listed (table 1) include such elements as:

Land values
Tax structures
Access patterns
Supply and demand trends
Ownership patterns
Labor or professional union policies
Ethnic and cultural values
Congressional attitude
Past legislation (federal, state, local)
Interstate regulations
Regional compacts
Public opinions and attitudes
Local ordinances
Institutional objectives
Past judicial precedences
Pending law suits
Pressure-group actions

By keying first on the services column (table 1), the system can be segmented as shown in figures 1 to 9. Ten services are listed in table 1, but transportation was not included for this particular viewpoint situation.

When the system is portrayed in this manner, the flow through the system can be coded as:

SERVICES ▶ EFFECTS ▶ DEVELOPMENTS ▶ LOCALES

For each social service in figures 1 to 9 the relevant relationships are shown among the service, environmental effect, development, and locale components of the system where natural vegetation management may ameliorate related adverse environmental effects.

THE SYSTEM FROM A SOCIAL-NEED VIEWPOINT

A given social service appears in the center of each figure. Interrelated environmental effects, technological developments, and locale packages are flow-charted outward from the center by relevant groupings.

Locales shown on the outer rim of each figure are coded as follows:

1. Urban
2. Suburban
3. Exurban
4. Rural

An asterisk identifies high-priority packages. For example, in figure 1 the SERVICE-EFFECT-DEVELOPMENT-LOCALE package labeled 1-2-7-3 is a high-priority package.

ARRANGEMENT OF THE SYSTEM FROM A SOCIAL NEEDS VIEWPOINT

SERVICES REQUIRED BY MAN	ENVIRONMENTAL EFFECTS	TECHNOLOGICAL DEVELOPMENTS USED TO PROVIDE THE SERVICES	LOCALES WHERE THE SERVICES ARE PROVIDED
PHYSICAL INFRA–STRUCTURE 1. WATER SUPPLY & WASTE DISPOSAL 2. ENERGY PROVISION 3. TRANSPORTATION 4. HOUSING 5. FLOOD CONTROL 6. RECREATIONAL STRUCTURES INSTITUTIONAL INFRA–STRUCTURE 7. EDUCATION 8. EMPLOYMENT 9. HEALTH & WELFARE 10. RECREATIONAL ACTIVITY	1. AIR QUALITY 2. WATER 3. SOIL 4. TEMPERATURE AND HUMIDITY 5. NOISE 6. FLORA & FAUNA	1. HEAVY INDUSTRY 2. LIGHT INDUSTRY 3. POWER 4. RESIDENCES 5. TRANSPORTATION 6. CULTURAL AND INSTITUTIONAL STRUCTURES 7. FORESTRY 8. AGRICULTURE 9. MINING	1. URBAN 2. SUBURBAN 3. EXURBAN 4. RURAL

FIGURE 1

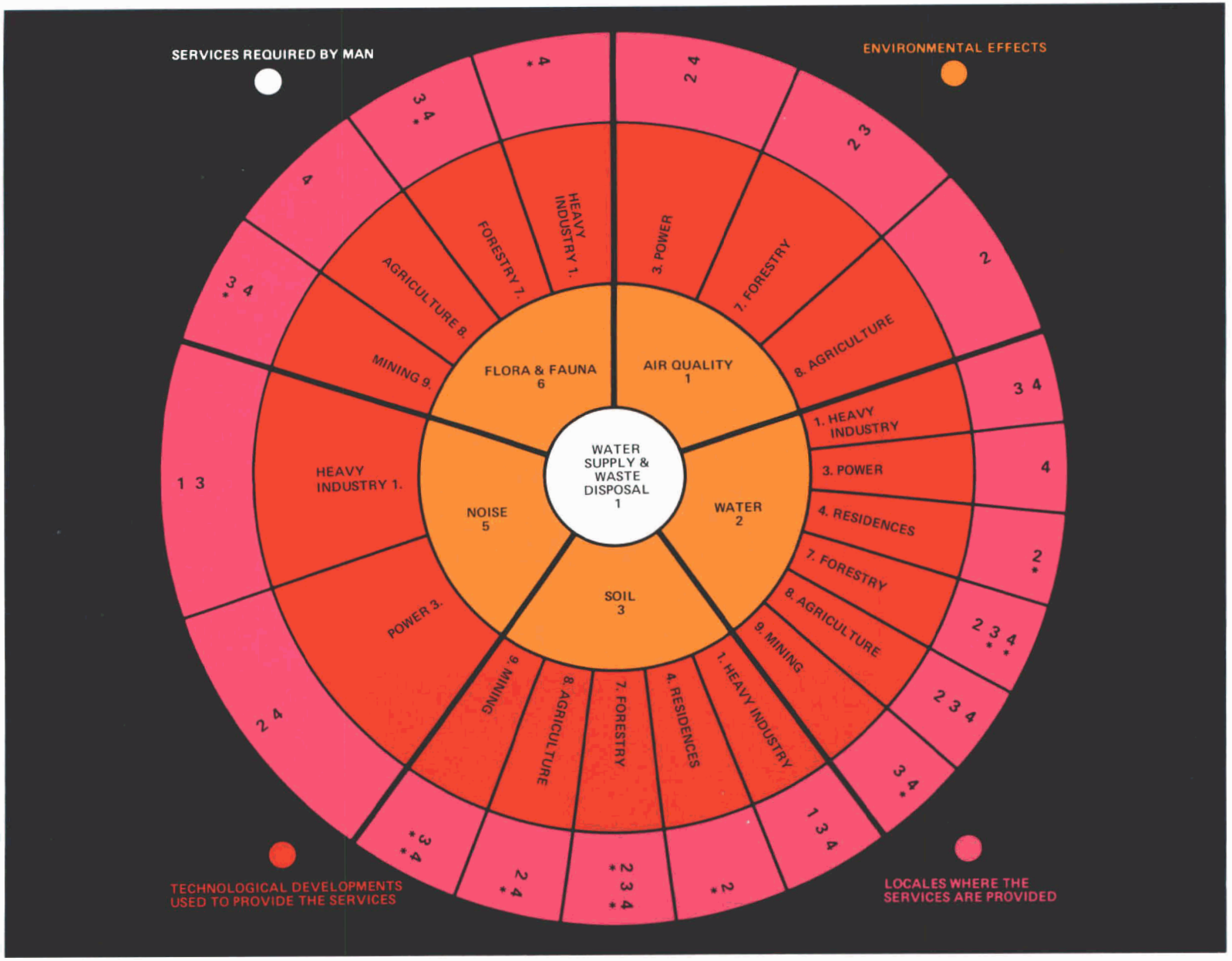

SERVICES REQUIRED BY MAN
ENVIRONMENTAL EFFECTS
TECHNOLOGICAL DEVELOPMENTS USED TO PROVIDE THE SERVICES
LOCALES WHERE THE SERVICES ARE PROVIDED
WATER SUPPLY & WASTE DISPOSAL 1
AIR QUALITY 1
WATER 2
SOIL 3
NOISE 5
FLORA & FAUNA 6
HEAVY INDUSTRY 1.
POWER 3.
MINING 9.
AGRICULTURE 8.
FORESTRY 7.
1. HEAVY INDUSTRY
3. POWER
4. RESIDENCES
7. FORESTRY
8. AGRICULTURE
9. MINING

FIGURE 2

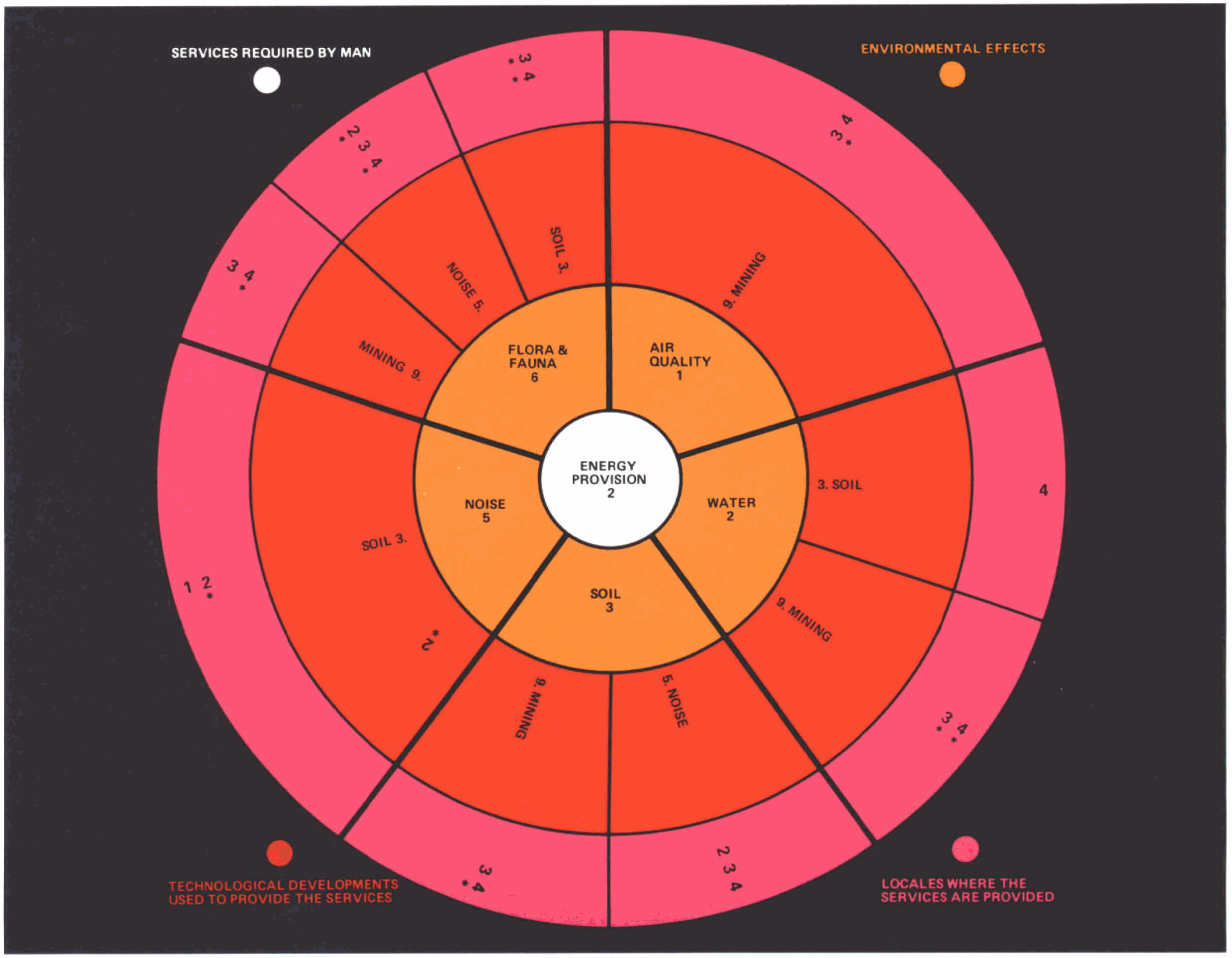

SERVICES REQUIRED BY MAN
ENVIRONMENTAL EFFECTS
TECHNOLOGICAL DEVELOPMENTS USED TO PROVIDE THE SERVICES
LOCALES WHERE THE SERVICES ARE PROVIDED
ENERGY PROVISION 2
FLORA & FAUNA 6
AIR QUALITY 1
WATER 2
NOISE 5
SOIL 3
9. MINING
3. SOIL
4
SOIL 3.
NOISE 5.
MINING 9.
9. MINING
5. NOISE
SOIL 3.
9. MINING
3. SOIL
4
* 3 4 *
* 2 3 4 *
3 4 *
3 4 *
* 2
1 2 *
3 4 *
2 3 4

FIGURE 3

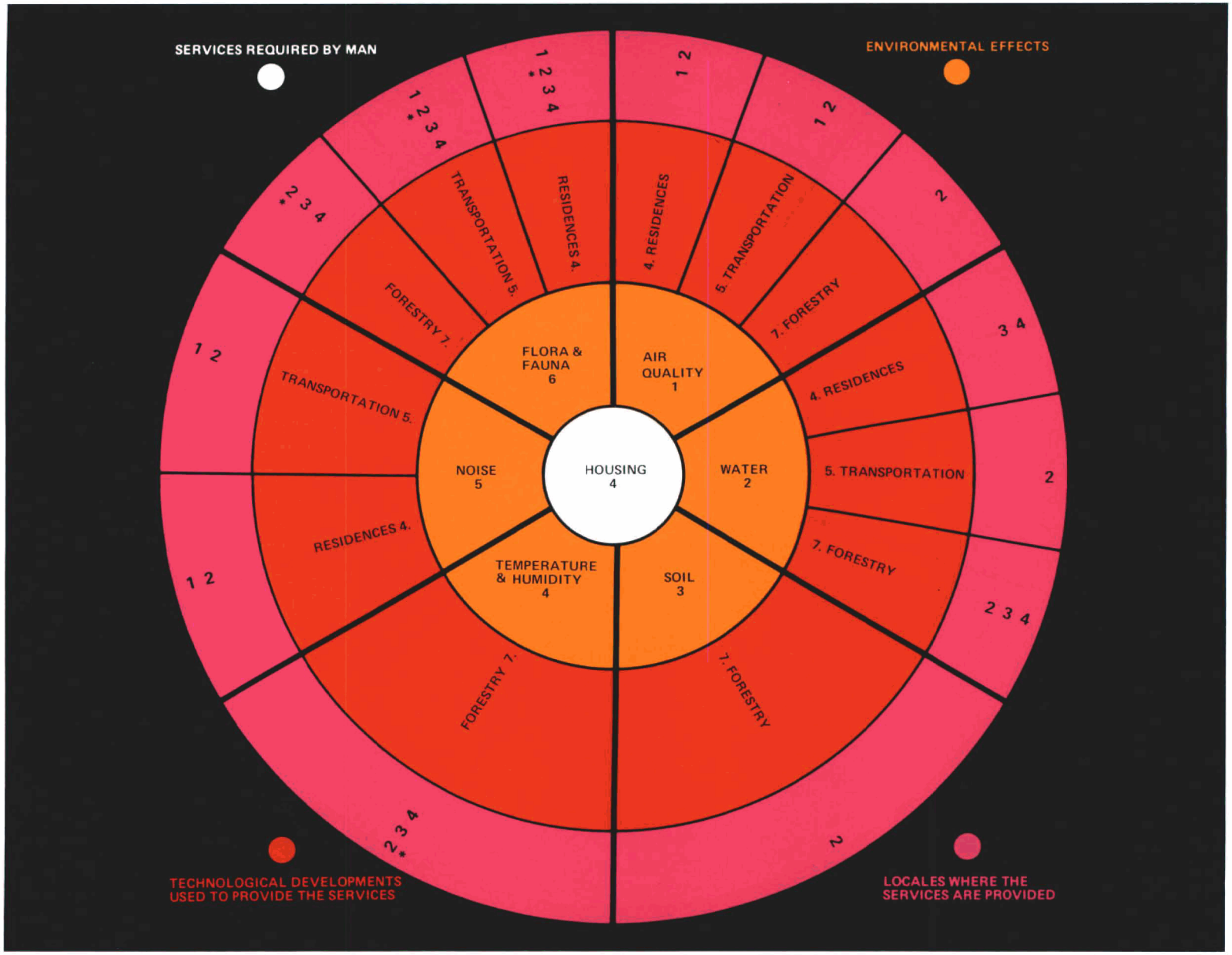

SERVICES REQUIRED BY MAN
ENVIRONMENTAL EFFECTS
TECHNOLOGICAL DEVELOPMENTS USED TO PROVIDE THE SERVICES
LOCALES WHERE THE SERVICES ARE PROVIDED
HOUSING 4
AIR QUALITY 1
WATER 2
SOIL 3
TEMPERATURE & HUMIDITY 4
NOISE 5
FLORA & FAUNA 6
RESIDENCES 4.
TRANSPORTATION 5.
FORESTRY 7.
1 2 * 3 4
1 2
2
3 4
2 3 4
2 3 *

FIGURE 4

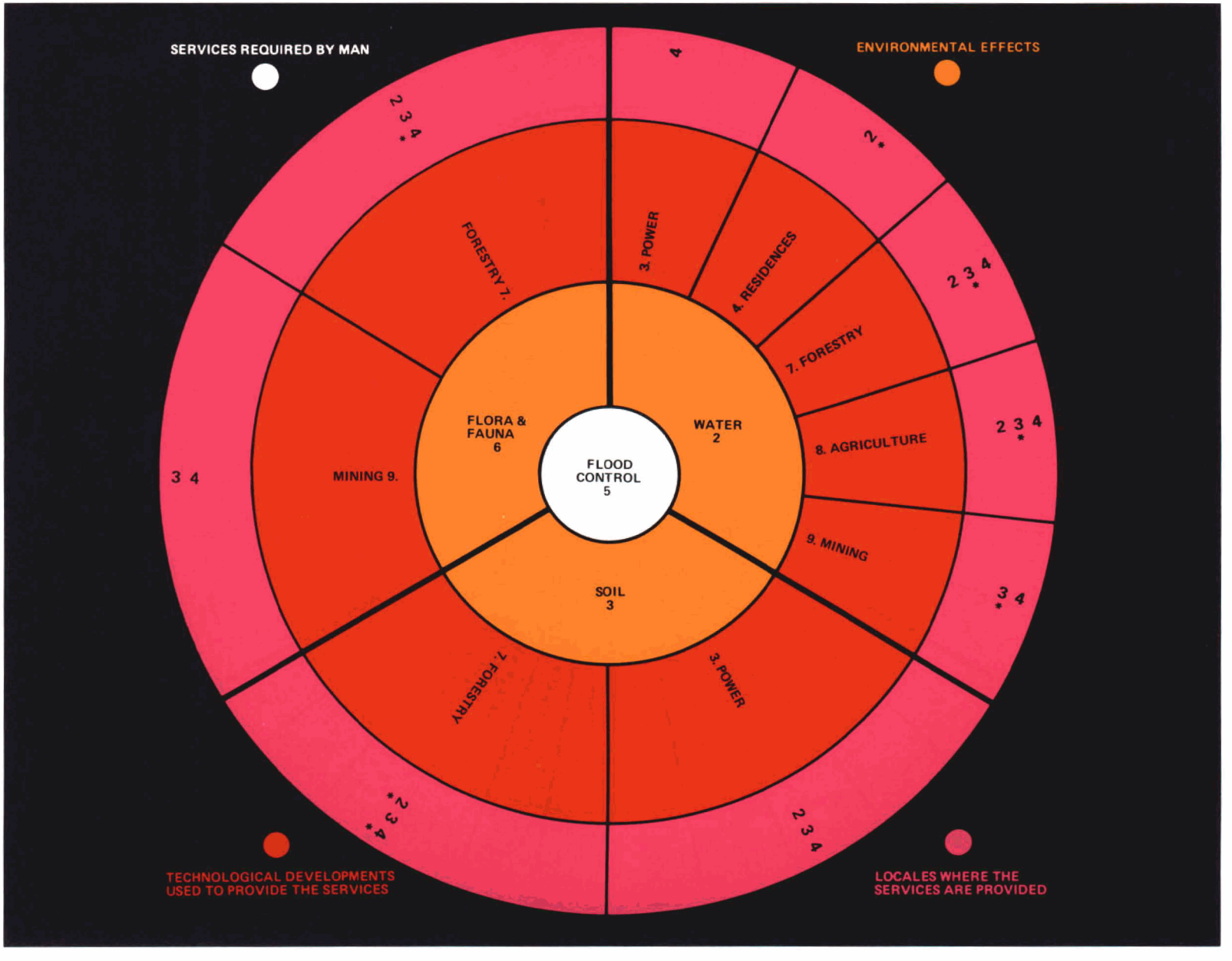

SERVICES REQUIRED BY MAN
ENVIRONMENTAL EFFECTS
TECHNOLOGICAL DEVELOPMENTS USED TO PROVIDE THE SERVICES
LOCALES WHERE THE SERVICES ARE PROVIDED
FLOOD CONTROL 5
WATER 2
SOIL 3
FLORA & FAUNA 6
3. POWER
4. RESIDENCES
7. FORESTRY
8. AGRICULTURE
9. MINING
FORESTRY 7.
MINING 9.
7. FORESTRY
3. POWER
4
2 *
2 3 4 *
2 3 4 *
2 3 4 *
3 4 *
2 3 4
2 3 4
3 4
4 * 2 3

FIGURE 5

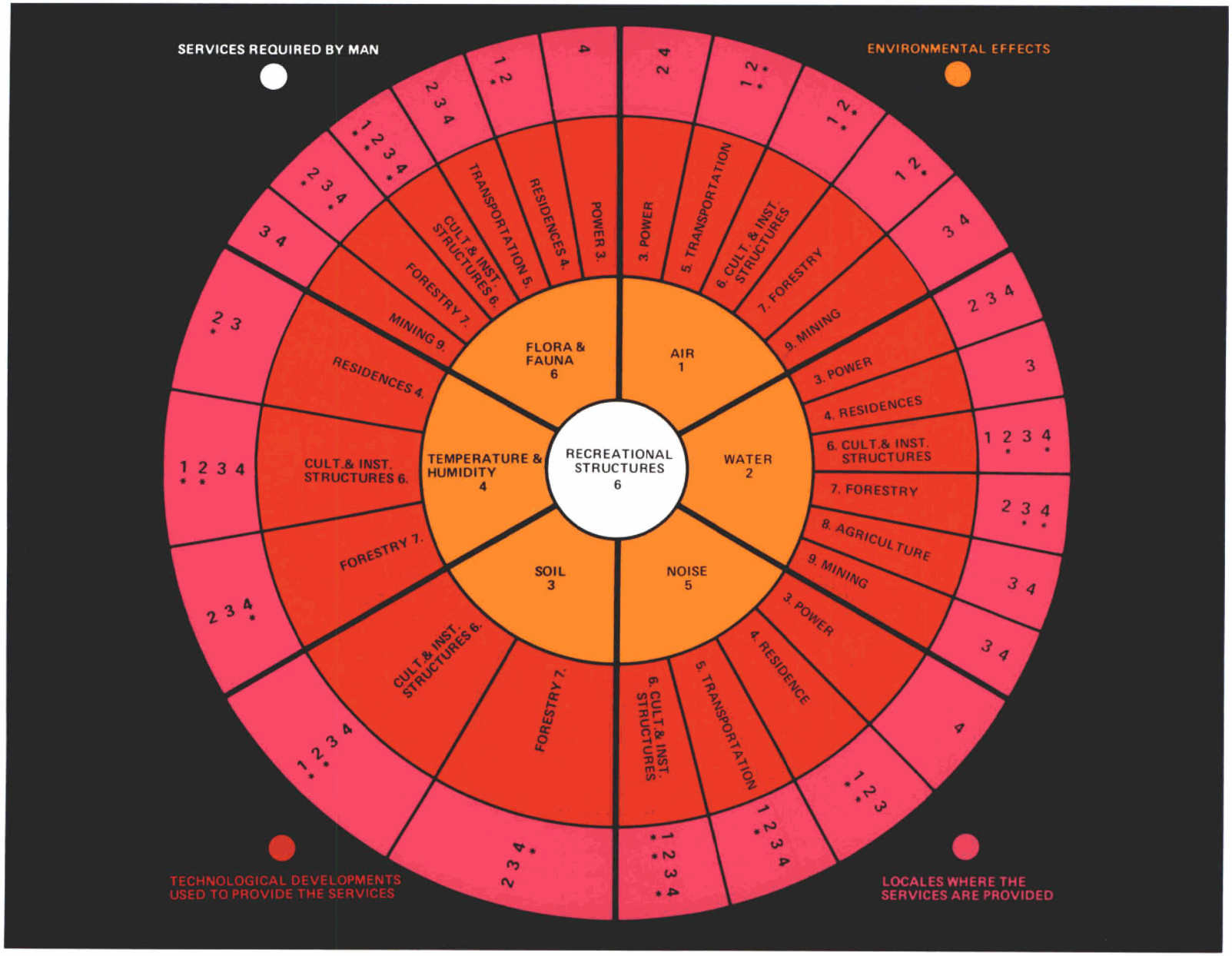

SERVICES REQUIRED BY MAN
ENVIRONMENTAL EFFECTS
TECHNOLOGICAL DEVELOPMENTS USED TO PROVIDE THE SERVICES
LOCALES WHERE THE SERVICES ARE PROVIDED
RECREATIONAL STRUCTURES 6
FLORA & FAUNA 6
AIR 1
WATER 2
NOISE 5
SOIL 3
TEMPERATURE & HUMIDITY 4
POWER 3.
RESIDENCES 4.
TRANSPORTATION 5.
CULT.& INST. STRUCTURES 6.
FORESTRY 7.
MINING 9.
3. POWER
5. TRANSPORTATION
6. CULT.& INST. STRUCTURES
7. FORESTRY
9. MINING
3. POWER
4. RESIDENCES
6. CULT.& INST. STRUCTURES
7. FORESTRY
8. AGRICULTURE
9. MINING
3. POWER
4 RESIDENCE
5 TRANSPORTATION
6. CULT.& INST. STRUCTURES
FORESTRY 7.
CULT.& INST. STRUCTURES 6.
FORESTRY 7.
CULT.& INST. STRUCTURES 6.
RESIDENCES 4.
MINING 9.

FIGURE 6

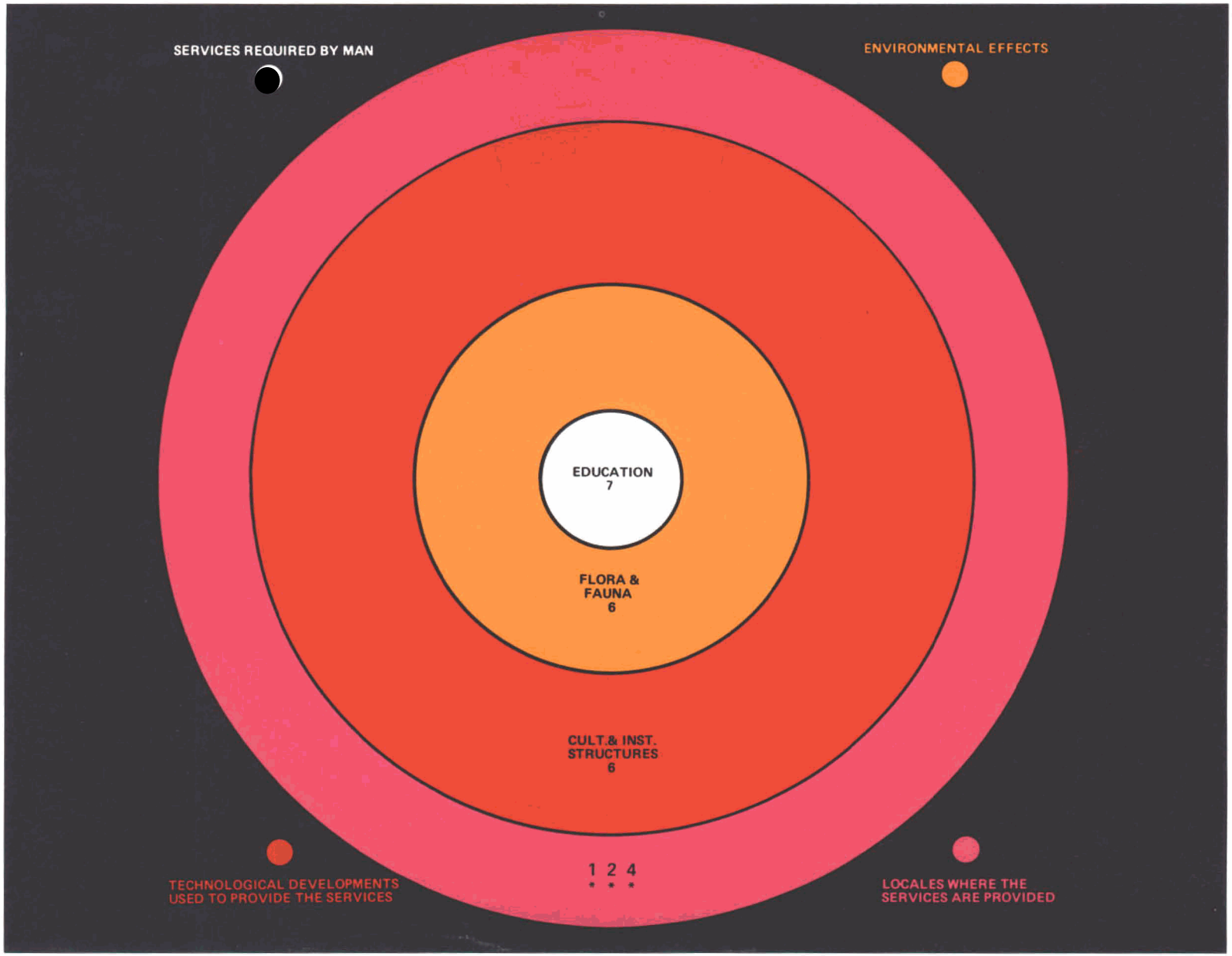

SERVICES REQUIRED BY MAN
ENVIRONMENTAL EFFECTS
EDUCATION
7
FLORA &
FAUNA
6
CULT.& INST.
STRUCTURES
6
1 2 4
* * *
TECHNOLOGICAL DEVELOPMENTS
USED TO PROVIDE THE SERVICES
LOCALES WHERE THE
SERVICES ARE PROVIDED

FIGURE 7


SERVICES REQUIRED BY MAN
ENVIRONMENTAL EFFECTS
4
4
4
4
4
4
FORESTRY 7.
7. FORESTRY
MINING 9.
8. AGRICULTURE
9. MINING
8. AGRICULTURE
7. FORESTRY
FLORA & FAUNA 6.
WATER 2
EMPLOYMENT 8
SOIL 3
TECHNOLOGICAL DEVELOPMENTS USED TO PROVIDE THE SERVICES
LOCALES WHERE THE SERVICES ARE PROVIDED

FIGURE 8

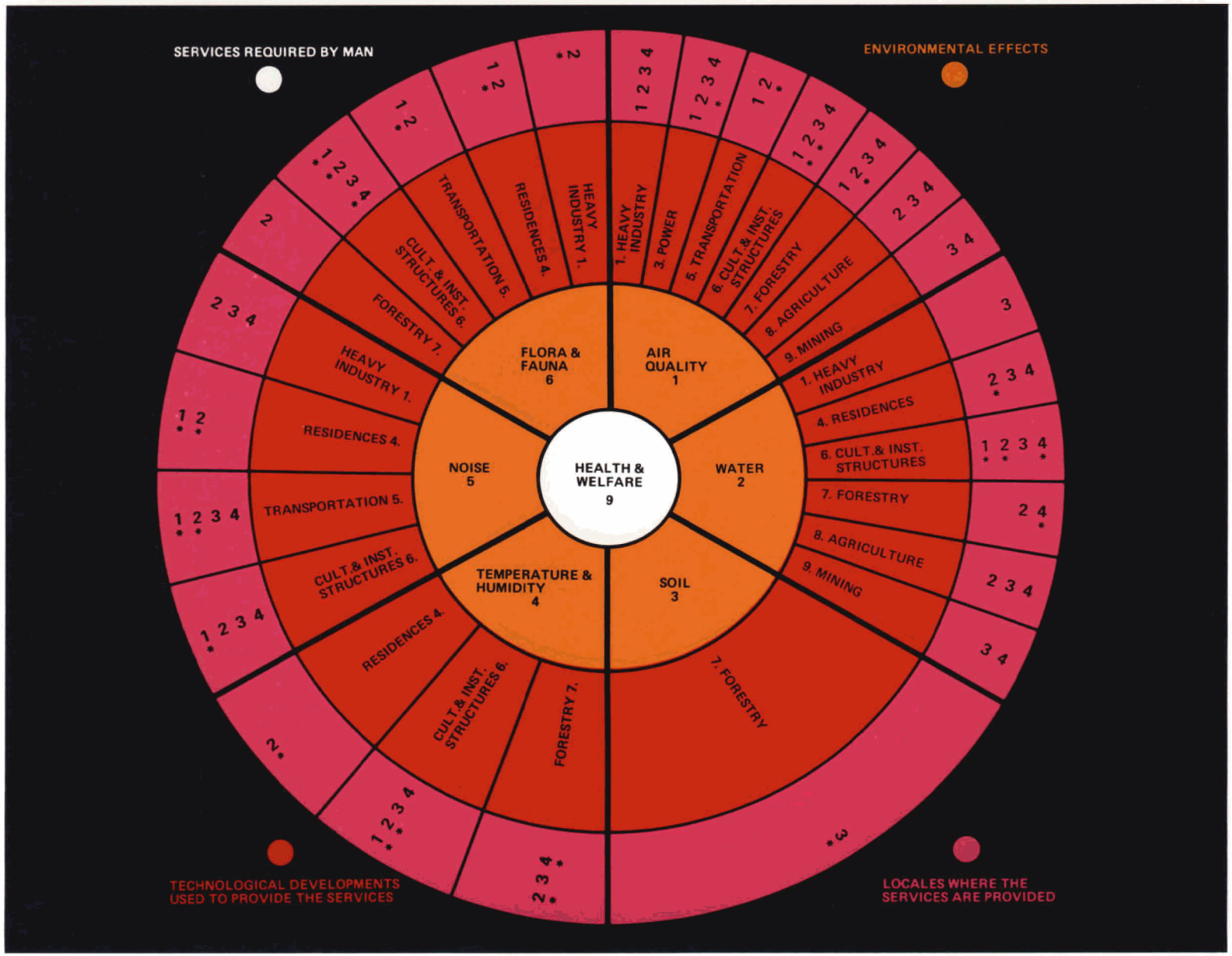
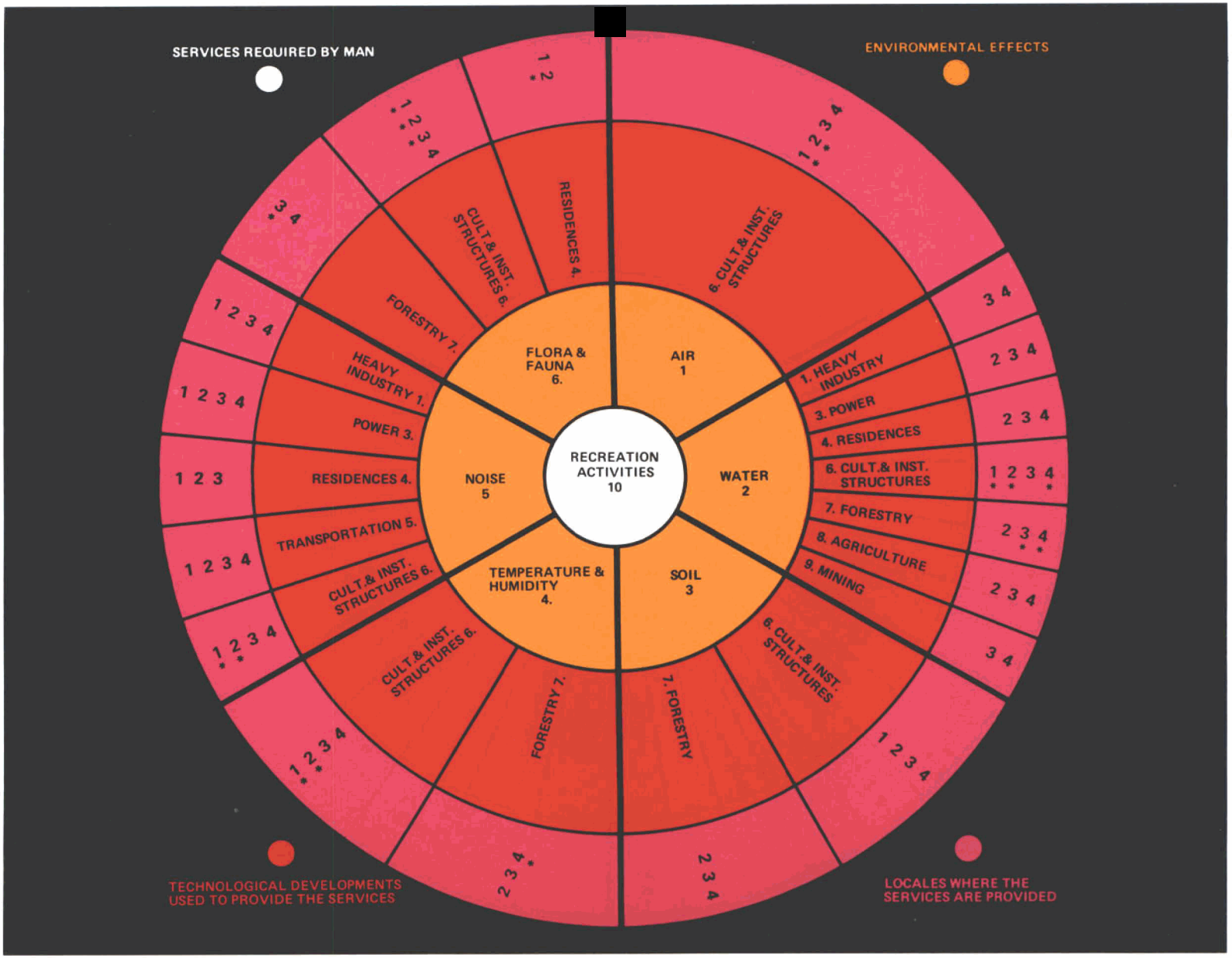

SERVICES REQUIRED BY MAN
ENVIRONMENTAL EFFECTS
TECHNOLOGICAL DEVELOPMENTS USED TO PROVIDE THE SERVICES
LOCALES WHERE THE SERVICES ARE PROVIDED
HEALTH & WELFARE 9
FLORA & FAUNA 6
AIR QUALITY 1
NOISE 5
WATER 2
TEMPERATURE & HUMIDITY 4
SOIL 3
HEAVY INDUSTRY 1.
RESIDENCES 4.
TRANSPORTATION 5.
CULT.& INST. STRUCTURES 6.
FORESTRY 7.
1. HEAVY INDUSTRY
3. POWER
5. TRANSPORTATION
6. CULT.& INST. STRUCTURES
7. FORESTRY
8. AGRICULTURE
9. MINING
4. RESIDENCES

FIGURE 9


SERVICES REQUIRED BY MAN
ENVIRONMENTAL EFFECTS
TECHNOLOGICAL DEVELOPMENTS USED TO PROVIDE THE SERVICES
LOCALES WHERE THE SERVICES ARE PROVIDED
RECREATION ACTIVITIES 10
FLORA & FAUNA 6.
AIR 1
NOISE 5
WATER 2
TEMPERATURE & HUMIDITY 4.
SOIL 3
RESIDENCES 4.
CULT.& INST. STRUCTURES 6.
FORESTRY 7.
HEAVY INDUSTRY 1.
POWER 3.
RESIDENCES 4.
TRANSPORTATION 5.
CULT.& INST. STRUCTURES 6.
1. HEAVY INDUSTRY
3. POWER
4. RESIDENCES
6. CULT.& INST. STRUCTURES
7. FORESTRY
8. AGRICULTURE
9. MINING