THE ENVIRONMENT IN ISRAEL

State of Israel
Ministry of the Environment

THE ENVIRONMENT IN ISRAEL

compiled and written by

Shoshana Gabbay

Jerusalem, 1994

Printed on recycled paper

"When the Holy One Blessed Be He
created the first man, He took him
and warned him about all the trees of
the Garden of Eden, saying:
See My works, how beautiful and perfect they are,
and all I created—I created for you.
Beware lest you spoil and destroy My world,
for if you will spoil it, there is no one to
repair it after you."
(Commentary on Ecclesiastes 7:28)

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TABLE OF CONTENTS

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Shoshana Gabbay

FOREWORD

When I assumed the position of Minister of the Environment on January 1st, 1993, I firmly resolved to change public perceptions concerning the environment, to upgrade environmental concerns in the scale of national priorities.

For decades, environmental issues were sidestepped in Israel. The country immersed itself in questions of survival. The hunger for development was all-encompassing. Today, we recognize that a state cannot be created on the foundations of destruction. If sustainable development is to be achieved, natural resources must be carefully managed and protected. Indeed, we have come to realize that environmental concerns are existential by their very nature, touching on survival itself.

In the year and a half which has elapsed since I began serving as Israel's Minister of the Environment, I have seen the seeds of change begin to take root and sprout. Environmental awareness has blossomed, environmental projects have multiplied, regional cooperation has begun to bud.

Perhaps our greatest opportunity for promoting environmental quality lies within the framework of the peace process. The Middle East, comprised of diverse geographic and climatic zones, constitutes a single environmental system which is particularly vulnerable to all forms of transboundary pollution. The people populating this fragile region are diverse as well, but over the past two years, since the initiation of the multilateral peace talks on the environment, they have been ready to transcend their differences in order to work together for a better environment. Representatives of Middle East nations have come together again and again to identify shared problems, formulate common solutions.

I believe that the environment holds the widest potential to serve as a meeting-ground among nations as they forge new paths toward sustainable development. In an interdependent world, phenomena such as acid rain, ozone depletion, desertification or marine pollution do not respect national borders. Regional and international problems must be addressed today, if destruction is to be avoided tomorrow.

Today, as we embark on the road toward peace, it is my hope and my conviction that our collective efforts will usher in a new era of peaceful coexistence and environmental well-being for all the people in this region.

Yossi Sarid
Minister of the Environment

INTRODUCTION

Environmental awareness is a prerequisite for environmental improvement. This assumption stood at the base of Agenda 21, the global plan for sustainable development which was adopted at the Rio Earth Summit. It also stood at the base of my own first initiative as Director General of the Ministry of the Environment—an initiative which bore fruit in the government resolution to declare this year as the Year of the Environment in Israel. This momentous decision proved essential in raising environmental awareness and political commitment to previously unknown levels.

This year's information campaign involved all government ministries, every municipality, numerous public organizations, the private sector and the entire educational system in a unique and unprecedented environmental partnership. The 650 central activities carried out by 160 organizations were essential stepping stones on the road toward increased environmental consciousness and participation. Beach cleanup campaigns, collection and safe disposal of batteries and "recruitment" of over one hundred thousand volunteer cleanliness trustees were some of the highlights of our own ministry's endeavor to increase public awareness.

Under the able and committed guidance and leadership of Minister of the Environment Yossi Sarid, we have made major strides in our pursuit of a better environment. Alongside growing public awareness and commitment, significant breakthroughs were made in pollution prevention and resource management.

In a landmark government decision, a comprehensive plan for closing some 400 illegal garbage dumps and replacing them with a few state-of-the-art sanitary landfills was approved and is now being carried out. In the area of hazardous substances control, our resolve to prevent the potentially catastrophic results of accidents led to the approval of a comprehensive contingency plan for integrated response in hazardous substances emergencies. Our ever-growing concern with the impacts of air pollution has resulted in an innovative and comprehensive program for the management of our country's air resources.

In all fields, plans are now being translated into action: tenders for building, operating and rehabilitating Israel's new-generation landfills have been published; bids for the establishment of a nationwide air monitoring network have been issued; river restoration programs are being carried out; criteria for granting "green labels" to environmentally-friendly products have been finalized; pilot recycling projects are being introduced.

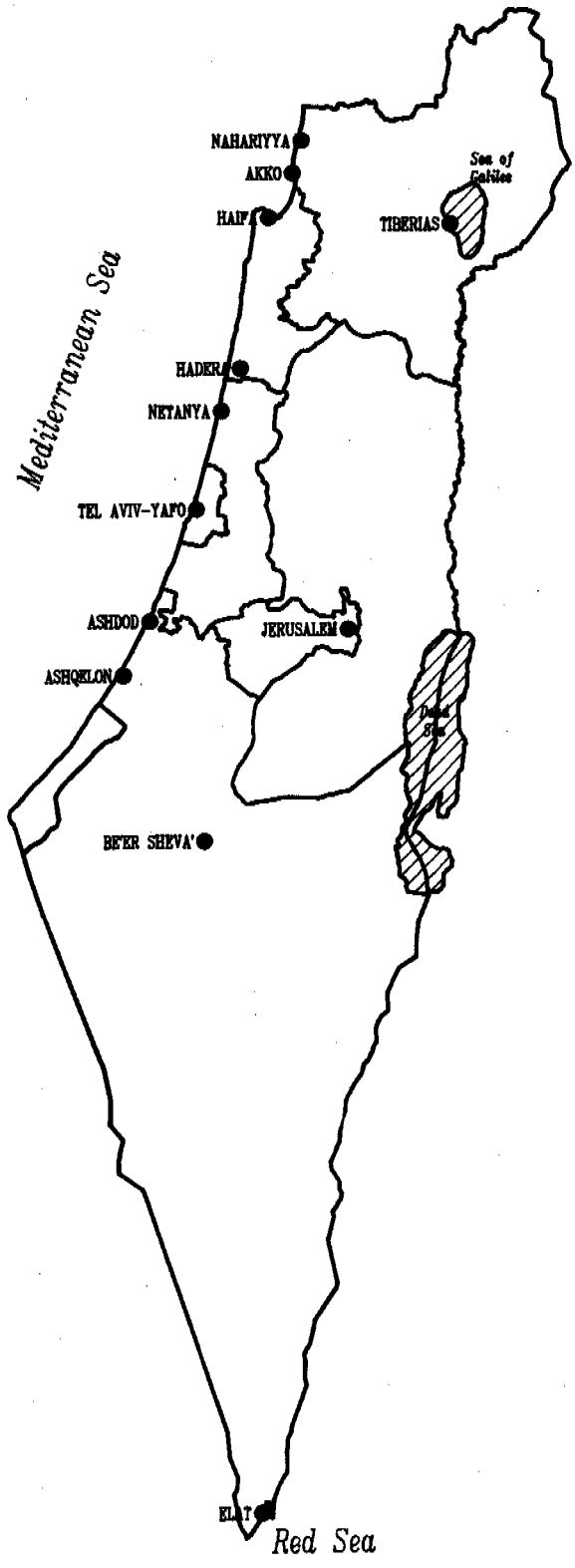
The recent reorganization of the ministry will further augment our ability to deal with ever-growing challenges, ever-pressing needs.

Today, we face new challenges and new opportunities as we take part in one of the most pivotal developments in recent history—the peace process. As the chairman of the Israel delegation to the multilateral peace talks on the environment, I have helped search for new paths of cooperation on the sensitive environmental issues facing the Middle East. As part of a contingency plan for marine pollution prevention in the Gulf of Aqaba, riparian states have committed themselves to joining efforts in case of an oil spill in order to protect this fragile ecosystem. Especially gratifying is the progress made on our proposal for regional cooperation in combating desertification, a project which has been hailed as a model of environmental cooperation. Combating desertification, combating environmental degradation—these will be the forms of combat in which we will engage in the years to come.

The challenges facing us on all fronts are great, but Israel is determined to surmount them. We have pledged ourselves to a path of peace, development and environmental protection. We stand ready to fulfill the motto of the Year of the Environment: "To the Environment with Love."

Dr. Israel Peleg
Director General

The Environment: Land, People and Administration


NAHARIYYA
AKKO
HAIFA
Sea of Galilee
TIBERIAS
Mediterranean Sea
HADERA
NETANYA
TEL AVIV-YAFO
ASHDOD
JERUSALEM
ASHQELON
Dead Sea
BE'ER SHEVA'
ELAT
Red Sea

LAND, PEOPLE AND DEVELOPMENT

Israel's uniqueness lies in the diversity of its land and its people. Located at the junction of Asia, Africa and Europe, the country makes up for its small size (21,500 square kilometers) with a wide range of physical conditions. Fertile plains and arid zones, seashore and desert, mountain ranges and the lowest point on earth—all are in close proximity to one another. The variety of Israel's geographical regions is complemented by the multiplicity of its population. Native-born Israelis and immigrants from every corner of the earth enrich the nation with their varied cultural backgrounds and traditions.

Natural Landscape

Israel is at a crossroads of climatic and botanic regions. The main topographic formation is the Rift Valley, running north-south along the east of the country for over 400 kilometers. Physical conditions along the valley change rapidly from the alpine environment of the Hermon slopes on the northern border, to the subtropical environment of the shores of Lake Kinneret (Sea of Galilee), to the Dead Sea—the lowest point on earth—and the Aravah, a desert plain extending south to Eilat at the northern tip of the Red Sea.

Topographical variations in the northern half of the country divide it into three regions: the limestone mountains of the north (Galilee) and center (Judean hills); the alluvial valley of the upper Jordan River and the valleys of Jezreel and Beit She'an; and the Mediterranean coastal plain, with sandstone ridges, sand dune areas, and fertile alluvial soils.

The southern half of the country can be classified as desert with precipitation below 250 mm yearly, reaching as low as 20 mm per annum at the southern tip of the country. The Negev desert contains unique features such as erosive craters *(makhteshim)* which cut deeply into the earth's crust, displaying a broad range of colors and rocks, and magmatic metamorphic rock which gives the Eilat area its own unique landscape.

Israel's location at the meeting point of four phytogeographic and zoogeographic zones—the Mediterranean, the Irano-Turasian (steppe), the Saharo-Sindic and the Sudanese—gives the country a rich variety of plant and animal life. Over 2,600 species of plant life (150 indigenous to Israel), 454 bird, 128 mammal, 8 amphibian and 106 reptile species are known to exist or to have existed in Israel.

Israel is the northernmost limit for the presence of plants such as the

papyrus reed and the southernmost limit for others like the bright red coral peony. Mountain gazelles roam over the hills; foxes, jungle cats and other mammals live in wooded regions; Nubian ibex inhabit the desert. Hundreds of thousands of birds migrate twice yearly along the length of the country, providing unique opportunities for birdwatching.

Israel's water bodies are also varied. To the west lies the Mediterranean Sea; to the east, the salt-laden Dead Sea with its unique attributes; in the north is the freshwater Lake Kinneret; in the south, the Gulf of Eilat and the Red Sea.

The People

Israel's greatest resource is its people, and the most outstanding characteristic of the population is its rate of growth. Since its establishment in 1948, Israel's population has increased seven fold—mainly as a result of large-scale immigration. The trend of decreased immigration which characterized recent decades was dramatically reversed at the end of 1989 as a massive wave of immigrants arrived in Israel from the former Soviet bloc. Between 1990 and 1993, some 530,000 immigrants entered the country—one-tenth of the present population. Immigration figures have begun a downward trend in 1994.

Israel's 5.3 million citizens come from all corners of the globe. Some 90% of the population are city dwellers. The three largest cities are Jerusalem (557,000 inhabitants), Tel Aviv (357,000) and Haifa (250,000). Nearly 6% of Israelis live in unique rural cooperatives—the *kibbutz* and the *moshav*—whose contribution to the country has exceeded their share of the population. The remaining 3.8% live in villages.

From a sparsely-populated country in its early years, Israel has been transformed into a densely-populated country in recent years. While average population density is about 250 per square kilometer, 92% of the population lives in an area which covers only 40% of the state's land. In the area north of Beersheba, Israel is now one of the world's most densely-populated countries, with 590 people per square kilometer. In the Tel Aviv region, population density is already in excess of 6,700 per square kilometer.

Economic Development

Scarcity of water, limited land reserves, and lack of natural resources have led Israel to base its economy on a highly-qualified work force and technological advances generated by a network of academic and research institutions. Today, some 90,000 students are enrolled in seven universities and a dozen other institutions of higher learning throughout the country.

Education is recognized as the key to Israel's future development. It seeks to impart a high level of knowledge, with an emphasis on the

scientific and technological skills which are essential for the country's continued development. Indeed, the percentage of Israel's population which is engaged in scientific and technological research is among the highest in the world, and relative to the size of its labor force, the country is a world leader in the number of published authors in such fields as the natural sciences, engineering, agriculture and medicine.

Despite its relatively small population, Israel occupies a respected position on the international scene in various areas of industrial and agricultural production. Much of the country's success is attributed to its development of products based on Israel's own scientific creativity and technological innovation. The educated, dynamic and ideologically-motivated farming community has spurred Israeli agriculture to impressive achievements in an extremely short period of time, while in industry, the highest growth rates are in the high-tech sectors, which are capital intensive and require sophisticated production techniques as well as considerable investment in research and development.

Attracted by its geographical diversity, archeological and religious sites, unlimited sunshine and modern resort facilities, nearly 2 million tourists visited Israel in 1993, a 10% increase over the previous year. Tourism, with its enormous potential, promises to be a major factor in the achievement of economic independence for Israel, especially in the wake of the current Middle East peace process.

Israel's experience in overcoming difficult climatic conditions, scarcity of water and limited arable land has become a model for developing countries around the world. In a world that is become more and more interdependent, Israel is committed to taking an active part in the global dialogue for peace and sustainable development, a dialogue which will open the way to new paths of international cooperation for the benefit of people everywhere, today and in the years to come.

ENVIRONMENTAL ADMINISTRATION

In the first two decades following its independence in 1948, Israel accorded high priority to intensive development programs. New towns were established, roads built, industries developed, agriculture expanded and water resources tapped. The rapid growth rate of population, urbanization, and industrial and agricultural output was a major cause of increasing degradation in environmental quality.

Historical Overview

Until 1973, responsibility for the environment was divided among several ministries. No single agency was invested with the authority to coordinate environmental protection activities. In the early 1970s, several factors merged to prompt organized governmental involvement in environmental protection—pressure by nature protection bodies and scientists, concern over the eutrophication of Lake Kinneret and inadequate sewage treatment, and the universal reawakening to the need for environmental protection catalyzed by the 1972 Stockholm Conference on the Human Environment.

Within a year of the Stockholm Conference, the Israeli government established the Environmental Protection Service (EPS), first as part of the Prime Minister's Office and later, within the Ministry of the Interior. The original mandate of the EPS granted it authority to advise ministries and planning bodies on environmental matters, design a system of environmental impact statements, submit an annual state-of-the-environment report to the government, collect and distribute environmental data, and prepare educational materials to increase environmental awareness.

The creation of the EPS in 1973 constituted the first step toward a comprehensive modern environmental administration in Israel. Among the most important achievements of the EPS during its formative years were the introduction of environmental considerations into the planning process, the appointment of environmental advisors to district planning and building commissions and the establishment of environmental units in municipalities. Later achievements included the establishment of an inspection patrol for the prevention of marine pollution in the Mediterranean Sea and the Gulf of Eilat, updating and enforcement of the Maintenance of Cleanliness Law, regulation of air pollution from power stations and industrial plants, establishment of an air pollution monitoring system, initial introduction of environmental studies into the school

curriculum, introduction of an environmental impact statement system, cooperation in international environmental activities, initial steps toward a national system for the collection and disposal of hazardous wastes, and establishment of two environmental funds (marine and cleanliness) which directly implement the "polluter pays" principle.

The Ministry of the Environment

While the EPS proved effective in introducing environmental considerations into Israel's decision-making and planning systems, it soon became clear that legal authority, enforcement powers, and concentration of responsibility were imperative for the development and implementation of a comprehensive, long-range environmental policy. In December 1988, following years of lobbying by environmentalists throughout the country, the government decided to establish a Ministry of the Environment. While questions of structure, budget, manpower, and authority have only been resolved recently, the very decision to establish the ministry constituted a positive change in the government's determination to tackle environmental issues—according environmental protection political legitimacy.

Shortly following its creation, all EPS authority was transferred to the new ministry; later, responsibility for several new environmental fields was transferred from other ministries, including the Prime Minister's Office and the Ministries of Defense, Industry and Commerce, Interior, Agriculture, and Health.

Environmental Policy

Basic to Israel's environmental management program is a policy founded upon cooperation and integration between environmental protection and economic development. Given the rapid rate of development, the focus of environmental policy has always been on preventive measures, and the land-use planning process has provided an important administrative framework for implementing this policy.

Environmental policy has been rooted in the conviction that it is far more effective to identify potential environmental conflicts, simulate or forecast their extent or severity, and incorporate appropriate environmental management measures in the planning process. The required environmental measures are most frequently determined on the basis of ambient, emission and design standards derived from the results of national and international research. Standards for pollutants are revised and updated based on evolving research in economics, technology, health and agricultural effects. In addition, monitoring and inspection systems provide an up-to-date picture of the state of the environment, allow authorities to predict environmental trends, enable alert and response actions in cases of

pollution episodes, and contribute to the development of pollution-abatement programs.

The goals of the Ministry of the Environment are to formulate a comprehensive national environmental policy and to develop the tools necessary for implementing this policy. The ministry seeks to incorporate environmental considerations into decision making and planning processes; to implement programs for pollution control, monitoring and research; to develop and update legislation and standards; to ensure effective enforcement and supervision; to promote environmental education and awareness; and to advance regional and global cooperation on the environment.

Structure of the Ministry of the Environment

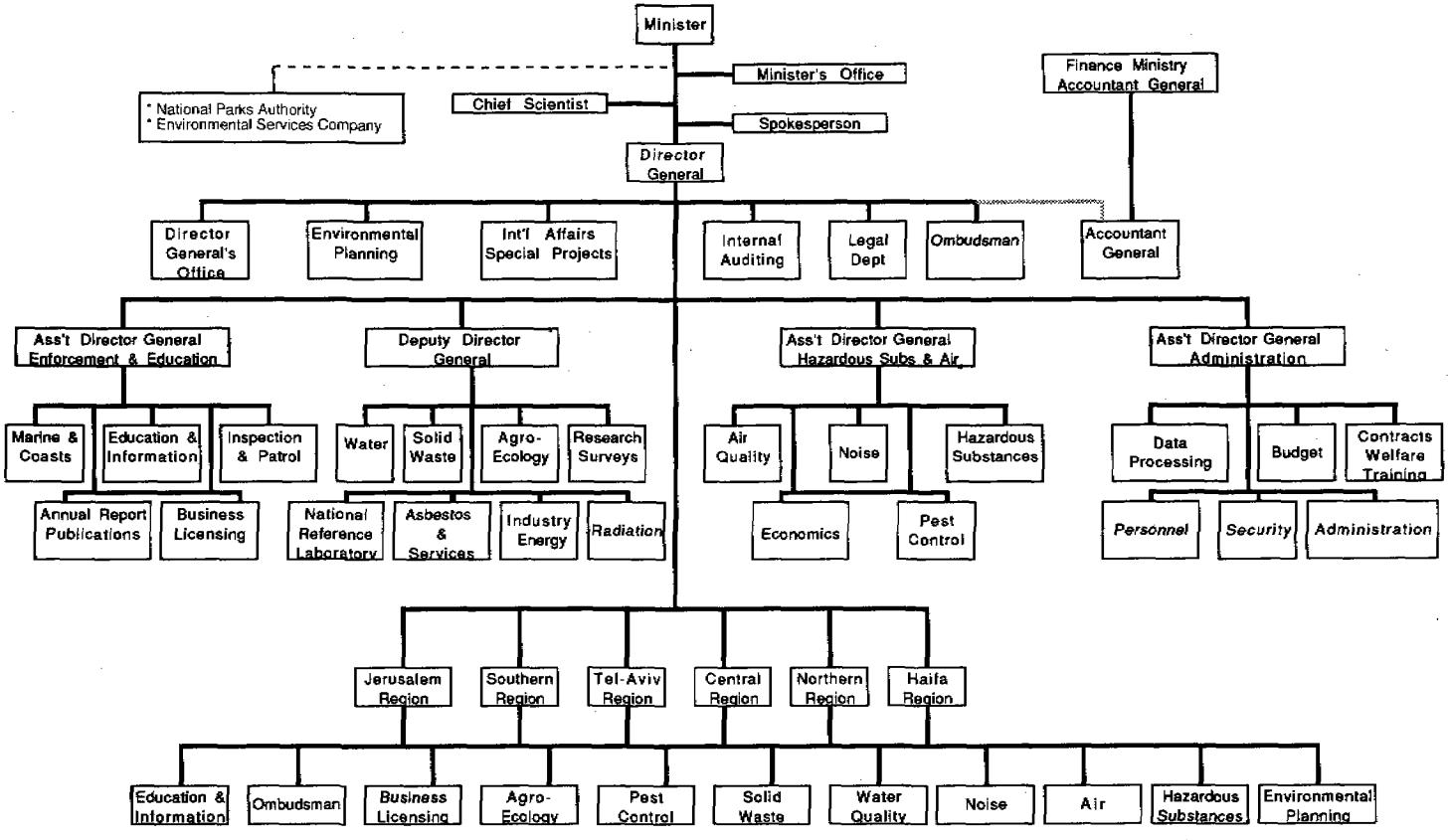
In order to promote more effective organization and optimal efficiency in the fulfillment of its goals, the Ministry of the Environment has recently undergone a major reorganization process, completed at the end of 1993. The administrative structure of the ministry is now based on professional staff units, divided into three groupings of responsibility and coordination, in addition to an administrative group. Some of the divisions are directly responsible to the director general (e.g. legislation, international affairs, planning), but the majority of professional divisions operate under the responsibility and coordination of three assistant directors general (Figure 1).

Over the past year, the number of staff employed by the Ministry of the Environment has significantly increased—from 226 in 1993 to 313 in 1994. Most of the additional manpower has been allocated to the regional level of the ministry, but professional staff have also been added to a number of divisions in the central office, most notably, environmental planning, hazardous substances, solid waste, and inspection and patrol. Furthermore, the ministry's budget, although still inadequate to meet the critical environmental needs of Israel, has been raised substantially in 1994. It now stands at $21 million (including the income generated by the marine pollution prevention and cleanliness funds), a 50% increase over the previous year.

The Ministry of the Environment operates according to the principle that the spatial-geographic dimension of an environmental problem dictates the organizational framework within which the problem is to be solved. Thus, a local problem falling within the domain of a specific local authority should be solved by that authority, using the planning, legal and technical means at its disposal. Where nuisances overlap local boundaries, regional solutions are sought. Issues of national scope are managed by the ministry, at a national level.

Figure 1

Organizational Chart - Ministry of the Environment



National Level

The Ministry of the Environment operates on three different levels—national, regional and local. At the national level, the ministry is responsible for formulating an integrated and comprehensive national environmental policy and for developing specific strategies, standards and priorities for environmental protection. The national level consists of over thirty divisions. Most of the divisions deal with the wide gamut of environmental subjects which are under the responsibility of the Ministry of the Environment; a few are concerned with public relations, interaction with citizens, internal auditing and administration.

The ministry is responsible for the following fields of activity: conservation of natural resources; pollution prevention—including air, water and marine pollution; supervision of sewage treatment facilities and effluent use and disposal; hazardous substances and waste, including asbestos and radiation; industry and energy; pest surveillance and control; solid waste and maintenance of cleanliness; agro-ecology; noise abatement; environmental planning—including operation of an environmental impact statement system; education and information; environmental legislation; business licensing; research and surveys; environmental economics; and international affairs. The function of the ministry's professional staff is to formulate national policy in each of these domains, define research priorities, create and update environmental standards, identify legislative needs, coordinate cooperation with other agencies, and guide the district and local levels in the implementation of national policy. An important element in national environmental policy is inspection and control. To strengthen environmental law enforcement, the ministry has reinforced national inspection units in such areas as marine pollution, river monitoring and hazardous substances in the agricultural sector, and has established a national inspection patrol, which operates on the regional level. In recent years, the environmental inspection patrol has focused on such neglected domains as solid waste disposal sites, littering, hazardous waste disposal, cleanliness in gasoline stations and illegal sign-posting along interurban roads.

The Ministry of the Environment also has ministerial responsibility for the National Parks Authority and for the Environmental Services Company, the government corporation formed in 1990 to operate the national site for the disposal and treatment of hazardous waste at Ramat Hovav. The ministry bears partial responsibility for the Nature Reserves Authority, the Lake Kinneret Authority and the Water Commission.

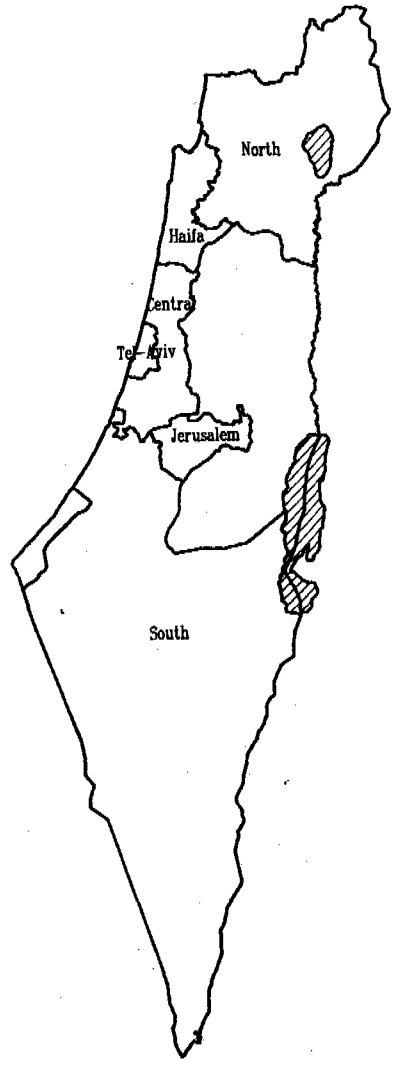
District Level

The establishment of the district administration is an important innovation which was instituted following the creation of the Ministry of the Environment. The district administration provides a forum for close

contact between local authorities and land-use planning authorities, as well as a link between the national staff and municipal units. The district offices—Northern, Haifa, Central, Tel Aviv, Jerusalem and Southern—coincide with the administrative boundaries established in the Planning and Building Law in order to facilitate administrative coordination with both planning authorities and the municipal sector (Figure 2).

Figure 2

Administrative District Boundaries



In the field of planning, the district offices provide environmental input and guidance on plans presented to the district planning and building commissions. With respect to their municipal function, the district offices work closely with the local sector to identify environmental problems and promote solutions.

The district administration is charged with implementing national environmental policy. It generally includes a director and an ombudsperson, as well as experts in such fields as environmental planning, business licensing, agro-ecology, air, water and sewage, hazardous substances, solid waste, noise, education and information, and pest control. The district administration works in tandem with the national inspection patrol, formulates environmental conditions for the licensing of businesses, guides local environmental units and local authorities in the implementation of environmental policy, supervises municipal environmental activities and facilities (e.g. solid waste disposal sites and sewage treatment plants) and initiates and promotes environmental projects to solve regional problems.

Local Level

On the local level, local authorities serve as the implementing arm of the central government in carrying out environmental policy. Environmental services are generally provided by municipalities; the central government steps in only when overriding reasons exist for superseding the responsibilities of the municipality.

Municipalities are responsible for the following environmental services: environmental planning; development, operation and maintenance of environmental infrastructures such as sewage collection and disposal, drainage, and garbage collection and disposal; pest control; street cleaning; preservation of local parks, landscapes and archeological and historic sites; inspection and enforcement of industries and businesses; and monitoring of air, noise and drinking water.

Because municipal activities are so important to environmental protection, the Ministry of the Environment has vigorously advocated financial support and the provision of professional staff and technical and scientific equipment to the local government. To improve environmental services on the local level, local environmental units were established in 1977, under the administrative jurisdiction of their respective municipalities but under the professional authority of the Ministry of the Environment (and previously, its predecessor, the Environmental Protection Service). The major functions of local environmental units are: monitoring air and noise conditions; offering advice and expertise to municipal officials, particularly in the fields of sewage, solid waste and hazardous waste disposal; increasing public awareness of environmental issues through information campaigns and educational projects; receiving and acting upon complaints from the public; advising local planning authorities on the environmental effects of proposed development plans; reviewing and

providing environmental advice on business license applications; acting as coordinators in the resolution of local environmental problems; recommending ways to improve local environmental conditions through legal and administrative measures; and increasing the level of public participation in local environmental decision making. As the local environmental units evolved, each developed expertise in the fields most appropriate to the locality.

Since many environmental problems cross municipal borders, cooperation between local authorities is of utmost importance. The trend in the environmental administration is toward greater cooperation among local authorities in a variety of regional matters, such as waste disposal and treatment, sewage disposal and treatment, air pollution and noise. Several town associations for environmental quality have been established.

Today, 27 municipal environmental units and associations of towns for environmental quality operate throughout the country, serving the majority of Israel's population. Of these, five environmental units were established in the Arab sector during the course of 1993. Another five local units are to be established during the course of 1994, two in the Arab sector. The addition of these and other units over the next few years will enable the remaining municipalities to be incorporated into the local environmental protection network.

Although municipal environmental units are not formally an integral part of the Ministry of the Environment, they are considered an extension of it. They are partially financed by the Ministry of the Environment; they receive professional guidance from the ministry; they consult with the ministry on matters of policy; and they supply the ministry with monitoring data.

Israel's experience with municipal environmental units has proven them to be a most effective tool for linking national environmental policies with everyday operations on the local level. Their special placement within local authorities, and their participation in deliberations of local planning and building commissions enable them to keep abreast of all plans and to work toward the revision or prevention of projects likely to generate adverse environmental impacts. While there will always be a need for complementary action by the central government, municipalities' growing sophistication in environmental management is expected to provide ever-increasing benefits to larger segments of the local population.

Environmental Resources and Pollution Control

WATER

Shortage of water may be the most crucial environmental problem facing Israel today, touching upon its very existence. Water scarcity is exacerbated by the deteriorating quality of water resources due to demographic, industrial and agricultural pressures. Since the mid-1970s, demand has at times outstripped supply.

Climate, Geography and Hydrology

Israel's water sources are limited by the country's climate, geography and hydrology. Seventy-five percent of the annual rainfall is concentrated into four winter months, with at least six rainless months. Rainfall averages 1,000 millimeters per year in some parts of the Galilee in the north in contrast to 25 millimeters in the southern Negev. Even greater variations occur from year to year, with periods of drought or near-drought interspersed with periods of heavy rainfall. The total mean annual precipitation over the catchment areas feeding Israel's various water sources amounts to 10,000 million cubic meters (MCM); of this, only 18% is utilizable, with the rest lost to the atmosphere or to the Mediterranean and Dead Seas. Global climate change may further magnify the pressure on Israel's water system by increasing temperatures and evaporation rates and changing the precipitation regime—for better or worse. Finally, while water demand is greatest in the heavily populated coastal regions and in the southern half of the country, rainfall, water storage reservoirs and water resources are largely concentrated in the north.

These climatic, geographic and hydrologic constraints necessitate a water management policy which is based on the maintenance of a long-term reserve for water regulation and use, the ability to cut allocations for water use in drought years, and the development and use of unconventional water sources.

Water Consumption

In 1993, Israel's water consumption stood at 1,679 MCM, as opposed to 1,541 MCM in the previous year. Agricultural consumption increased by 10.2%, from 940.5 MCM in 1992 to 1,035.5 MCM in 1993; industrial demand grew by 3.7% from 102.7 to 106.5 MCM; and domestic use rose by 12% from 498 to 536 MCM. Israel's primary consumer of water is agriculture. Throughout the 1970s and 1980s, water allocations to agriculture stood at about 1,200

MCM annually, about 75% of total consumption. Drought-enforced reductions in allocations to the agricultural sector are responsible for much of the drop in consumption in recent years. Domestic and municipal uses account for just under a quarter of total use while industry accounts for less than 7% of consumption. Consumption is expected to continue to rise due to the growth in population and economic output.

Principal Water Sources

About two-thirds of Israel's annual fresh water potential are derived from the three major reservoirs: Lake Kinneret (the Sea of Galilee), the coastal aquifer, and the inland, mountain aquifer (Yarkon-Tanninim). Lake Kinneret, Israel's only natural surface storage reservoir, has a utilizable water yield of about 470 MCM, the Yarkon-Tanninim aquifer has a total safe yield of about 300 MCM while the coastal aquifer has a total safe yield of 240-300 MCM. The remaining aquifers are more limited in size and are generally exploited locally. They include an aquifer of Cenomanian-Turonian age underlying the western slopes of the Galilee Mountains, basalt aquifers in the eastern and lower Galilee, a group of small aquifers in the Carmel Mountains and local aquifers in several parts of the Aravah and Negev (Figure 3).

The coastal aquifer extends over 120 kilometers of Israel's Mediterranean coast; its width varies from 3-10 kilometers in the north to 20 kilometers in the south. It is composed of sandstone and sand layers of Pliocene-Pleistocene age. The mountain aquifer is named for its two main natural outlets: the Yarkon Springs, which rise 15 kilometers east of Tel Aviv, and the Tanninim Springs, 60 kilometers to the north. It consists of Cenomanian and Turonian dolomite and limestone rock strata, dipping from their outcrops in the highlands of the West Bank mountains in the administered territories to depths of a few tens to a few hundred meters below the Eocene foothills and the Pliocene-Recent Pleistocene coastal plain.

Israel's renewable water resources equal approximately 1,600 MCM per year, with an additional 240 MCM added through effluent reuse and some 40 MCM from collection and storage of storm runoff. Total river flow accounts for somewhat over one-third of the total, of which 90% comes from the Jordan River basin. Northern tributaries to the Jordan River, which deliver approximately 520 MCM to Lake Kinneret, come from Lebanon (the Hasbani River), Israel (the Dan Springs) and the Golan Heights (the Banias River and Hermon Spring). Based on this annual inflow, some 470 MCM per year are withdrawn through the National Water Carrier—the main distribution system for water from the lake to the south of the country.

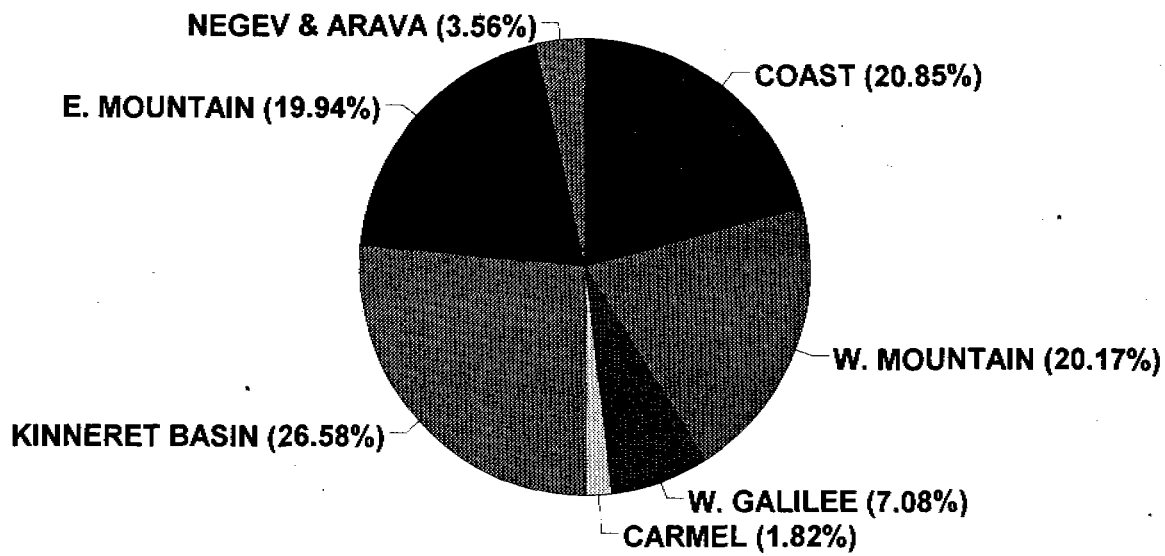
Lake Kinneret, which divides the upper and lower portions of the Jordan River system, is the only fresh water lake in Israel. It has a catchment area

Figure 3

AVERAGE GROUNDWATER YIELD

MCM, 87/88-92/93

YIELD: PUMPAGE AND SPRING VOLUME
TOTAL YIELD: 1893 MCM



SOURCE: HYDROLOGICAL SERVICE OF ISRAEL

of 2,730 square kilometers; its area is 170 square kilometers; its maximum depth is 43 meters; and its maximal volume is about 4,300 MCM. The water level, fluctuating in accordance with its use in the national water system and the amount of precipitation and inflow, varies between 213 and 208.9 meters below sea level.

In the lower Jordan River, water flow has been greatly reduced because the water is impounded in Lake Kinneret and the Yarmouk. The quality of water in the lower part of the Jordan is affected by seasonal changes in salinity, especially as a result of the diversion of saline springs away from Lake Kinneret (in order to reduce salination) and due to industrial and domestic effluents.

Israel's widely dispersed water resources have been consolidated into an integrated water supply network serving all but the extreme southern tip of the country. The 130-kilometer-long National Water Carrier, composed of canals, tunnels, pipes and reservoirs, constitutes the principal leg of this system. While Lake Kinneret is the main surface storage reservoir of the system, water pumped from aquifers and from other sources is added to the main stream of the Carrier as it flows southward. Most of Israel's regional supply networks are linked to the National Water Carrier, which can transport some 1.4 million cubic meters a day from Lake Kinneret for distribution to coastal areas and the Negev desert. When water demand is low due to rainfall, water from the Carrier is used to artificially recharge groundwater sources. The system thus serves to improve the country's hydrological situation by making up for seasonal changes.

Supplemental Sources

Since surface and groundwater sources can no longer meet the demands of a growing population and economy, Israel is increasing its development and use of treated wastewater, brackish water and water harvesting (collection, storage and use of storm runoff).

Israel is a world leader in recycling wastewater, which now accounts for almost 20% of total supply, up from 3% two decades ago. Nearly 70% of the wastewater collected in sewers is treated and reused for agricultural purposes, mainly for the irrigation of non-food crops and animal fodder, in accordance with permits issued by the Ministry of Health. By the end of the century, recycled wastewater may theoretically provide 400 MCM of water per year for irrigation purposes.

Surface runoff in most watersheds in Israel occurs for only a few days a year, after heavy rains. The total mean annual exploitable yield is estimated at 100 MCM per year. Several schemes have been set up for the collection of floodwater, some used for artificial recharge and others as surface water impounding reservoirs. Special techniques have also been developed to harvest water in the arid Negev desert. These techniques involve the construction of small dams and trenches to collect and make

optimal use of rainfall and storm runoff. They are used for growing trees and shrubs in areas where rainfall is less than 300 millimeters per year, for halting desertification at the northern edge of the Negev, and for directing rainwater into channels that recharge aquifers.

Brackish water from aquifers is used to irrigate salt-tolerant crops developed in Israel. Israel already uses some 180 MCM of saline water a year for agricultural and industrial purposes. Olive, fig and date trees can tolerate salty water as can broccoli, tomato, spinach, beet and other vegetables, provided sufficient flushing of the salts from the soil is provided.

Due to high costs and energy requirements, seawater desalination may only become a viable option in the longer term. Brackish water, on the other hand, can be desalinated for about a third of the cost of seawater desalination. In Israel, nearly 40 desalination units, used for water supply and research purposes, have been erected over the past few decades—with a total capacity of 50,000 cubic meters per day. Of these, 23 plants treat brackish water by reverse osmosis on a commercial basis.

Since 1979, water for Eilat at the southern tip of Israel has been partially supplied by several desalinating units, using reverse osmosis to desalinate water with a salinity level of 6,600 ppm total dissolved salts from a nearby aquifer. In January 1994, a new desalination plant was inaugurated in Eilat with a production capacity of 6,300 cubic meters per day, raising the capacity of all desalination facilities in this area to 27,000 cubic meters per day. These waters are mixed with wellwater pumped from the Paran region, some 120 kilometers north of Eilat.

Cloud seeding provides yet another source of supplemental water, but this technique is expected to provide only a marginal addition to available rainfall.

Water Potential

Water resource development and consumption have grown rapidly since the establishment of the state in 1948. Today, all feasible resources are exploited, including springs, groundwater reservoirs, aquifers and the Jordan River system. Pumping from Lake Kinneret cannot be augmented without the risk of increased salinity due to saline springs on the lake bottom or without adversely affecting water quality by creating an unbalanced growth of algae. Coastal rivers have been drained to the point of nonexistence, due to the tapping of their water at source in order to integrate them into the national network. Finally, withdrawal of water exceeding the natural recharge rate in Israel's coastal aquifer has led to the intrusion of seawater and brines; Israel's inland aquifer, a deeper, karstic limestone system, has also been penetrated, although to a lesser degree, by saline water.

Shortage of water is reflected in Israel's per capita water potential—about 330 cubic meters per annum, among the lowest in the world. As the

quality of effluents improves, more reclaimed water will be diverted for agricultural use while freshwater will be directed toward urban and industrial use. By the year 2000, total water consumption is expected to reach 2,025 MCM—1,470 MCM freshwater, 160 MCM saline water and 395 MCM effluents.

Water Conservation

In view of water scarcity, Israel must increase water use efficiency and stimulate greater conservation. This may be achieved through more realistic water pricing, education and information, technical assistance and financial incentives.

In the agricultural sector, substantial savings have been achieved through technological improvements in irrigation methods, including micro-sprinklers, drip irrigation and computerized and automated control systems. Israeli agricultural research has led to the introduction of crops requiring a minimal amount of water or able to thrive on brackish water without diminished yield.

Israel is a world leader in the development of drip irrigation, a technique by which relatively small amounts of water are delivered directly to the roots of growing plants by means of perforated plastic piping. When the flow of water is controlled by sensors linked to central computers, efficiencies (the proportion of water that reaches the roots) can reach 95%. Drip and other forms of micro-irrigation reduce water use by one-third or more, depending upon the crop. Despite high capital costs for installation, nearly half of all irrigated land in Israel is now under micro-irrigation. These techniques have the further advantage of reducing adverse environmental impacts associated with continuous irrigation. Drip irrigation can avoid or reduce salination trends and, by enabling farmers to deliver precise quantities of chemical fertilizers directly to the plants, can also reduce fertilizer contamination of soils and groundwater.

In the domestic sector, low-flow household faucets and low and variable-flow toilets have cut water use. Municipalities have increased efforts to improve the water system itself: reducing pressure, maintaining valves and repairing leaks. Water-saving devices are now required in all new buildings in Israel; throughout the country, municipalities are initiating improved watering techniques for public lawns and gardens and have expedited the replacement and maintenance of pipes to prevent leaks and explosions. Xeroscaping, the use of water-saving plants in landscaping, has also been introduced. A notable example is Jerusalem which has cut its water use by about 10% in recent years. Water consumption in 1992 returned to 1986 levels despite a 20% increase in population.

In the industrial sector, techniques such as process metering, mapping of pipes, pressure reductions and heat recovery have yielded savings. Water is

conserved by the recirculation of cooling water and steam, pressure reducers, and reuse of treated industrial wastewater. Despite the accelerated growth in industrial activity in Israel, industrial use of water has not increased substantially.

A highly successful public education campaign has been undertaken, especially during the drought-ridden years. Citizens are encouraged to use water-saving devices, repair leaking faucets and report leaks in the public sector under the motto "Every Drop Counts." Water conservation is also integrated into the school curriculum, ensuring that Israeli youth grow up with both an awareness of the problem and the knowledge and tools needed to conserve this scarce resource. Data show that at the height of the water conservation campaign, in 1990/1, average per capita consumption in the municipal sector was significantly reduced. When the information campaign dwindled, after two rain-laden seasons, consumption began to rise again. Urban water consumption decreased from 85 cubic meters per capita per year to 70 cubic meters between 1989 to 1991; domestic water consumption was reduced from 60 cubic meters per capita per year to just above 50 cubic meters.

Water Quality in the Coastal Aquifer

Under conditions of water scarcity, on the one hand, and intensive development, on the other hand, the degradation of water quality becomes a critical problem. Curbing the process of water quality deterioration is one of the central challenges confronting the environmental administration in Israel.

About one-third of Israel's population and a major portion of its industry and agriculture are concentrated in the region overlying the coastal aquifer. Chemical and microbial pollutants, salination, nitrates, heavy metals, fuels and toxic organic compounds all threaten to contaminate the aquifer.

Salination and chloride accumulation: Salination of the coastal aquifer has resulted from the intrusion of sea water and from the slow accumulation of dissolved salts from irrigation water and other sources. Overpumping has exacerbated the problem since lowered groundwater levels prevent the flushing of pollutants and salts into the sea. Other causes of salination include the import of water from the National Water Carrier and other groundwater basins, irrigation by effluents and groundwater recharge.

A practical model has been developed in Israel to calculate and predict the displacement of the saltwater-freshwater interface in the layered coastal aquifer. The model should help in decision making related to the exploitation of this freshwater resource.

Over the past 25 years, average chloride concentrations in the coastal aquifer have increased from 110 mg/liter to 150 mg/liter. The average increase today is about 1 mg/liter a year. While growing awareness has led

to better management and a decrease in overpumping, the prognosis for this aquifer remains bleak. According to estimates of the Hydrological Service, 10% of the wells have already reached a salinity level exceeding 250 mg/liter, a concentration unsuitable for unrestricted agricultural irrigation. Within twenty-five years, over half of the wells will exceed permitted salinity levels (Figure 4).

Nitrate accumulation: Nitrate concentrations in the coastal aquifer have increased considerably due to intensive use of fertilizers in agriculture and the use of treated effluents for irrigation. Since 1950, nitrate concentrations have increased from 30 mg/liter to an average of 40-50 mg/liter today, with an annual rate of increase of close to 1 mg/liter. Some 17% of current groundwater production exceeds levels of 70 mg/l, and nearly 60% exceeds recommended levels of 45 mg/l. Within twenty-five years, 26% of the wells are expected to exceed nitrate levels of 70 mg/l and 67% will exceed 45 mg/l levels.

Heavy metals: Contamination by heavy metals is minimal and is confined to sites in the environs of specific industrial zones. Due to the slow transit rate of heavy metals through the ground, the problem may become more evident in future years. Regulations enforced by the Ministry of the Environment prohibit the discharge of industrial wastes, including heavy metals, into the municipal sewage system and strictly limit the concentrations and amounts of heavy metals discharged to municipal wastewater plants. This is of special importance since nearly 70% of Israel's wastewater is reused for irrigation.

Stricter legislation and enforcement of hazardous substances laws and regulations is expected to make a significant contribution to the prevention of pollution by heavy metals. In addition, Licensing of Businesses Regulations, in force since 1990, require all hazardous waste from industrial plants to be disposed at the national hazardous waste site at Ramat Hovav. The recent government decision on closing some 400 illegal garbage dumps and replacing them with a handful of state-of-the-art sanitary landfills should further decrease water contamination.

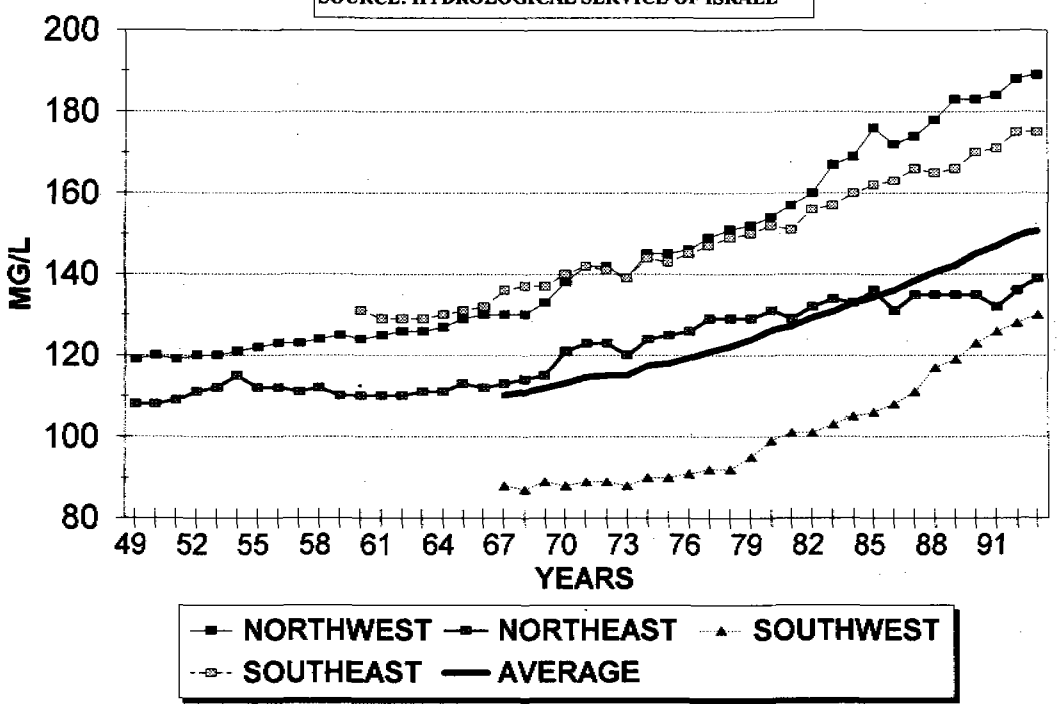
Fuel contamination: Contamination of groundwater by fuel, at a scope of some 2,510 cubic meters, was discovered at 11 sites during the period spanning January 1992 to April 1994. Out of this total, some 1,000 cubic meters of fuel were attributed to a leak from the Ashdod oil refineries in March 1992 and about 1,200 cubic meters to a leak from the Israel Electric Corporation facilities in Ramat Hovav in January 1994. Major leaks are generally the result of human error and neglect; smaller-scale leaks are attributed to damage to pipelines by mechanical equipment and to corrosion of old pipelines, especially near the Haifa oil refineries. Over the past few years, microbial remediation methods have been successfully used to treat and rehabilitate sites contaminated by fuel.

Figure 4

CHLORIDE CONCENTRATIONS

MAJOR COASTAL AQUIFER REGIONS

SOURCE: HYDROLOGICAL SERVICE OF ISRAEL



To prevent soil and groundwater pollution from fuel leaks, new gasoline stations are required to install secondary containment equipment around their underground gas tanks. Such containment pools must be sealed by cement or high-density polyethylene sheets. In addition, observation wells must be installed between the fuel tank and the pool wall, and gas stations must be equipped with oil-water separators. To assess the scope of the problem in older gas stations, the Ministry of the Environment will carry out surveys, utilizing observation wells near underground fuel tanks, and will follow up on the condition of old fuel tanks at the time of their replacement by new tanks.

A joint team headed by the Water Commissioner and the Ministry of the Environment has completed draft regulations designed to prevent pollution resulting from contamination of groundwater by fuel.

Organic micro-pollutants: Data on organic micro-pollutants in water sources have only begun to accumulate in recent years. In the wake of the discovery of relatively high pesticide concentrations in some wells of the coastal aquifer, two developments have taken place: an advisory committee was appointed to review Israel's water quality standards in order to adapt them to stricter standards worldwide, and a survey to assess the degree of pollution by organic micro-pollutants in well water was initiated by the central laboratory of the Mekorot Water Company.

The survey, which was initiated in 1991, is monitoring 18 micro-pollutant compounds derived from industrial sources, nine pesticides and four trihalomethanes. Of the 468 wells tested so far throughout the country, 108 wells (23%) showed traces of micro-pollutant concentrations and 13 (2.8%) revealed at least one substance which exceeded the standard in at least one test. The most prevalent micro-pollutant discovered (over 60%) was trichloroethylene. All of the contaminated wells, most of them situated in the highly-industrialized Haifa Bay and Holon (near Tel Aviv) areas, were known to be polluted previously and have been taken out of service for drinking water purposes. Data accumulated will serve as a baseline for future changes in water quality.

While the results showed that widespread pollution does not exist, the data should expedite the adoption of a new drinking water standard by the Ministry of Health. A draft regulation has already been submitted which relates to a much wider group of contaminants, including organic solvents and pesticides.

Microbial pollution: Bacteriological standards for drinking water, tightened in 1989, state that water is unfit for drinking if routine microbiological tests reveal more than 3 coliform microbes and/or 1 fecal coliform in a water sample of 100 milliliters. Tens of thousands of tests on the microbiological quality of drinking water are conducted each year by the Mekorot Water Company and by local authorities, under the supervision of the Ministry of Health. Mekorot tests water sources and

supply lines before connection with consumers while the Ministry of Health tests the microbiological quality of drinking water at water sources and supply lines within local authorities.

In both cases, only a small percentage of tests (about 4%) shows excess contaminants, most due to antiquated and leaking sewage pipes, especially in the northern part of the country. Results show a steady decline in substandard results in recent years (half the violations since 1989).

To solve remaining problems, several measures have been adopted, including separation of wells from pollution sources, obligatory chlorination or other disinfection means, and installation of treatment systems. Major reduction in microbial pollution is expected in the near future as a result of the active advancement of wastewater treatment systems throughout the country.

The Yarkon-Taninim (Mountain) Aquifer

Because of the deterioration in both quantity and quality of the water in the coastal aquifer, the mountain aquifer is becoming the main supplier of drinking water in the country. However, this deep limestone aquifer is especially prone to contamination due to its karstic nature and the quick transit of pollutants through it. While salinity does not constitute a problem today, overexploitation can lead to a rapid rate of saline water infiltration into the aquifer from surrounding saline water sources. Since the replenishment region of the aquifer is found in the administered territories, future agreements between Israel and the Palestinians on use of the shared mountain aquifer must include stringent requirements with regard to monitoring and control of urban pollution, wastewater, and hazardous agricultural and industrial wastes in order to prevent the contamination of this highly-susceptible aquifer.

Lake Kinneret

During the past 50 years, several changes made in the catchment basin of Lake Kinneret have modified the balance of the lake's ecosystem. Draining of the Hula wetlands in the 1950s caused sediments and nutrients to flow directly into the lake while increased population and agricultural activity in the lake's watershed area have led to contamination by several different pollutants, especially pesticides, fertilizers and cowshed wastes.

The need to manage environmental quality in the lake and its watershed and to protect them from nutrient overload, agriculture, grazing, sewage and even tourists has led to the organization of an effective management system, coordinating research with practical administration and long-range planning. As a result, marked decreases have been noted in bacterial and dissolved nitrogen concentrations and in the number of incidents of pesticide

contamination. On the other hand, a gradual rise in total nitrogen concentrations, a clear decrease in zooplankton growth and an increase in algal biomass have been noted.

Recent studies of Kinneret water quality undertaken at the Yigal Allon Kinneret Limnological Laboratory have shown that overall water quality in the lake has not deteriorated and eutrophication has not taken place during the past twenty years. An analysis of primary production and chlorophyll has revealed no significant rise in these parameters between 1972 and 1993. Improvement in water quality in the lake in recent years is expressed in a reduction in water salinity (up to 215 chlorides mg/liter in the epilimnion in the fall of 1993) and a rise in the concentration of dissolved oxygen and pH of the epilimnion. Microbial water quality in pumping sites was good during 1993. Monitoring of bacterial indicators for fecal pollution indicated that most of the bacterial pollution reaches the lake in the winter with flooding.

Water from Lake Kinneret will meet new, stricter drinking water standards of no more than one turbidity unit when filtered. An advisory committee of the Water Commissioner has advocated centralized filtration of all water pumped from Lake Kinneret and supplied by the National Water Carrier. The recommendation, carrying a $100 million price tag, is under economic evaluation. The alternative is to meet new standards by building dispersed filtration plants at the points of entry of the water to the municipal distribution systems. It is expected that the filtration system will be completed by 1997.

Improvement of water quality should also result from the reflooding and rehabilitation of agricultural areas in the Hula Valley, part of the Kinneret watershed. Drainage of Hula Lake and the surrounding wetlands, begun in 1951, rid the area of the malaria-infested swamps and reclaimed 4,000 hectares for agricultural use. However, it exposed land rich in minerals and nutrients to the atmosphere, triggering the production of nitrates which poured into Lake Kinneret during the winter rains. Research conducted in the 1960s and 1970s estimated that the nitrogen outflow from the drained area amounted to nearly 50% of the nitrogen input into the Kinneret. The $25 million reflooding and rehabilitation project, meant to help rectify the ecological and economic damage caused by drainage of the Hula thirty years ago, will result in the creation of a wetlands wildlife park that will include a lake and islands surrounded by marshes and boating canals for visitors. Within the framework of the four-year project, some 800 hectares will be rehabilitated and 100 hectares reflooded.

The case of the Kinneret serves as an excellent example of what effective basin management can achieve in preventing pollution and enhancing environmental quality. The cooperative efforts of the Kinneret Authority, the Kinneret Limnological Laboratory and the Ministry of the Environment have proven invaluable in preserving the well-being of the lake.

River Restoration

With the exception of the upper part of the Jordan River and its tributaries, nearly all rivers in Israel share a common characteristic: pollution. The reason in most cases can be traced back to the scarcity of water in Israel. Water is all too frequently trapped at its source to supply urban and agricultural demand. The situation is aggravated by the discharge of urban effluents—and at times industrial and agricultural effluents as well—which prevents fauna and flora from surviving while fostering the growth of mosquitoes and algae.

The situation, however, is changing. In November 1993, a National River Administration was established to oversee the restoration of the country's rivers. The administration, consisting of representatives of a number of government ministries and green organizations, is charged with coordinating the efforts of the various bodies working to clean up the rivers, restore landscapes and rehabilitate ecosystems, flora and fauna for purposes of recreation, tourism, education and research.

Yarkon River: Since rivers are usually located under the jurisdiction of several local authorities, river authorities are being established in Israel to deal with the problem of polluted rivers. A prominent example of the restoration of a badly polluted river is the Yarkon, the longest of the coastal rivers. The 27-kilometer long river, originally fed by springs which were diverted through pipes to the Tel Aviv area and the Negev, flows through Israel's most densely-populated area. Before its waters were diverted in 1956, some 220 MCM of fresh water flowed in the Yarkon, supporting fishing and a rich water vegetation. Following diversion, sewage was introduced, and the natural habitat of plants and animals was destroyed.

In an effort to improve the state of the river, a Yarkon River Authority was set up in 1988. The authority, consisting of representatives of 19 organizations and local authorities, is responsible for cleanup, restoration and development of the river, making it suitable for leisure and recreation. Extensive efforts are being made to remove accumulated trash and debris from the river and to clean the river banks. Administrative and legislative measures are being taken to ensure that sewage is not discharged into the river, and monitoring is carried out to ascertain that vegetation and fish are not damaged.

The success of the rehabilitation program is already evident in the return of flora and fauna to a restored seven-kilometer stretch, in the development of boating and fishing areas and in the eradication of mosquitoes using biological control. A few kilometers upstream, near Petah Tikvah, the National Parks Authority officially inaugurated the Mekorot Hayarkon (Sources of the Yarkon) National Park in October 1993. The park includes historic sites, a pastoral atmosphere and riverbank vegetation with public access.

With respect to the as yet uncleaned parts of the river, first priority is being accorded to stopping the discharge of sewage. Current efforts are focused on upgrading the treatment plant serving Ramat Hasharon, Kfar Sava and Hod Hasharon which discharges 25,000 cubic meters of effluents a day.

Lachish River: Sewage and waste in the Lachish River, which flows in the northern part of Ashdod, have plagued the city's residents for years; but this source of dismay will soon be transformed into a source of pleasure. As a result of an intensive restoration project, initiated in 1991 by a number of organizations, the Lachish River Park was inaugurated in October of 1993. The restoration of a three-kilometer stretch of the river will serve as an aesthetic buffer separating Ashdod's residential area from its heavily industrialized zone.

The first stage of the Lachish restoration program is scheduled for completion next year once sewage treatment and cleanup of the river, river banks and adjacent areas are completed. Following years will see the preparation of an infrastructure for sailing, recreation, sport and leisure activities, and the development of commercial tourism projects.

Kishon River: In Haifa, the creation of a Kishon River Authority was approved in May 1994. The Kishon River, which starts in the Jezreel Valley and empties into the sea at Haifa, is one of the most polluted of Israel's rivers. Sewage, pesticide runoff and industrial wastewater from some of the country's biggest chemical plants ends up in the river. Analyses carried out on sediments in the river found high concentrations of heavy metals, originating in the industrial effluents which have been discharged into the river for dozens of years. To begin dealing with the tens of thousands of tons of sludge which have entered the river, shallow tunnels were dug along the riverbanks and covered with sealed polyethylene sheets; they are used to store the sludge as a temporary measure until a disposal solution is found. Upgrading of the existing Haifa wastewater treatment plant, at a cost of $27 million, will considerably improve water quality in the Kishon.

Plans are on the drawing board for transforming the river into a tourist attraction, replete with small harbor and fishing boats. Meanwhile, however, a three-kilometer section of the river upstream, in the Kiryat Tivon area (between the Jezreel and Zevulun Valleys) has been prepared to serve as a park.

Due to the complexity of the ecological system of the Kishon River and Haifa Bay, the European Investment Bank will finance a research study on the carrying capacity of Haifa Bay and on the rehabilitation of the Kishon River. While information on the quantity and quality of the sewage discharged into the Kishon exists, little is known concerning the fate of these pollutants in the marine environment. The study will help develop an integrated approach, based on the processes occurring in Haifa Bay,

which will make it possible to develop new standards for sewage and effluent discharge into the Bay.

The Alexander River: The Alexander River, polluted by wastewater discharged by the municipality of Netanya, is due for major cleanup once a new sewage treatment plant, scheduled for operation next year, is established. The area has also been selected as the site for a Technion - Israel Institute of Technology study on the applicability of wetlands technologies to Israeli conditions using effluents from the sewage plant.

The Ministry of the Environment has supported the establishment of a pilot plant for the treatment of Netanya's effluents using the wetlands method. A large wetted area will be covered with water vegetation to facilitate biological treatment, and the water will then be discharged to the river. The area will serve as a nesting site for birds, reed vegetation, birdwatching and walking paths.

The Ayalon River: The Ayalon River near Lod once served as a sewage conduit and garbage dump, home to discarded refrigerators and building debris. Today, the river and its banks have been cleaned, the riverbank is being transformed into a municipal park and, following a legal suit, the sewage of Lod and Ramle is being transported via pipeline to the Nesher reservoir for agricultural irrigation. A regional wastewater treatment plant is now being planned to treat the sewage discharged by some 500,000 residents of Ramle, Lod, Shoham, Modi'in and nearby communities.

Wastewater Treatment

Municipal and industrial sewage remain the major culprits responsible for Israel's polluted rivers, but increased public awareness and legal proceedings, are making a difference. Jerusalem which discharges over 20 MCM of its sewage into the Soreq River, has agreed to accelerate its timetable for construction of a $100 million sewage treatment plant, due to pressure from the Ministry of the Environment. In Eilat, a legal suit has led to a court order obliging the city to construct a 40-kilometer pipeline to divert its sewage northward where it will be used for agricultural irrigation following treatment in a sewage plant.

While in some cases restoration efforts call for the removal of effluents from streams altogether (e.g. the Taninim River), in most cases efforts are focused on improving effluent quality to a degree which will allow recreational uses or even fishing. Advanced treatment plants, expected to be operational within one to three years, are now under construction in Netanya, Ramat Hasharon, Hod Hasharon, Kfar Sava and Ra'anana. Their operation will significantly upgrade water quality in the Yarkon, Poleg and Alexander Rivers.

Cesspools and septic tanks, mostly in Israel's rural sector, once constituted major sources of groundwater pollution—but no more.

Regulations promulgated in 1992, under the Water Law, prohibit the construction of new cesspools and place severe restrictions on existing ones, including timetables for their elimination. The regulations call for disconnecting sewage outlet pipes from industrial and domestic cesspools and for connecting them to a suitable sewage network.

A national program for sewage was first drawn up in 1970 and came into effect in 1973. Over $160 million were invested in the program, which comprised a large scheme for the densely-populated Tel Aviv metropolitan area, two regional projects and forty-four smaller-scale municipal projects.

Of the total volume of wastewater produced in Israel, about 90% is collected by means of central sewage systems, 80% is treated and nearly 70% is reclaimed for reuse. Of the total wastewater volume, a third is treated to a high level in the Dan Region Wastewater Treatment Project, another third is treated to lower levels and the remaining third is left more or less untreated.

The Dan Region Wastewater Project is a sophisticated system serving an area of 220 km^2 which encompasses the large metropolis of Tel Aviv-Jaffa and seven other municipalities, with a population of 1.3 million. Ninety percent of the wastewater processed comes from households and 10% from industry. In 1993, 87 MCM of wastewater were treated at the plant, of which 75 MCM were recharged and about 100 MCM (together with groundwater) were supplied for agricultural irrigation in the Negev. The Dan Project provides for biological treatment of wastewater including nutrient removal (to a level of 20-25 mg/liter BOD and 30-40 mg/liter suspended solids). The secondary effluent is then recharged into the groundwater aquifer by means of spreading sand basins for additional polishing and long-term storage. The water is eventually pumped and used for unrestricted irrigation in Israel's arid Negev desert. The high quality of the treated water after recharge conforms to drinking water standards, but is not used for this purpose. An extensive hydrological and water quality monitoring program, carried out by means of a network of observation wells and recovery wells surrounding the recharge basins, has confirmed the high quality of the reclaimed water.

In the Haifa region, another large-scale project treats about 38 MCM of wastewater yearly. The technique uses an integrated technology of activated sludge and trickling filter which produces medium-quality effluent (60-80 BOD/SS). The effluent is piped 30 kilometers eastward to irrigation reservoirs that serve the Jezreel Valley. There water quality further improves after a long retention time in effluent reservoirs.

Throughout the country, numerous smaller municipal and local wastewater treatment systems exist. The quality of effluents produced by these treatment plants is not uniform, and all too often local authorities do not operate and maintain their facilities properly. Leakages occur from some sewerage systems as a result of blockages or the poor condition of the piping, leading to environmental nuisances. In Jerusalem, for example, some

22 MCM of effluents are discharged untreated into the Soreq River. Effluent quality in Jerusalem is in the range of 450-500 BOD/SS.

Increased awareness is resulting in improvements in existing plants and in the planning of new treatment plants which conform to new Israeli standards on effluents. Effluent regulations, promulgated in 1993, require secondary treatment to a level of 20 mg/liter BOD and 30 mg/liter suspended solids as a minimum baseline level. Higher degrees of treatment are required by the Ministry of the Environment if effluents are to be discharged into rivers rather than for agricultural use. In such cases, nutrient removal and disinfection are prescribed.

National Sewage Administration

The improvement of wastewater systems will be accelerated with the recent establishment of a National Sewage Administration, composed of representatives of local government and relevant government ministries. The administration is responsible for formulating a national wastewater planning policy, as follows:

- Preparation of national masterplans for wastewater treatment and effluent utilization in agriculture;
- Approval and preparation of programs for wastewater treatment;
- Establishment of regional water and sewage administrations;
- Allocation of budgets for implementation of wastewater treatment programs.

A professional committee on sewage, including specialists in hydrology, health and environment, is affiliated with the national administration.

The administration has two central goals: advancement of sewage treatment to a level which will enable reuse or environmentally-safe disposal; and upgrading of existing water systems in local authorities. A tri-annual program for the establishment and/or rehabilitation and expansion of treatment plants in 89 authorities has already been drawn up. Among the central projects slated for priority treatment are wastewater treatment plants in Netanya, Hadera, Kfar Sava, the Lower Galilee, Hof Hacarmel, Ashdod and eastern Jerusalem.

A five-year plan for solving sewage problems in the small settlements of Israel is currently being drawn up. Criteria for priority action include proximity to rivers and other water sources and sewage requirements in settlements with no or inadequate facilities.

Effluent Reuse

The combination of severe water shortage, contamination of water resources, densely-populated urban areas and highly intensive irrigated

agriculture, makes it essential that Israel put wastewater treatment and reuse high on its list of national priorities. Effluents constitute the most readily available and cheapest source of additional water, and provide a viable partial solution to Israel's water scarcity problem.

By the beginning of the next century, a significant increase in water demand is expected. As a result, the volumes of fresh water now diverted for agriculture will decrease to about half that supplied in the past. This will create an increasing demand for effluents for irrigation in the agricultural sector. By the year 2000, some 400 MCM of effluents may be reused for irrigation in agriculture; at the same time, fresh water demand for urban consumption (domestic and industrial) will increase considerably, to 730 MCM.

At the request of the Water Commission, Israel's water planning company, Tahal, has recently prepared a national masterplan for effluent reclamation, describing present conditions and prescribing a program for future development. The plan constitutes a framework for preparation of national and regional masterplans for effluent reclamation including flow forecasts, principal treatment sites, principal schemes planned, projected interregional transfers and estimates of investments in effluent reclamation in Israel. The aim is to achieve maximum treatment in order to prevent environmental nuisances and to enable effluent reuse in agriculture throughout the country.

Studies on the human health consequences of permissible effluent irrigation have shown that no negative effects have resulted from the reuse of treated wastewater practiced in Israel over the last thirty years. The Ministry of Health maintains a permit system designed to ensure that irrigation with effluents is limited to crops such as cotton, corn for fodder, etc. Only highly treated effluents, after chlorination, are used for irrigation of orchards and other edible crops, but effluents are never used for irrigation of vegetables or other crops which may be consumed directly without cooking.

Effluent Reservoirs

The large-scale reclamation of effluents practiced in Israel makes it necessary to store the effluents in seasonal reservoirs (100 thousand to 3 million cubic meters in volume). The reservoirs, some 160 in number, are a part of numerous small reuse schemes in Israel, as well as of large-scale projects such as those in the Haifa region (the Kishon scheme). The reservoir is filled throughout the year with effluents at a relatively constant flow, while water is withdrawn only during the dry months. The reservoirs are often used as a polishing step in the treatment of the wastewater which is then used for the irrigation of cotton, silage and other non-food crops. During the retention period in the reservoir, which varies

from two to several months, a series of physical, chemical and biological processes take place, affecting water quality.

A survey of Israel's wastewater collection reservoirs, undertaken by the Ministry of the Environment and the Nature Reserves Authority, has revealed that while some improvement in water quality, due to self-purification processes, occurs in the reservoirs in the spring, water deterioration occurs in the autumn. The quality of the final effluents, at the point of discharge, was found to be highly variable and dependent on many factors, including:

- Retention time of the water in the reservoir: Since irrigation is undertaken in summer only, effluent quality can be very high in spring (5-30 mg/liter BOD) when the reservoir is full and retention time is long. In the later summer, however, water quality usually deteriorates and can reach values of BOD as high as 200 mg/liter;
- Level of treatment of the effluents introduced into the reservoir;
- Ratio of effluent to rainwater and spring water stored in the reservoir;
- Addition of high strength agricultural effluents to domestic effluents.

On the basis of the findings, the survey concluded that effluent reservoirs should only receive relatively high-quality effluents (20/30 mg/liter BOD/SS). Furthermore, reservoirs should not be considered integral parts of the treatment system unless long retention time is ensured by the use of a series of reservoirs before discharge of the water for irrigation purposes.

Industrial Wastewater

By law, no plant which produces industrial wastewater can be approved until it ensures adequate treatment of its wastewater prior to discharge into the municipal system. The Model Local Authorities By-Law on the discharge of industrial wastes into the sewage system prohibits the discharge of industrial wastes into the sewage system in a manner, quantity or quality that might cause damage to the sewage system, to the flow of sewage or to the treatment process. Thus, many factories have established in-house facilities for the pretreatment of industrial sewage before their discharge into the municipal sewage system.

Current criteria for wastewater treatment levels do not take into account the level of total salts and their composition. Yet, in view of the ever-growing quantities of effluents used for irrigation purposes, high salinity levels threaten to damage agricultural soils, reduce crop yields and, in certain cases, cause groundwater salinity.

The major sources that contribute to the high sodium concentration in Israel's wastewater include domestic and industrial water softening and the meat "koshering" process. Fresh water in Israel has a high average hardness, and water softeners are used routinely in factories for steam

production, cooling towers, laundries, textile dye works and other industries. Along its passage through a city, water is enriched with salts, typically in the range of 170 mg/liter—although higher values have been reported. As a result of the release of sodium salts (mainly NaCl), effluents have a higher salt content and a higher sodium adsorption ratio (SAR) than the urban water supply. The average SAR increase is about two units, from 2.5 in good quality water to 5-8 in sewage water. Such an increase in the SAR is coupled by a similar increase in the exchangeable sodium percentage (ESP) of the soil.

While the model by-law on industrial wastewater discharge into the sewage system forbids the discharge of chlorides in concentrations greater than 200 milligrams per liter above their concentration in the water supplied to the plant, the provision remains unenforced. In order to circumvent discharge into the municipal sewage system, some industries discharge their salts to evaporation pools or to the sea. Plans are currently underway to enable the discharge of salts (produced as a result of water softening via the regeneration of ion exchange) from industrial plants in the Dan metropolitan area through an outfall to the sea. It is estimated that this solution will reduce chloride concentrations in effluents produced in the Dan Wastewater Treatment Plant by 50 mg/l.

The Ministry of the Environment is currently investing efforts in guiding industries to reduce salt emissions through more efficient use of the raw materials responsible for salination and through recycling for reuse. Since the regeneration of ion exchange contributes some 30% of the total quantity of sodium emitted by industry into wastewater, the ministry has completed a draft regulation, within the framework of the Water Law, to reduce salt emissions from this process. The ministry is also encouraging major contributors, such as the food and textile industries, to adopt technologies for the recycling of sodium hydroxide for reuse purposes. Several plants have begun using these technologies.

In addition to these savings and recycling measures, the ministry is also examining the following options:

- Discharge of brines into the sea;
- Replacement of sodium salts with potassium salts in ion exchange and in other industrial processes;
- Reduction of the sodium discharges resulting from the use of detergents, shampoos, dishwashing and washing machine powders (which contribute some 50% of total sodium emissions to wastewater);
- Precipitation of Ca and Mg in the effluents from ion-exchangers and recycling of the NaCl solution;
- Construction of centralized systems for the supply of soft water in industrial areas;
- Substitution of domestic ion-exchangers of the self-regenerating type by the portable type;

- Reduction of the discharge of salts by the meat "koshering" process;
- New membrane technology for salt recovery.

Administration

All water resources in Israel belong to the state. Management decisions on water quantity, production and supply rest with the Water Commissioner who reports to the Minister of Agriculture. The Ministry of the Environment is responsible for the prevention of pollution of water resources and the Ministry of Health for the quality of drinking water. The Ministry of the Interior, local authorities and a few other bodies have subsidiary roles.

The Water Commissioner allocates water to local authorities and other large users. The local authorities are in turn responsible for developing, maintaining and operating the water supply systems within their jurisdiction. This includes metering residential, public, commercial and industrial use, levying progressive water charges, and publishing information designed to encourage efficient water use.

The Water Commission has two main operational arms: Mekorot, the national water company and Tahal, the water planning company. Mekorot is a public corporation which owns and is responsible for the water supply infrastructure, including pumping stations, wells, irrigation projects and the National Water Carrier. Tahal is a government corporation with responsibility for overall planning, research and design.

The Ministry of the Environment is responsible for preventing pollution of Israel's water sources. It compiles data on potential sources of pollution, undertakes supervision and control over human activity which may damage water resources, and initiates and implements plans for the preservation and restoration of rivers and inland water bodies. Several government agencies, including the Ministry of the Environment, are currently cooperating in order to establish a central laboratory for testing groundwater quality as well as an information center on water quality to facilitate data exchange among the relevant bodies.

Supervision and authority over wastewater treatment is divided among four government ministries: Interior, Environment, Health and Agriculture while local authorities are responsible for collection, treatment and disposal of wastewater. While local authorities are required by law to install sewage systems, wastewater is treated to varying degrees by different municipalities. In the past, opposing considerations guided the numerous bodies responsible for sewage, especially with regard to the location of treatment plants, the level of treatment and the utilization of the effluents for agriculture. The establishment of the National Sewage Administration is thus of special significance.

Legal Framework for Water Protection

The Water Law of 1959 establishes the framework for the control and protection of Israel's water resources. The law states that all water sources in Israel are public property and that every person is entitled to use water, as long as that use does not cause the salination or depletion of the water resource. In 1971, the law was amended to include prohibitions against direct or indirect water pollution, regardless of the state of the water beforehand.

The provisions of the Water Law were originally executed by the Minister of Agriculture, the Water Commissioner and the Water Board. After the establishment of the Ministry of the Environment, authority was transferred to the Minister of the Environment to protect water quality, to prevent water pollution, and to promulgate regulations.

A 1991 amendment to the Water Law provides for more effective enforcement by such means as significantly harsher fines and obligatory cleanup by polluters. Regulations promulgated pursuant to the law include: prohibitions on the rinsing of containers used for spraying of chemical and biological substances into water sources; prohibitions on aerial spraying of chemical and biological agents for agricultural purposes near surface water sources; and severe restrictions on the use of cesspools and septic tanks. Regulations on the prevention of water pollution from underground and above-ground fuel storage tanks and pipelines are now nearing completion while regulations on the reduction of salt use in industrial water-softening processes have been signed.

The Ministry of Health has prepared regulations establishing protection zones around drinking water wells. Israel's regulations on drinking water, within the framework of the Public Health Ordinance, set a limit on the types and concentrations of various chemicals and microbes in drinking water and specify requirements for sampling and testing. A draft regulation updating Israel's drinking water regulations has been prepared and will soon be issued by the Ministry of Health. It will include new standards for several components in drinking water, including synthetic organic chemicals such as volatile organic compounds and pesticides, and will revise existing standards for other components in the water.

Regulations promulgated under the Public Health Ordinance specify the treatment required for wastewater, and list the crops suitable for effluent irrigation in accordance with the treatment level.

The Model Local Authorities By-Law (Discharge of Industrial Sewage into the Sewage System), 1981, charges all generators of wastewater with responsibility for adequate treatment and disposal in a manner which will avoid health and environmental nuisances and the contamination of water sources.

Regulations under the Prevention of Sea Pollution (Land-Based Sources) Law, 1988, forbid the discharge of wastewater into the sea.

The Local Authorities Sewage Law of 1962 prescribes the rights and duties of local authorities in the design, construction and maintenance of sewage systems. This law requires each local authority to maintain its sewage system in proper condition.

The Streams and Springs Authorities Law, 1965, empowers the Minister of the Environment to establish an authority for a particular stream or part of a stream, spring, or other water source. The functions of such authorities include nuisance abatement and pollution prevention.

Extensive use is made of the Licensing of Businesses Law to implement guidelines on treatment of industrial effluents in various industries (e.g. textiles, food and metal) and in the treatment of cowshed wastes.

AIR

In Israel, as elsewhere in the world, rapid technological development, improvement in standards of living and increased population density have brought in their wake pollutant emissions from both stationary and mobile sources. Israel's specific conditions—concentration of population and industry in the coastal area, small land area, variety of natural assets, and singular geological, topographical and climatic features—aggravate the problems of air pollution.

Sources of Air Pollution

The main sources of air pollution are energy production, transportation and industry. Since these are largely concentrated in the coastal plain, the highest levels of pollution have been detected in this area.

Natural conditions for pollution dispersion in the atmosphere of the coastal area are not favorable. One of the most problematic air pollutants in Israel, as confirmed by air quality monitoring carried out since 1970, is sulfur dioxide (SO_2). Until recently, relatively high concentrations of SO_2, emitted for the most part by power plants and oil refineries, have been recorded in the Ashdod and Haifa Bay areas. Intense industrial activity in Haifa Bay, coupled with difficult atmospheric dispersion conditions caused by the influence of the Mediterranean Sea and the complex topography of Mount Carmel, makes this area one of the most problematic in terms of air pollution.

The rapid emergence of industrial plants in the vicinity of urban centers has exacerbated air pollution problems throughout Israel. Pollution sources include cement plants, quarries, chemical and petrochemical plants and several other industries.

Dense vehicular traffic is also a major contributor to air pollution, causing high nitrogen oxide (NO_x) concentrations, especially in the heavily populated urban centers of Tel Aviv, Jerusalem and Haifa. The problem is compounded by the operation of diesel-powered buses and trucks. Increased motorization has had a major impact on the deterioration of air quality, especially in the coastal area. The high amount of solar radiation in Israel has led to ever-increasing levels of photochemical air pollution.

Principles of Air Resources Management

Israel's air quality policy is based on the following elements: prevention of air pollution through the integration of environmental considerations and physical planning; monitoring and intermittent control systems; legislation

and enforcement including ambient and emission standards; improvement of fuel quality; research and international cooperation; individual treatment of pollution sources; and reduction of pollutant emissions from motor vehicles.

Wherever possible, the policy of the Ministry of the Environment has been to limit air pollution through rational physical planning. The Planning and Building Law, through its Environmental Impact Statement Regulations of 1982, serves an important function in air quality preservation, by restricting emissions of air pollutants from planned installations, as dictated by emission standards based on best available technology (BAT). Preparation of an environmental impact statement (EIS) is required for any of the following types of projects, if significant environmental impact is expected: electric power plants, hazardous waste disposal sites, mines, quarries, and industrial plants located outside areas assigned for industrial activities whose siting, scope of activity or production processes are likely to cause a significant impact on the environment beyond the locality. Projects for which EISs have been prepared include the coal-fired electric power plants in Hadera and Ashkelon, the crude oil refineries in Haifa and Ashdod and the cement plants in Haifa, Beit Shemesh and Ramle.

Because of the lack of statutory regulations dealing with emission standards, personal decrees currently constitute one of the most important legal instruments in Israel for controlling air pollution from existing stationary sources. Personal decrees have been issued by the Minister of the Environment under the Abatement of Nuisances Law. They include specific stipulations to polluters on how to prevent air pollution, and have been issued to a number of older power plants, crude oil refineries, cement plants, the phosphate loading terminal in Ashdod Port, several chemical and petrochemical plants, two asphalt plants, a food production factory and a lead acid battery factory.

Personal decrees issued to power stations and other industrial plants in the Haifa and Ashdod areas require, *inter alia*, use of low-sulfur oil. In view of the success in reducing sulfur dioxide pollution in the Haifa and Ashdod areas, means are currently being sought to reduce the sulfur content in other large plants and industrial complexes which are situated in areas close to residential and other pollution-sensitive areas (such as those in Petah Tikvah). A prominent example is an amendment to an existing personal decree to the Nesher Cement Company which was signed in October 1993. The amended decree requires the company to monitor SO_2 emissions continuously, and to restrict emissions to 400 $\mu g/m^3$. Efforts are now being made to obligate the oil refineries to use low-sulfur oil throughout the year until such time as scrubbers are installed. Similar environmental limits on air pollution are also introduced into the business licenses of problematic plants, under the Licensing of Businesses Law. As statutory regulations fixing emission standards come into force (within one year), personal decrees should become obsolete.

Israel's New Air Resources Management Program

Despite major investments in air pollution prevention in past years (especially in the reduction of sulfur dioxide emissions), the state of air pollution in Israel remains unsatisfactory. In order to bring about significant improvements in air pollution abatement and prevention, a comprehensive new program for the management of air resources in Israel was completed by the Ministry of the Environment in June 1994. The landmark program relates to: vehicular sources of air pollution; stationary sources of air pollution; fuel quality, energy and the environment; international treaties; legislation; and air monitoring, data and supervision.

The program delineates a two-stage working plan for each of the pollutants emitted by Israel's major sources of air pollution, namely: gasoline and diesel vehicles, power plants (coal and oil-fired stations and gas turbines), oil refineries, industrial plants, incinerators, air conditioners and coolers, and agricultural activities. For each pollutant, existing and proposed legislative instruments are presented along with an action plan for pollution abatement and prevention.

In the wake of the program, scales of priority are already being changed. Emphasis is being shifted from ambient standards to emission standards; increased attention is directed at technological solutions to pollutant emissions from stationary sources; concentration is focused on the reduction of vehicular emissions; new efforts are being invested in controlling photochemical smog; steps are being taken to establish a nationwide monitoring network and a national center for the collection, processing and analysis of the findings; and preparations for a comprehensive Clean Air Act, designed to provide Israel with the statutory tools necessary to manage its air quality resources in the best manner possible, have been initiated.

Air Pollution Emissions

National estimates of air pollutant emissions play an essential role in air resources management, both nationally and internationally. The Ministry of the Environment, in cooperation with the Central Bureau of Statistics, has prepared estimates on the countrywide quantities of pollutants emitted into the atmosphere from fuel combustion (Table 1).

Israel's energy economy is based on fossil fuels, especially oil and coal. In 1993, over 11.5 million tons of crude oil and 5.8 million tons of coal were imported into Israel. Coal now supplies over 27% of the total energy requirement of the country (97% for electricity generation and the rest for industry) and oil supplies about 70%. Attention is currently being focused on the possibility of importing natural gas for electricity production, as a partial substitute for petroleum-based fuels in the future.

Table 1

Emission of Air Pollutants Arising from Fuel Combustion
Selected Indicators: quantity per capita and per square kilometer

1980; 1985; 1987–1993

	Unit	1980	1985	1987	1988	1989	1990	1991	1992	1993
Average population	Million	3.88	4.23	4.37	4.44	4.52	4.66	4.95	5.12	5.26
Area	Sq Km	20,325	21,501	21,501	21,501	21,501	21,501	21,501	21,501	21,501
Carbon dioxide (CO_2) as C										
Quantity emitted	1,000 Tons	6,341	7,242	8,387	8,756	9,173	9,566	9,778	11,077	11,497
Average per capita	Tons	1.63	1.71	1.92	1.97	2.03	2.05	1.98	2.16	2.19
Average per sq km	Tons	312	337	390	407	427	445	458	515	535
Carbon monoxide (CO)										
Quantity emitted	1,000 Tons	284	371	406	450	474	490	533	609	674
Average per capita	Kg	73.20	87.71	92.91	101.35	104.87	105.15	107.68	118.94	128.14
Average per sq km	Tons	13.97	17.26	18.88	20.93	22.05	22.79	24.79	28.32	31.35
Sulfur oxides (SO_x)										
Quantity emitted	1,000 Tons	308	251	281	272	269	272	252	283	273
Average per capita	Kg	79.38	59.34	64.30	61.26	59.51	58.37	50.91	55.27	51.90
Average per sq km	Tons	15.15	11.67	13.07	12.65	12.51	12.65	11.72	13.16	12.70
Nitrogen oxides (NO_x)										
Quantity emitted	1,000 Tons	79	111	127	137	142	146	151	178	190
Average per capita	Kg	20.36	26.24	29.06	30.86	31.42	31.33	30.51	34.77	36.12
Average per sq km	Tons	3.89	5.16	5.91	6.37	6.60	6.79	7.02	8.28	8.84
Hydrocarbons (HC)										
Quantity emitted	1,000 Tons	34	45	49	54	57	60	65	74	82
Average per capita	Kg	8.76	10.64	11.21	12.16	12.61	12.88	13.13	14.45	15.59
Average per sq km	Tons	1.67	2.09	2.28	2.51	2.65	2.79	3.02	3.44	3.81
Suspended particulate matter (SPM)										
Quantity emitted	1,000 Tons	27	22	25	25	26	25	23	26	26
Average per capita	Kg	6.96	5.20	5.72	5.63	5.75	5.58	4.65	5.08	4.94
Average per sq km	Tons	1.33	1.02	1.16	1.16	1.21	1.21	1.07	1.21	1.21
Lead (Pb)										
Quantity emitted	1,000 Tons	0.43	0.54	0.66	0.51	0.28	0.29	0.30	0.34	0.35

In 1993, liquified petroleum gas (LPG), used mainly for cooking and domestic heating, and natural gas for industry supplied some 2% of the total energy requirement. Gasoline, mostly for vehicles, constituted over 13% of the energy requirement; kerosene, supplied as jet fuel, and to a much smaller extent, for domestic space heating and cooking, constituted 6.5% of the total; light distillate fuel oil (equivalent to ASTM fuel oil No. 2), for diesel-powered vehicles, electric gas turbines and domestic and industrial heating was about 10.5% of the total. Heavy oil (equivalent to ASTM fuel oil No. 5 and 6) provided about 38% of Israel's energy requirement (divided evenly between the electricity production sector and heavy industry).

In order to assess total emissions of combustion-derived pollutants, an emission inventory was prepared using emission factors published by the U.S. Environmental Protection Agency. It is based on the annual consumption of hydrocarbon fuels and on the annual mileage covered by vehicles.

Findings indicate that with the exception of three pollutants—sulfur oxides, total particulate matter and lead–emissions of all pollutants have increased drastically since 1980:

Carbon dioxide (CO_2): In 1993, emissions (calculated as carbon) reached 11.4 million tons, an increase of 81% in comparison to 1980 levels (Figure 5).

Carbon monoxide (CO): In 1993, emissions reached 647 thousand tons, 128% more than the quantity emitted in 1980. The rise in carbon monoxide emissions is attributed to the dramatic increase in vehicle use (Figure 6).

Sulfur oxides (SO_x): In 1993, emissions reached 273 thousand tons—down from 308 thousand tons in 1980. The 11.4% decrease is due to the partial shift in electricity generation from high sulfur residual oil to low-sulfur coal in the early 1980s, and from the reduction in the average sulfur content of heavy residual oil from 3.5% to 2.5% in 1993. A further reduction to 2% was recently instituted (Figure 7).

Figure 5

Carbon Dioxide Emissions

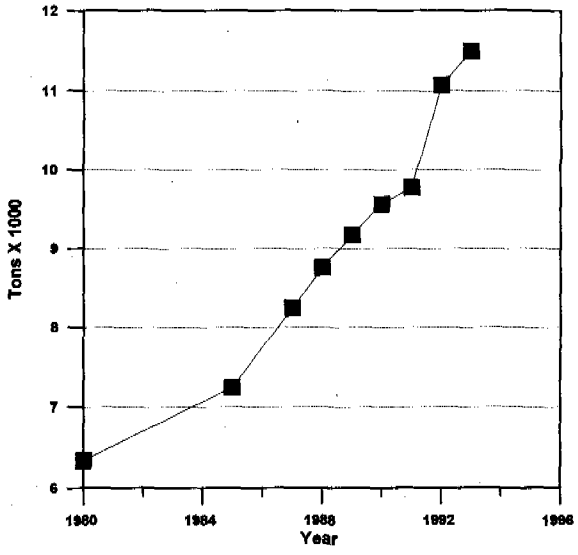


Figure 6

Carbon Monoxide Emissions

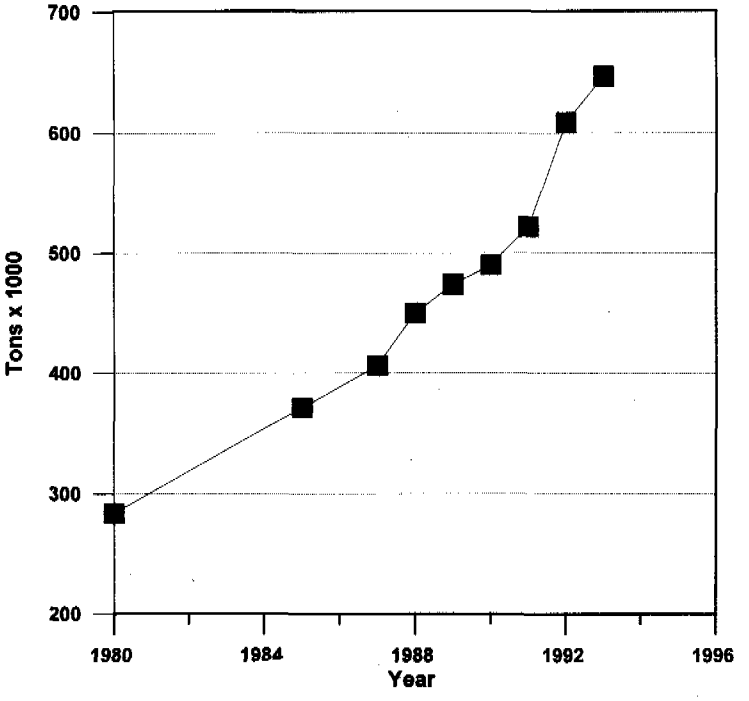


Figure 7

Sulfur Oxide Emissions

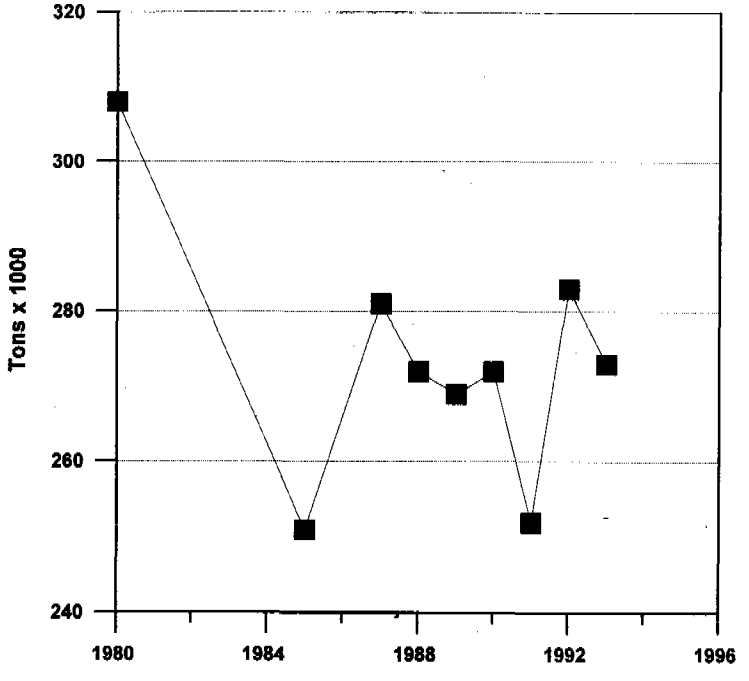
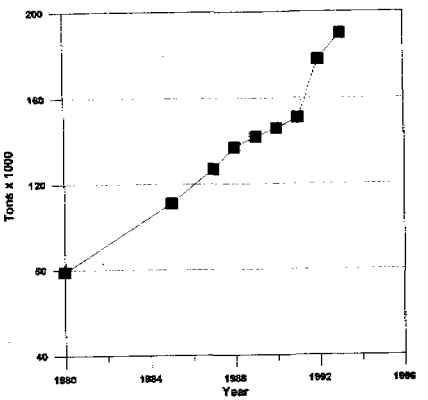


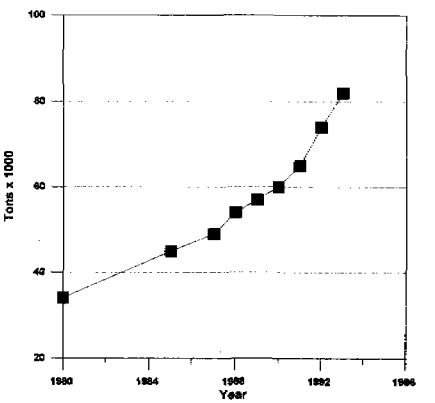
Figure 8

Emissions of Air Pollutants

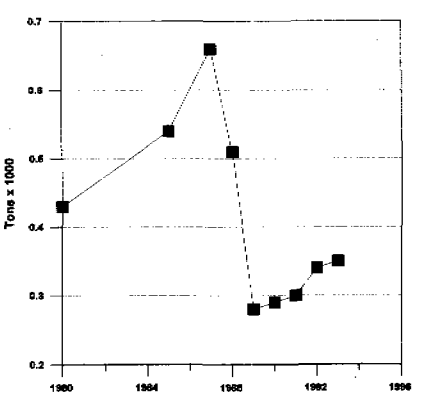
Nitrogen Oxides



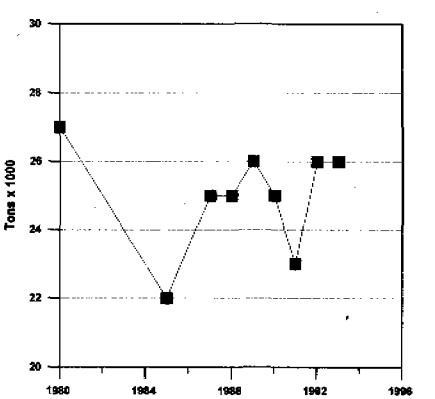
Hydrocarbons



Lead



Suspended Particulate Matter



Nitrogen oxides (NO_x): Emissions have increased yearly and reached 190 thousand tons in 1993 as opposed to 79 thousand tons in 1980. This increase (141%) is attributed to the rising consumption of gasoline and diesel; the rise was partially offset by the decreased use of heavy residual oil and the switch to coal (Figure 8).

Hydrocarbons (HC): Emissions reached 82 thousand tons in 1993, as opposed to 34 thousand tons in 1980—an increase of 141% (Figure 8).

Suspended particulate matter (SPM): In 1993, emissions stood at 26 thousand tons, just below the 1980 average (27 thousand tons). SPM emissions have slightly decreased (3.7%), since increased diesel fuel consumption by buses and trucks was offset by decreased consumption of heavy residual oil and the installation of high-efficiency electrostatic precipitators in Israel's coal-powered stations (Figure 8).

Lead (Pb): In 1993, emissions reached 350 tons, compared to 432 tons in 1980. The 18.6% decrease is attributed to the reduction in the lead content in gasoline, from 0.42 grams per liter to 0.15 grams per liter (Figure 8).

Air Quality Monitoring

Air quality monitoring in Israel started in the beginning of the 1970s in the Tel Aviv and Ashdod areas, when the major emphasis was on pollutants emitted by the Reading and the Eshkol power plants. During the course of the 1980s, four regional automatic networks for air monitoring were set up around the major power plants in Israel by the Environmental Protection Service (forerunner of the Ministry of the Environment) and local environmental units. These networks, in Haifa, Hadera, Ashdod and Ashkelon, work alongside additional stations run by local authorities in Jerusalem, Petah Tikvah and Ra'anana and stations run by the Israel Electric Corporation around its power plants in Ashdod, Tel Aviv and Haifa. The major parameter monitored in all the stations is SO_2. In some, nitrogen oxides and particulate matter are also measured; in a few, ozone and/or carbon monoxide are measured. In 1994, 63 air monitoring stations operated in Israel, including the newest network for the monitoring of airborne chemicals in the Ramat Hovav industrial chemical complex and hazardous waste site.

In order to provide a long-term view of air quality in Israel, data from a representative sampling of air monitoring stations included in the national network (nine monitoring stations) have been compiled and analyzed over the past decade. The stations are located in commercial urban centers, industrial urban areas, industrial suburbs and residential suburbs.

Following is a short review of major findings with respect to compliance with Israel's ambient air quality standards. The standards for the major pollutants, promulgated in 1971 and revised in 1992, are presented in Table 2.

Table 2

Israel Ambient Air Quality Standards Abatement of Nuisances Regulations (Air Quality)

Part A—Gases

Pollutant	Chemical Formula	Concentration (in milligrams per cubic meter)	Time Period
Ozone	O_3	0.230	0.5 hour
		0.160	8 hours
Sulfur Dioxide	SO_2	0.500*	0.5 hour
		0.280	24 hours
		0.060	1 year
1,2 Dichloroethane	CH_2ClCH_2Cl	6.0	0.5 hour
		2.0	24 hours
Dichloromethane	CH_2Cl_2	6.0	0.5 hour
		3.0	24 hours
Toluene	C_7H_8	10.0	24 hours
Tetrachloroethylene	C_2Cl_4	5.0	24 hours
Trichloroethylene	C_2HCl_3	1.0	24 hours
Hydrogen Sulfide	H_2S	0.045	0.5 hour
		0.015	24 hours
Styrene	C_8H_8	0.100	0.5 hour
Formaldehyde	CH_2O	0.100	0.5 hour
Carbon Monoxide	CO	60.0	0.5 hour
		11.0	8 hours
Nitrogen Oxides (as NO_2)	NOx	0.940	0.5 hour
		0.560	24 hours

* 45 exceedances of the SO_2 standard of 1/2 hour periods are permitted annually if they do not exceed 1.0 mg/m^3.

Part B —Suspended Particulate Matter

Pollutant	Chemical Formula	Concentration (in milligrams per cubic meter)	Time Period
Suspended Particulate Matter	–	0.300	3 hours
		0.200	24 hours
		0.075	1 year
Respirable Particulate Matter	–	0.150	24 hours
		0.060	1 year
Vanadium (in Suspended Particulate Matter)	V	0.001	24 hours
Sulfate Salts	$SO_4^{=}$	.025	24 hours
Phosphate (in Suspended Particulate Matter)	P_2O_5	.250	0.5 hour
		0.100	24 hours
		0.040	1 year
Lead (in Suspended Particulate Matter)	Pb	0.0050	24 hours
		0.0015	30 days
		0.0005	1 year
Cadmium (in Suspended Particulate Matter)	Cd	0.00020	24 hours
		0.00006	30 days
		0.00001	1 year

Part C —Settling Particles

Pollutant	Chemical Formula	Concentration (in tons per square kilometer)	Time Period
Settling Dust	–	20.0	30 days
Phosphate	P_2O_5	0.25	24 hours
		5.0	30 days

Comment: Measurement methods prescribed by the USEPA in Regulations on National Primary and Secondary Ambient Air Quality Standards (40 CFR 50) and method TO-14 for VOCs, or equivalent, are required.

Sulfur dioxide: With the exception of Haifa and Ashdod, no violations of the absolute standard (1,000 micrograms/cubic meter) were recorded during 1986-1993. While violations were recorded throughout 1986-1991, the highest concentrations occurred in 1990 in Haifa (2,623 $\mu g/m^3$) and in Ashdod (2,462 $\mu g/m^3$). Peak concentrations in 1993 were all well below the standard. No violations of the statistical standard—which allows for 45 episodes in which half-hour concentrations are between 500-1000 $\mu g/m^3$—were recorded. (All concentrations are half-hour averages.)

Nitrogen oxides: During 1986-1993, violations of the standard (940 micrograms/cubic meter) were recorded in Jerusalem, Ashdod and Tel Aviv. In Jerusalem, violations were noted in 1989-1991 with concentrations varying between 964-1,064 $\mu g/m^3$; in Ashdod, a violation was recorded in 1989 at 1,635 $\mu g/m^3$; in Tel Aviv, monitoring results showed concentrations as high as 2,576 $\mu g/m^3$ in 1993 (half-hour averages).

Ozone: In 1993, violations of the standard (230 micrograms/cubic meter) were noted in Jerusalem, Ashdod and Haifa. The following concentrations were recorded: in the commercial center of Jerusalem—281 $\mu g/m^3$; in the industrial center of Ashdod—261 $\mu g/m^3$; and in the industrial suburb of Haifa—235 $\mu g/m^3$. The most severe violation ever recorded was noted in the industrial center of Hadera in 1985–732 $\mu g/m^3$ (half-hour averages).

Suspended particulate matter: During 1986-1993, violations of the standard (200 micrograms/cubic meter) were noted in most areas. The most blatant violations were recorded in 1992 in a residential area of Hadera, where the maximal concentration for 24 hours reached 704 $\mu g/m^3$ and in the commercial urban center of Petah Tikvah where the concentration reached 380 $\mu g/m^3$ in the same year (24-hour averages).

Air quality monitoring in Tel Aviv, Ashdod and Haifa continues to indicate negative environmental impacts. The power plant and the oil refinery are the major culprits in Haifa; industrial areas in B'nai Brak and Petah Tikvah and the Reading power plant are responsible for air pollution in the Tel Aviv area; and both the power plant and oil refinery are major contributors to pollution episodes in Ashdod.

Future Directions in Monitoring

Availability of nationwide accurate data on air quality is a prerequisite for the formulation of a comprehensive national air quality management program. In Israel, however, monitoring stations are limited to the environs of power plants and major industrial areas. In some areas in which industrial plants abound, such as Tel Aviv and Beersheba, monitoring does not exist. Monitoring of vehicular pollutants in city centers and densely-populated areas is sporadic at best. Moreover, under unfavorable meteorological and topographical conditions, the pollutants may be transported from one region to another, adversely affecting areas dozens of

kilometers away. The need for a nationwide monitoring system which will cover all geographical areas of the country is therefore imperative. Furthermore, a national control center for data storage, analysis and display is sorely needed—for education and information purposes and for the development of long-term strategies for pollution prevention.

Israel has recently prepared a preliminary program for a multi-million dollar national air monitoring system with a central data storage and display center. A tender to select a planner for this project has recently been published. The national system will be based on three levels of activity, collection and processing of data: individual stations, regional control centers and a national data processing center. Three types of individual stations are envisioned: stations for the monitoring of pollutant concentrations from stationary sources; stations along the roadside for the monitoring of carbon monoxide and nitrogen oxides emitted from mobile sources; and stations equipped with facilities for the monitoring of airborne chemical substances.

Some 50 additional stations are planned in addition to the 63 stations currently in operation. New regional stations will be set up in Nazareth, Tel Aviv-Ramle, Jerusalem and the south. The project will be implemented over a three-year period with first priority to the establishment of monitoring stations in the Tel Aviv metropolitan area (Figure 9).

Vehicular Pollution

Without doubt, the major challenge in coming years will be to significantly reduce pollution from vehicular sources. Despite a fourfold increase in the number of motor vehicles over the past two decades, little has been done to reduce emissions, either by legislation or by supervision and inspection.

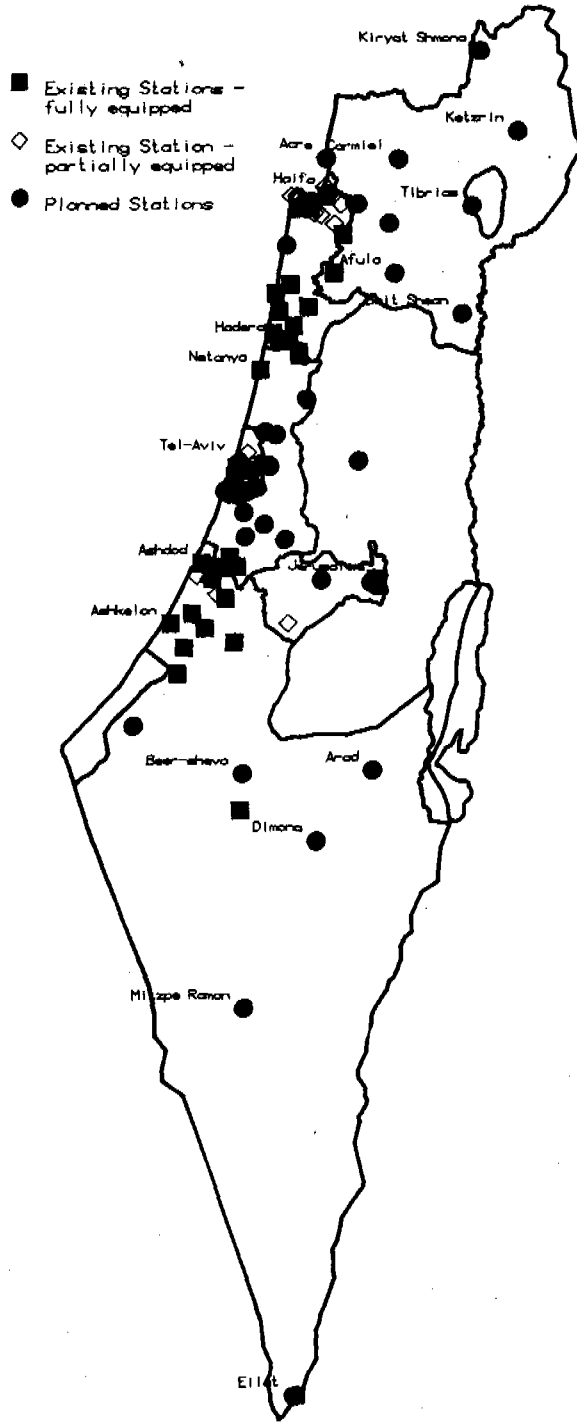
Urban traffic constitutes an ever-growing menace to air quality in Israel. Vehicle density has risen from 34 cars per thousand in 1954 to over 230 in 1993. The number of cars in 1993 reached 1.37 million. It is estimated that by the year 2000 the number of cars in Israel will exceed 2 million.

Transportation sources are responsible for a lion's share of the country's carbon monoxide pollution and for a substantial percentage of the concentrations of lead, hydrocarbons, nitrogen oxides and particulates in the environment. With the exception of lead, the concentrations of all these pollutants have risen dramatically over the past decade.

Vehicle maintenance is checked once a year, during the annual registration test. Vehicular emissions are also tested on the roadside in accordance with standards set in the Abatement of Nuisances Regulations. Authorized examiners of the Ministry of Transport and the Ministry of the Environment, in coordination with the police, are empowered to conduct spot checks of vehicles, but both are short of staff and equipment. Only a very small percentage of vehicles are actually checked.

Figure 9

National Air Monitoring Network



Several steps have already been instituted to help abate the problem; others are planned. All new cars imported into the country, beginning with 1995 models, must be equipped with catalytic converters; a gradual switch to unleaded gasoline is underway; and the lead content in regular gasoline has been reduced from 0.42 grams per liter in 1987 to 0.15 today. A complete phaseout of leaded gasoline within ten years is anticipated.

The Ministry of the Environment estimates that by the year 2000, some 50% of Israel's motor vehicles will be equipped with catalytic converters and by 2025, all the vehicles will be so equipped. Since vehicles equipped with catalytic converters emit only a tenth of the pollution discharged from regular vehicles, the increased presence of these cars should bring about a real reduction in vehicular emissions. Furthermore, since such vehicles require lead-free gasoline, the consumption of unleaded gasoline should rise concomitantly. Until recently, only one type of unleaded gasoline was available in Israel—95 octane. In order to further increase unleaded gasoline consumption, reduce the price of unleaded gasoline and promote sales, 91 octane gasoline is gradually being converted to unleaded gasoline throughout the country.

Emissions from diesel-powered vehicles (trucks, buses and taxis) are a particularly troublesome form of air pollution in urban areas. Since diesel vehicles emit respirable particulate matter (PM_{10}) at a rate which is 100 times greater than the rate of particulates emitted from gasoline vehicles, the Ministry of the Environment opposes the trend of introducing private diesel cars to Israel. The ministry has called for an adequate and constant supply of lower sulfur diesel fuel (0.3% instead of 0.4%) as a first step while encouraging the Ministries of Energy and Transport to adopt tougher European standards on sulfur content, cetane number, viscosity and density. While the permitted sulfur concentration in diesel fuel for vehicles has been reduced to 0.3% in April 1994, the proposed adoption of the European directive should bring about a further reduction of sulfur to 0.2% and to 0.05% in the future. Efforts are also invested in ensuring that a proper infrastructure of garages exists in Israel to assure a high level of maintenance.

Electric cars could provide one solution for reducing automotive air pollution, especially in urban areas. Therefore, efforts are being invested in the introduction of electric vehicles in Israel. The Israel Electric Corporation, which operates an electric vehicle on an experimental basis, has initiated a study on the economic feasibility of such vehicles. It is estimated that the number of commercial cars and light trucks which can be switched to electric power may reach 5-15% of this vehicle fleet. The potential market for private electricity-powered vehicles is estimated at 15,000 vehicles. One possibility worthy of review is conversion of the urban bus fleet to electricity.

Other steps currently being undertaken or promoted include the promulgation of regulations on the prevention of vehicular emissions (both

black smoke and carbon monoxide) which will enable the Ministry of the Environment and the police to better deal with the problem of emissions; increased roadside supervision and enforcement of vehicle emission standards in accordance with European Union standards; restrictions on the use of private vehicles (particularly restricted entry into city centers); encouragement of public transport; information campaigns to increase public awareness; and promotion of research on the epidemiology of respirable suspended particles produced from diesel vehicles and sulfates.

Photochemical Pollution

High concentrations of nitrogen oxides (NO_x) and ozone have been linked to respiratory disease, general health deterioration and adverse impact on agriculture and vegetation. In light of significant violations of the NO_x standard in the Tel Aviv area, the Ministry of the Environment has placed the issue high on its list of priorities. Requirements for catalytic converters for all new vehicles will help reduce NO_x emissions substantially. However, they are not effective against diesel-powered vehicles which are major sources of NO_x pollution.

While the problem of NO_x is severe on the local level, near roads or in busy urban centers such as Tel Aviv, the resultant problem of smog (produced by a photochemical reaction of NO_x with hydrocarbons and other elements) is more widespread. High concentrations of ozone (indicative of photochemical smog) have been found at distances of up to dozens of kilometers away from the source of emission. In the wake of these findings, a computerized model to project future photochemical air pollution levels was developed based on forecasts for the development of energy and transportation for the years 2000-2010. The results showed that concentrations which are double the standard may be expected by the year 2000.

In order to begin effective prevention, the scope and nature of the ozone problem must first be determined. Relatively few points of sampling for ozone exist, and no analysis of the problem has been conducted in Israel to date. To solve the problem, ozone and NO_x-specific monitoring stations will be established, within the framework of the national air monitoring system, and an instrumented airplane will be used to survey ozone in the center of the country during the summer months for a three-year period. Additional activities currently on the drawing board include preparation of a photochemical dispersion model to help cope with smog episodes, ozone forecasting, and development of public awareness.

To slow down the rate of increase of NO_x concentrations, several means must be undertaken, including adoption of new technologies for the prevention of NO_x emissions, a switch to the use of natural gas, monitoring of all major sources, adoption and enforcement of strict emission standards, and reduction of private vehicle use in city centers.

Emission Standards

In order to protect human health and to preserve the environment, environmental policy must be based on a number of principles: precautionary action, the polluter pays principle and cooperation between environmental and economic bodies. Emission standards are a major means of implementing this policy. National legislation is aimed at establishing targets for the minimization of air pollutants, and emission standards are to be based on best available technologies.

Thus far, emission standards in Israel have been established only within the framework of personal decrees issued under the Abatement of Nuisance Law for over 20 industrial plants. For other plants, specific limits, based on emission standards issued by the Federal Government of Germany, were set within the framework of business licensing.

At present, the Ministry of the Environment has completed Hebrew drafts, modeled on the German regulation, TA-Luft 1986, and on its Dynamic Concretisation Clauses of 1991, for the following emission standards: total dust (particulate matter), volatile organic compounds, nitrogen oxides from small and large furnaces, sulfur dioxide from small and large furnaces, vaporous or gaseous inorganic substances, inorganic dust particles and carcinogenic substances. The draft regulations will soon be distributed to the relevant government agencies and to the general public for comment. It is anticipated that they will come into force within a year.

Prevention of Nuisances from Waste Incinerators

Although there are as yet no regulations in Israel regarding the control of air pollution emissions from waste incineration installations, the Ministry of the Environment has issued guidelines based on directives promulgated by the European Union and on German regulations. The guidelines cover installations for the incineration of municipal waste, and are not intended for incineration of hazardous waste. They are meant to aid the Ministry of the Environment as well as municipal environmental units to determine requirements within the framework of business licenses and environmental impact statements.

Following are the emission standards set in the guidelines (under standard conditions and 11% oxygen):

TSP: 30/10 mg/m^3, 0.5/24 hours.
Total HC: 20/10 mg/m^3, 0.5/24 hrs.
HCl: 60/10 mg/m^3, 0.5/24 hrs.
CO: 100/50 mg/m^3, 1/24 hrs.
HF: 4/1 mg/m^3, 0.5/24 hrs.
NO_x: 400/200 mg/m^3, 0.5/24 hrs.
SO_2: 200/50 mg/m^3, 0.5/24 hrs.

Cd and compounds: 0.05 mg/m^3, 0.5 hr.
Hg and compounds: 0.05 mg/m^3, 0.5 hr.
Sb+As+Pb+Cr+V+Sn+Co+Cu+Mn+Ni: 0.1 mg/m^3, 0.5 hr.
Dioxines and Furanes: 0.1 ng/m^3, 0.5 hr.

The Ministry of the Environment has also adopted the requirements set forth in the European directive on the incineration of hazardous waste. The requirements included in this directive will apply to all hazardous waste incinerators which will be established in Israel, such as the Ramat Hovav hazardous waste site.

Air Quality Research

Research on various aspects of air pollution is an integral part of Israel's environmental policy. Such research includes epidemiological health surveys to check the impact of air pollution on the health of the population, monitoring and study of air pollutants in various sensitive areas, and means of abating air pollution through improvements in the intermittent control systems operating in Haifa and Ashdod. Further details on air quality studies undertaken in Israel are included in the Environmental Research chapter of this book.

Electricity Production and the Environment

The production capacity of the Israel Electric Corporation (IEC) consists of three oil-fired plants in close proximity to the coastal cities of Haifa, Ashdod and Tel Aviv, with a total capacity of 2,160 MW, two coal-fired plants at Hadera and Ashkelon, with a total capacity of 2,500 MW and gas turbines at various sites around the country with a total capacity of 1,435 MW. IEC development plans call for an increase of about 3,000 MW until the year 2000, of which 1,650 MW are slated for coal-fired units and the rest for gas turbines.

Environmental supervision over the coal-fired stations in Hadera and Ashkelon is implemented within the framework of a prevention of nuisances plan, incorporated within the operational permit itself. This procedure calls for stringent regulation and control procedures—including the establishment of a monitoring network—to ensure that environmental quality in the region is not degraded. Environmental inspection over oil-powered stations in Haifa, Ashdod and Tel Aviv is undertaken within the framework of personal decrees published under the Abatement of Nuisances Law. These administrative orders specify the steps which must be taken by the power plants to prevent and reduce pollution.

Sulfur Dioxide Control

High levels of SO_2 pollution in the metropolitan areas of Haifa and Ashdod have led to major efforts to control SO_2 emissions from the power stations located in these cities. Present SO_2 control for the oil-fired power plants is based on tall stacks and on the switch to low (up to 1%) and very low (up to 0.5%) sulfur fuel mandated by an intermittent control system during meteorological conditions unfavorable for the dispersion of pollutants. The use of low-sulfur fuel has increased dramatically over the years, reaching over 35% of the total oil-fired production system in 1993. Some 760,000 tons of low-sulfur fuel (compared to 465,000 in 1992) were used in the IEC's power stations in 1993—40% in the Tel Aviv power station and 39% in Haifa's power station. Very low-sulfur fuel was introduced at the Haifa power plant in 1991 and at the Ashdod power station in 1993. As a result of these improvements, the ratio of SO_2 emission to electricity production in 1993 decreased to less than half of its 1981 value.

To attain additional improvements in air quality in the future, the board of directors of the IEC has decided to install seawater scrubbers in its Haifa and Ashdod power stations at an investment of some $180 million. Current plans call for the first units to be equipped with scrubbers in the latter part of 1996, with additional units to be so equipped every six months thereafter. Use of scrubbers and/or the switch to low-sulfur oil or natural gas in coming years will reduce emissions to levels equivalent to 0.5% sulfur by the turn of the century.

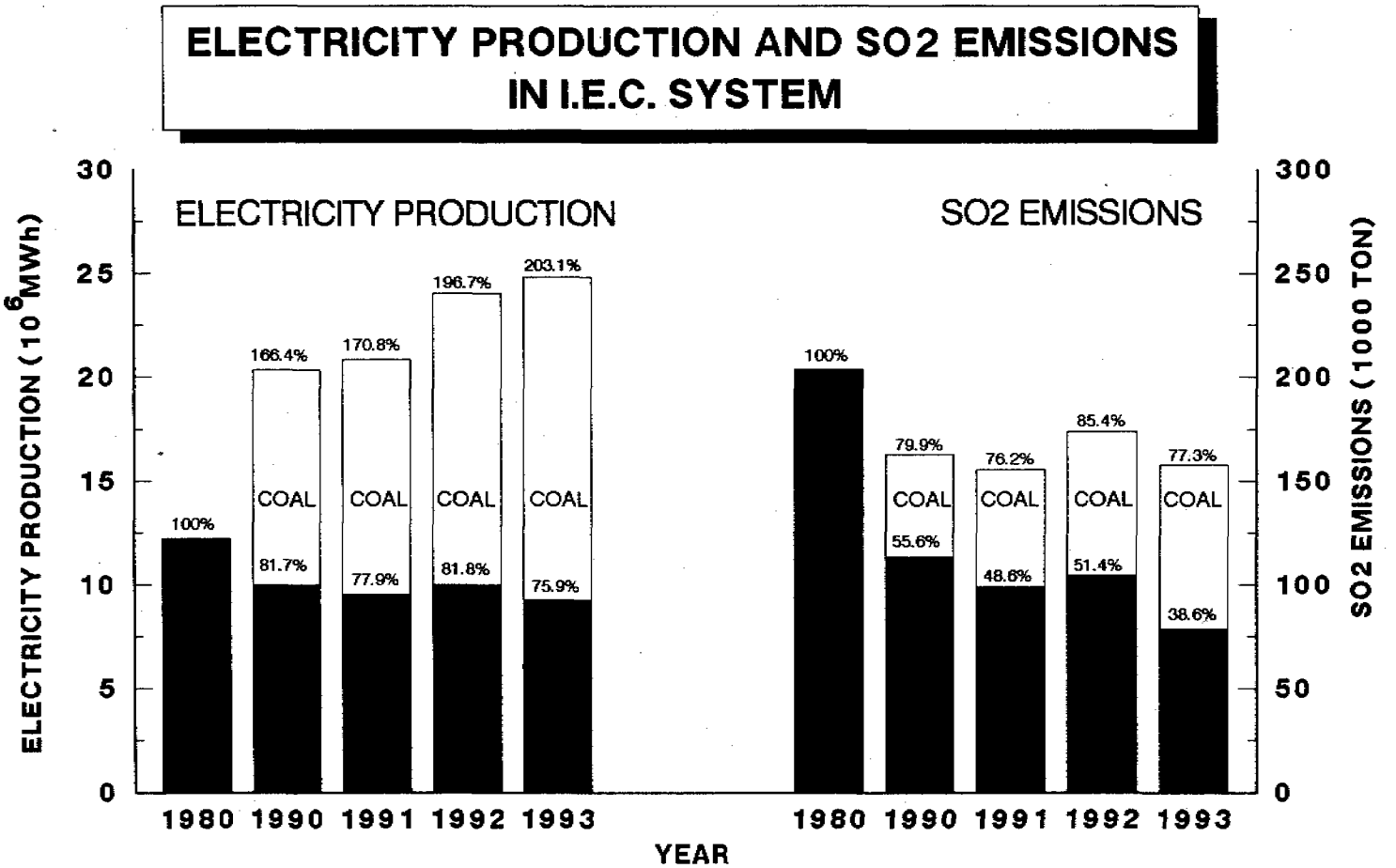
The IEC's coal-fired power plants do not pose significant air pollution problems due to the low-sulfur content of the coal (average of about 0.7%) and the tall stacks (250 meters) at these plants. Within the framework of plans for the prevention of environmental nuisances which were established for the Hadera and Ashkelon plants, the maximum concentrations of sulfur dioxide in the vicinity of coal-fired power stations were set at half the official standard. Based on the positive experience with the existing facilities, the construction of additional coal-fired stations has been approved for the two sites. The additional power station at Ashkelon, planned for operation in 2001, will include SO_2 scrubbers (Figure 10).

Nitrogen Oxide Control

NO_x emissions are a major pollution source, but the relative contribution of the power plants to the total load of these emissions is less substantial than SO_2 emissions (about 40% in contrast with 60%). Most NO_x pollution is attributed to vehicular emissions.

The NO_x controls planned for the new power stations are based on low NO_x combustion systems in the boilers. The IEC will be using boilers which comply with the U.S. Environmental Protection Agency standard.

Figure 10


ELECTRICITY PRODUCTION AND SO2 EMISSIONS IN I.E.C. SYSTEM
ELECTRICITY PRODUCTION
SO2 EMISSIONS
ELECTRICITY PRODUCTION (10^6 MWh)
SO2 EMISSIONS (1000 TON)
YEAR
1980 1990 1991 1992 1993
1980 1990 1991 1992 1993
COAL
100%
166.4%
170.8%
196.7%
203.1%
81.7%
77.9%
81.8%
75.9%
100%
79.9%
76.2%
85.4%
77.3%
55.6%
48.6%
51.4%
38.6%

Particulate Control

In recent years, many activities were undertaken to improve combustion and reduce particulate emissions in oil-fired power stations. The residual oil currently supplied in Israel contains high levels of asphaltenes which prevent complete combustion of the fuel. However as a result of improvements, including the replacement of fuel spray orifices and changes in the combustion systems of the boilers, as well as functional changes in the boilers, particulate emission rates were reduced to below the rate allowed in the personal orders (0.34 kg per million kilo-calories).

At the Haifa and Ashdod power plants, considerable reduction of particulate emissions will be attained following the installation of electrostatic precipitators with the SO_2 scrubbers. Today, some improvement is being achieved as the result of increased use of low-sulfur fuel which contains about 30% less asphaltenes. An Mg-based chemical additive is used in oil-fired power stations to neutralize the acidity of the emissions and to protect the equipment from corrosion.

Israel's coal-fired power station in Hadera was designed to attain the American emission standard in effect at that time (0.18 kg per million kilo-calories) which is equivalent to a concentration of about 135 milligrams per normal cubic meter. Flue gas conditioning is carried out, when needed, to improve the function of the electrostatic precipitators. In the Ashkelon power station, as well as in new stations, the electrostatic precipitators are designed according to the new American emission standard (0.006 kg per million calories, equivalent to a concentration of 40 milligrams per normal cubic meter).

Other Sources of Electricity Production

Gas turbines now form a considerable part of the installed capability of the electricity production system, but they are used sparingly due to their high operating costs. The first gas turbines to be operated in Israel (20 megawatts) were small and were based on jet engines which consume light diesel oil (0.4% sulfur). The larger new industrial gas turbines currently being built (100 and 200 megawatts) are subject to the same environmental requirements regarding the sulfur content (0.4%), as well as reduction of nitrogen oxide emissions in accordance with the USEPA standard and American stack sampling techniques.

The Ministry of Energy is currently checking the possibility of importing natural gas for the gas turbines. Natural gas is a clean, sulfur-free fuel with minimal pollutant emissions. It can be used in both the gas turbines and the fuel oil production units.

The country's indigenous energy resources are limited: little natural gas has been found and even less oil. Thus far, oil shale is the only fossil fuel to

have been discovered in Israel in substantial quantities. Oil shale for steam generation now accounts for some 3% of total energy consumption with plans underway to establish an 80 MW unit for demonstration purposes.

In Israel, the potential use of clean wind energy, as a substitute for fossil fuels, is not high (estimated at about 600 MW). The IEC has already established a wind farm in the Golan Heights with a total capacity of about 6 MW.

The first wind turbine was established in the Yodfat area (the center of the Lower Galilee) in 1986 for experimentation and research, following wind measurements throughout the Galilee at 12 sites. This wind turbine supplies over 300,000 kilowatt hours per year. It is estimated that the Yodfat mountain range can contain 27 similar wind turbines, at a capacity of 300 kilowatt each, which can produce 20 million kilowatt hours per year.

The Ministry of Energy is carrying out a number of research and development projects aimed at developing renewable and/or indigenous energy sources such as solar, wind and biomass energy. The ministry's goal is to produce 8% of Israel's energy needs from these sources by the year 2000.

Solar Energy Research

The only energy resource Israel has in abundance is sunlight and the country is an acknowledged world leader in the development and utilization of this technology. Used mostly for domestic water heating, solar energy provides about 3.5% of the gross energy consumption.

With an average of 300 sunny days a year, Israel is an ideal laboratory for testing one of the most promising and environmentally-safe alternatives to fossil fuels: solar energy. Israel began its solar energy research soon after its establishment in 1948. Several major developments have resulted from this research: flat solar collectors for domestic use (required in all new buildings), solar ponds and the technology of parabolic troughs developed by the now-defunct Luz corporation.

Although these efforts are already contributing hundreds of megawatts to the world's energy budget, additional developments must be achieved: efficiency must be increased and methods to convert solar energy to storable and transportable forms must be developed. In order to develop technologies to overcome these obstacles, two major research centers are carrying out solar energy research: the Weizmann Institute of Science and the Ben-Gurion Solar Energy Research Center.

The Weizmann Institute has set up two state-of-the-art solar energy research facilities designed to test promising new technologies under realistic conditions. The Institute's Schaefer Solar Furnace can provide 20 kilowatts of solar radiation at concentrations of more than 10,000 times the intensity of the sun. This is accomplished by means of a 100-square meter mirror that reflects the sunlight onto a seven-square-meter concentrating

dish. A larger 3,000-kilowatt facility—the Canadian Institute for the Energies and Applied Research—enables technologies to be tested on an even larger scale. This facility consists of a field of 64 large computer-controlled mirrors which track the sun and concentrate its energy onto a 54-meter-high receiving tower. The energy collected by the field of mirrors is directed to several different laboratories located in a central tower. The main goals of the research performed in these laboratories are:

- Direct conversion of solar energy to electric energy using solar heated air and a modified gas turbine;
- Conversion of solar energy to storable and transportable chemical energy through the splitting of water to hydrogen or other similar processes;
- Conversion of solar energy to laser light to be used in the chemical industry or for remote environmental measurements from satellites.

The Ben-Gurion National Solar Energy Center at Sde Boker provides another testing ground for an array of solar-thermal facilities. All facilities at the site are monitored by a computerized system which collects and compiles performance and solar radiation data. The overall research direction at the center aims at improving the efficiency and cost-effectiveness of solar power generation on a large scale. To this end, the center uses a variety of research tools including: two grid-connected photovoltaic systems, each of several kW capacity; an oil-heating loop of linear parabolic concentrators of 960 m^2 aperture and a 2,800 m^2 loop of direct steam-producing parabolic troughs.

The center is active in solar radiation studies, photovoltaic research, solar-thermal research and dust research (means of suppressing the deposition of dust on the collectors of solar power stations). Moreover, it is continuing studies begun by the world's largest manufacturer and operator of solar thermal power plants, Luz, which was forced to shut down due to financial difficulties. While demonstrating the viability of thermal oil as a heat transfer fluid in its plants, Luz was also active in the development of the Direct Steam Generation (DSG) process as a replacement to the Heat Transfer Fluid (HTF) oil circulation method. The Sde Boker facility is designed to function as a demonstration plant for the DSG technology as well as for intermediate-scale tests.

Energy Conservation

Energy conservation is probably the most effective method of reducing energy-related environmental effects. The savings potential in energy conservation is estimated at 10% of the national energy consumption. Energy conservation measures include efficient energy use by consumers, improving the efficiency of energy systems, utilizing waste energy, and switching from fossil fuels to alternative energy resources. This is achieved through

technical consulting and guidance, education, initiation of legislation and regulations, and provision of incentives for energy conservation projects and surveys.

Regulations in effect since 1980 require the installation of solar water heaters in new buildings. Since 1986, new residential buildings must also comply with an Israeli standard which mandates thermal insulation levels that provide thermal comfort at reasonable energy consumption. Regulatory action requires large-scale industrial consumers of energy to appoint energy conservation officers, to monitor energy consumption and to undertake energy conservation surveys.

Energy conservation projects include the production and utilization of biogas, a computer program for the reduction of energy consumption in new buildings, cool storage by load shifting, and power generation from geothermal/moderate temperature heat sources.

International Conventions

As a small country, Israel is a small contributor to such global trends as ozone depletion and climate change. Nevertheless, efforts are currently being invested in implementing the provisions of the Montreal Protocol and in ratifying international accords such as the Climate Convention and the Convention on the Transboundary Transport of Air Pollutants.

Ozone Depletion

Israel ratified the Vienna Convention for the Protection of the Ozone Layer, the Montreal Protocol on Substances that Deplete the Ozone Layer and the London Amendment in June 1992. Since Israel consumes, but does not produce CFCs and halons, annual quotas for import have been restricted to the volume of imports recorded in 1986 (about 4,000 tons of CFCs and 500 tons of halons).

Israel is currently investing major efforts in addressing the problem of methyl bromide. This soil fumigation agent and pesticide has been targeted as a potential ozone-depleting substance, and heavy pressure has been exerted to reduce or ban its use. Methyl bromide is produced in very large quantities at the Dead Sea Bromide Works, where 90% of the production is designated for export. While Israel uses some 2,800 tons of methyl bromide a year in agriculture, it produces about one-third of the world's supply of this pesticide.

Due to the risks associated with continued methyl bromide use, Israel's Minister of the Environment appointed a task force in September 1993 to survey the status of methyl bromide use in Israel and worldwide and to present recommendations on means of reducing emissions and introducing substitutes. While international and local experts have noted that no one

effective alternative to methyl bromide exists or is likely to be discovered in the near future, the committee's recommendations, published in February 1994, include a wide range of suggestions on reduction of doses, use of alternatives, accelerated research and development of methods for adsorption, neutralization and recycling, and training and information. The committee concluded that research and development integrated with instruction, information, legislation and inspection of methyl bromide applications can bring about significant reductions in methyl bromide emissions to the environment and faster adoption of alternatives. In the wake of the report, a team of specialists has been appointed to supervise the use of methyl bromide.

Climate Change

Although Israel has not yet ratified the Climate Change Convention signed at the Earth Summit in Rio de Janeiro in June 1992, Israeli scientists have taken an active part in research efforts on the possible impacts of climate change on this area of the world. In 1991, the Ministry of the Environment and the Israel National Academy of Sciences sponsored an international workshop on the subject. Its objectives were to determine the requirements of climate change research in Israel. Examples of the research projects encouraged by workshop participants include: a study of the impact of land-use intensity on the national water balance and energy consumption; a study on the impact of afforestation on the national water balance; studies on the impact of sea level rise on the shoreline of Israel; and studies on the effects of water level change on economics, energy, agriculture and water demand.

One of the most critical issues raised in the workshop was the availability of a fresh water supply in the eastern Mediterranean in the face of climate change. A central question for Israel is the impact of climate change on the desert line. Israel is divided into two distinct areas of nearly equal size: the northern part which receives adequate amounts of precipitation and the southern part which is a dry desert. Potential changes in the regional distribution of precipitation as a result of atmospheric warming may transform Israel's south into an area well-endowed with rain, or alternatively, may transform the presently rainy north into a desert. Additionally, a rise in sea level will exert pressure on Israel's invaluable coastal aquifers and bring them under threat of an accelerated rate of salination.

The eastern Mediterranean area, and Israel in particular, has a wide multi-disciplinary body of research on climate change; a relatively high number of observations; and a distinct boundary region through all relevant scientific disciplines including meteorology, geology, geomorphology, hydrology, botany, zoology, archeology and history.

Legal Framework for Air Pollution Prevention

The Abatement of Nuisances Law of 1961 is the principal legislative instrument for controlling air pollution at present. The law deals in a broad fashion with the prevention of air pollution, stating that a person shall not cause any considerable or unreasonable pollution of the air from any source whatsoever, if it disturbs, or is likely to disturb anyone nearby. In a similar manner, the law deals with the more specific nuisances of odors. The law authorizes the Minister of the Environment to promulgate regulations defining what constitutes considerable or unreasonable air pollution and odors. Israeli air quality standards were defined in a regulation first promulgated in 1971 and revised in 1992.

The law also empowers the Minister of the Environment to address specific polluters with personal decrees, which instruct them on the steps they should take to prevent the pollution which they create. These decrees have become the backbone for controlling industrial air pollution. The Abatement of Nuisances Law further provides that any permit required for the operation of an undertaking shall be conditional upon compliance with the various provisions of the law.

Regulations that have been promulgated pursuant to the Abatement of Nuisances Law include:

- The Regulation on Air Pollution from Premises, 1962, which prohibits emissions of black smoke into the air (in accordance with the Ringelmann Chart) and the Regulation on Air Pollution from Vehicles, 1963, which prohibits the emission of black smoke from motor vehicles (in accordance with the Hartridge Smoke Meter). A companion regulation details how to measure smoke from vehicles;
- The Regulation on Air Quality, 1971, revised and expanded in 1992, defines unreasonable air pollution for specific levels of air pollutants;
- The Regulation on Emission of Particulate Matter in the Air, 1972, defines the permissible emission rate of particulate matter from an industrial facility in terms of the quantity of raw materials supplied to the production process;
- The Regulation on Air Pollution from Heavy Fuel Oil Burners used for Household Heating, 1972, prohibits the use of heavy fuel oil in households for central space heating systems;
- The Regulation on Prevention of Unreasonable Air and Smell Pollution from Solid Waste Disposal Sites, 1990, prohibits the burning of waste at solid waste disposal sites and requires measures for the prevention of emissions of air pollution, smoke and odors.

In line with Israel's new program for the management of air resources, efforts are now being directed at the drafting of a new and comprehensive Clean Air Act.

Local authorities may enact by-laws on air pollution prevention. The

municipality of Petah Tikvah, near Tel Aviv, was the first local authority to enact a by-law on air pollution prevention in 1988. It grants the municipality new tools with which to handle air pollution and odors from industrial plants within its jurisdiction. The municipality of Karmiel followed suit in 1993. By-laws have also been enacted for associations of towns for environmental quality on air monitoring fees. The town associations of Hadera, Ashdod, Ashkelon and Haifa have passed such by-laws.

The Traffic Ordinance (New Version), 1961, authorizes traffic magistrates to enforce those provisions of the Abatement of Nuisances Law which involve motor vehicles. Regulations promulgated under this ordinance prohibit the registration of a vehicle unless it conforms with inspection standards for emissions, including European Union standards.

The Operation of Vehicles (Engines and Fuel) Law, 1960, allows the Minister of Finance, after consulting with the Minister of Transport, to regulate the kind of fuel by which any motor vehicle shall be propelled and operated and the kind of engine which shall be installed in a motor vehicle. The Minister of Finance is empowered to enact regulations under this law which may include examination of fuel station tanks and containers, spot checks of motor vehicles and fuel tanks, and fuel sampling directions.

A 1982 regulation within the framework of the Planning and Building Law, 1965, prohibits the planning authorities from considering plans for certain types of projects, including projects which are expected to cause air pollution, unless environmental impact statements have been submitted for them.

The Licensing of Businesses Law, 1968, allows local authorities to impose special environmental limits for the issuance of business licenses; these limits may be based on U.S. Environmental Protection Agency regulations, on emission standards issued by the Federal Government of Germany, or on any other standards acceptable to the Ministry of the Environment.

The Public Health Ordinance, 1940, covers many aspects of public health; sections related to the prevention of environmental nuisances are implemented by the Ministry of Health and the Ministry of the Environment.

SOLID WASTE

Population growth, rising standards of living and changes in consumption patterns have resulted in the discharge of increasing quantities of waste into the environment worldwide. Each person in Israel produces some 1.6 kilograms of solid waste a day. The total quantity of waste produced in the country annually by a population of about 5.3 million is equal to 3.1 million tons—with quantities increasing at an average rate of 2% yearly. In a country with meager land resources, on the one hand, and ever-increasing quantities of refuse, on the other hand, sound management of solid waste is imperative.

Solid Waste Disposal: An Historical Perspective

While plans for more effective disposal of solid waste date back some twenty years, solutions to the ever-growing problem have not been forthcoming. Until recently, the basis for government policy was rooted in the National Outline Scheme for Solid Waste Disposal, approved in 1989.

The rationale behind the masterplan was to minimize environmental pollution by operating a few large landfills serving as large a population as possible. However, the masterplan set no timetable for establishing new landfills nor for shutting down unauthorized dumps; it allowed for their continued use until an alternative was found. Moreover, the long and difficult statutory approval process for new landfills (requiring approval on the national, district and local levels) was further delayed due to local opposition. In the case of two nationally-approved central landfill sites (Ein Hashofet on the southern part of the Carmel mountains and Beit Guvrin on the southern coastal plain), the detailed approval process was halted at the local and district levels by the NIMBY (Not In My Back Yard) syndrome. As a result, detailed plans for authorized sanitary landfills were not approved in most areas, and over two-thirds of Israel's population remained without a comprehensive solution to the problem of solid waste disposal.

In 1993, some 96% of Israel's domestic waste was landfilled in about 400 waste dumps—29 of which received over 25 tons of waste per day. Most of the sites were poorly designed and managed; many had reached or are soon to reach full capacity—with no alternative in sight. Some local authorities (e.g. Herzliya, Netanya, Hadera, Haifa, Petah Tikvah, Ra'anana, Kfar Sava and others) have already exhausted their landfill space and will soon have no solution for disposal. The most difficult problem lies in

Hiriya, a landfill which receives about 2,500 tons of refuse a day from the Greater Tel Aviv metropolitan area. This landfill, which will soon reach full capacity, is plagued by the entire gamut of problems associated with improper waste disposal: potential contamination of water sources, stench, air pollution, aesthetic blight, and threats to flight safety due to the congregation of birds in the flight paths leading to Ben-Gurion International Airport.

Towards Environmentally-Sound Waste Management

Today, the outlook for solid waste management is no longer grim. In June 1993, the government took a landmark decision designed to expedite the establishment of central landfills, shut down hundreds of illegal waste dumps and create an infrastructure for environmentally-safe solid waste disposal both in the short and long terms. Specifically, the decision calls for closure of most of the country's small garbage dumps within the next three years and for their replacement by a few authorized sanitary landfills, as follows:

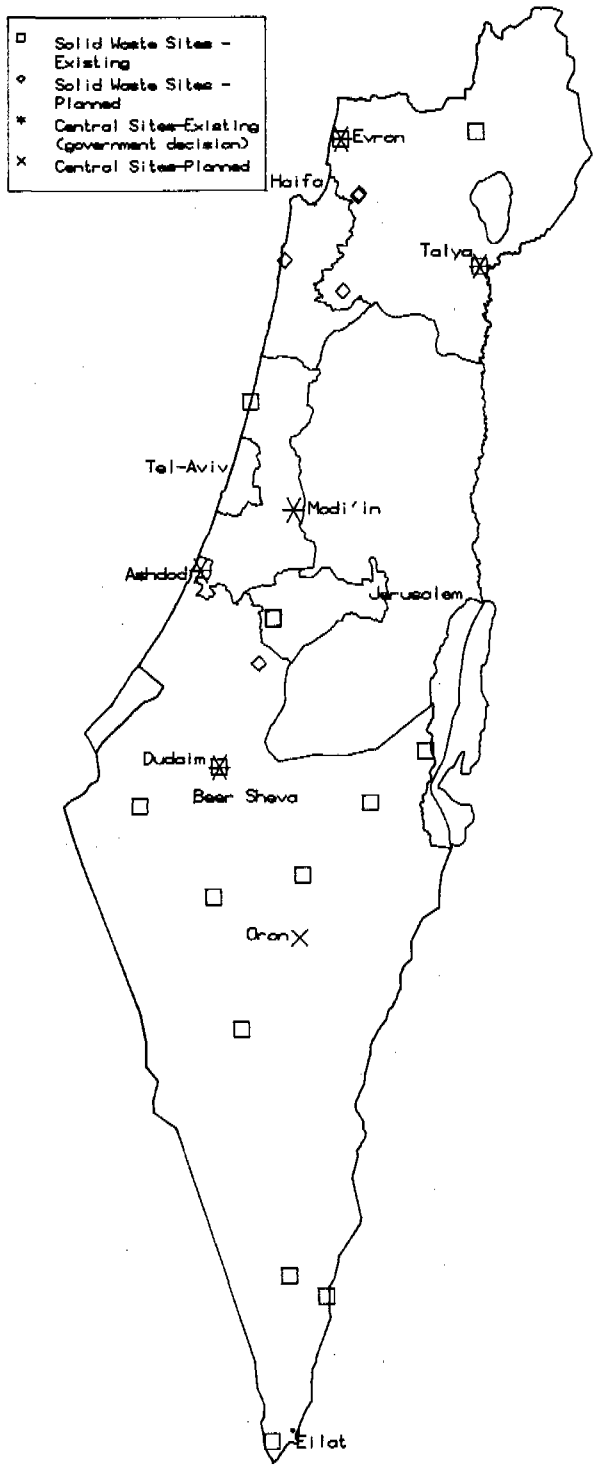
- Two existing landfills—Ashdod (in the southern coastal area) and Evron (in the Western Galilee)—will be prepared and equipped to serve as regional sites on a temporary basis (about three years);
- Two existing landfills—Duda'im (northwest of Beersheba) and Talya (in the northern Jordan Valley)—will be improved according to strict environmental requirements and expanded within one year to serve as central sites for a significant part of the country's waste, with the exception of hazardous waste;
- The Hiriya landfill, near Tel Aviv, will be closed by the end of 1995 and will subsequently be rehabilitated;
- Oron, a phosphate quarry (still in operation), in the center of the Negev, will be considered and checked as a central landfill for the long run.

In line with the government decision, the National Planning and Building Board approved a far-reaching amendment to the National Outline Scheme for Solid Waste Disposal in May 1994. The amendment gives expression to the government decision as follows: conversion of the existing landfills at Duda'im, Talya, Ashdod and Evron into central landfills and the addition of a central landfill at Oron, as a long-term alternative to the waste generated by the Tel Aviv metropolitan region. (Figure 11).

At the end of three years, the Ashdod landfill will be closed and Evron will be transformed once more into a local landfill. To accelerate the implementation of the amended masterplan, all of the new central sites will be subject to national planning at a detailed level, and will be accompanied by environmental impact statements.

Figure 11

Solid Waste Sites in Israel



The National Board also included the Kalanit site at Beit Guvrin, which met staunch opposition at the regional level of planning, among the sites destined for national planning at a detailed level. Another central landfill in Ein Hashofet is currently undergoing deliberations at the regional level of planning. All landfill sites which appear in the original masterplan will be required to adapt themselves to new state-of-the-art standards in accordance with conditions stipulated by the Ministry of the Environment in their business licenses. Otherwise they will be slated for closure.

The original masterplan for solid waste disposal was based on the geographic division of the country into waste collection areas, each served by a solid waste disposal site. However, due to problems such as land scarcity and potential risks to groundwater, several geographical areas were not assigned landfills at all. The amended plan views the collection areas as guidelines only. Today, waste generated in any area will be able to be transported to any other area in order to ensure environmentally-safe disposal. Thus, with the closure of the Hiriya landfill (by December 31, 1995), the waste of the Tel Aviv metropolitan area will be transported nearly ninety kilometers southward to the Duda'im site just north of Beersheba.

The Implementation Process

An interministerial committee, headed by the director general of the Ministry of the Environment, has already published tenders for two central sanitary landfills as a first step in implementing the revolutionary plan. The tenders relate to the planning, establishment, operation, closure and rehabilitation of the Duda'im and Talya landfills, based on state-of-the-art standards.

In the case of Talya, vigorous opposition to the landfill was originally voiced by nearby settlements based on fears that the landfill will generate odors, pollution and landscape damage. To deal with the problem, a collaborative conflict management approach was adopted by all parties. Discussions led to the adoption of a workable compromise whereby the Ministry of the Environment agreed to reduce the amount of waste transported to the Talya landfill to a maximum of 1,200 tons per day and to include adjacent communities in the entire process of environmental impact statement review and supervision over both waste transport and landfill operation.

All of the regional and central sites, along with other landfills included in the masterplan, will be established and operated according to professional guidelines prepared by the Ministry of the Environment so as to prevent environmental and health risks. They will include state-of-the-art technologies for every stage of landfilling from siting to post-closure,

including sealing, leachate detection, collection, treatment and disposal, methane gas collection and use, proper covering of the waste during operation, closure procedures (landfill capping), and monitoring of possible contamination of groundwater during and after closure (up to 30 years).

The Ministries of the Environment and the Interior are responsible for closing and rehabilitating illegal dump sites and for ensuring that all of Israel's solid waste will be discarded at authorized landfills. In 1993, 83 illegal dumps were closed; another 70 major sites are scheduled for closure over the next two years. It is estimated that by 1996, some 80% of the country's waste will be safely discarded at environmentally-sound landfills.

A joint team including representatives of the Ministries of the Interior, Environment, Finance and the Israel Lands Authority will classify sites due for closure according to their economic value. Certain sites, such as Hiriya, may be transformed into parks; others will be rehabilitated and reused for other purposes. In sites where development is not economically feasible, the government will cover rehabilitation costs.

The Ministry of Finance has agreed to offset the increased cost of solid waste disposal which will result from longer transport distances and higher tipping fees. Financing by the Treasury will be based on a formula which will be determined according to financial calculations of the cost of transport plus tipping fee.

The Ministry of the Environment is currently determining priorities for closing down and rehabilitating unauthorized dumps, taking into account, *inter alia*, environmental and logistic considerations. Concomitantly, recycling projects are being promoted, and possibilities for incineration are being examined by an interministerial committee chaired by the Minister of Energy and Infrastructure.

The Recycling Path

The impending closure of hundreds of waste dumps and their replacement by a few regional and central landfills, coupled with ever-increasing requirements for high environmental standards in landfilling, will significantly increase the cost of solid waste disposal. Calculation of the true economic and environmental costs of landfilling is expected to expedite the move to low- or non-waste technologies and to encourage the implementation of waste reduction, reuse and recycling options. To facilitate these developments, Israel is redoubling its efforts to promote recycling by every possible means—research, legislation, pilot projects, to name but a few. A recently-established interministerial steering committee on recycling will also be instrumental in further promoting the subject.

On the research front, four feasibility studies have been undertaken in recent years to investigate the economic, environmental and technological

feasibility of recycling paper and cardboard, plastic containers, glass and tires. The studies conclude that collection and recycling make economic as well as environmental sense—saving foreign currency, diminishing investments in the import of raw materials, reducing costs for collection and disposal of waste, increasing the life of existing landfills and minimizing environmental nuisances. The studies reveal that increased production in existing recycling plants is possible, but that the bottleneck lies mainly in collection, transportation and marketing.

Several initiatives are currently focusing on recycling projects in local authorities. Pilot facilities for separation at source are being set up in commercial centers, school premises and other locations in local authorities throughout the country. Kiryat Tivon, with 13,500 inhabitants, constitutes a national model for recycling since its pioneer program was accompanied by a wide-based educational component from the very start. The results so far have been encouraging. Recent data reveal that out of 450 tons of waste produced each month, over 13% (weight) and 30% (volume) are collected for recycling, through six drop-off recycling centers and a curbside commingled collection program for paper, plastics, glass and textiles. It is estimated that over 60% of the population takes part in the project.

Another project, accompanied by wide-scale education and information activities, has been running successfully in the municipality of Rishon Lezion since 1988. In this municipality of nearly 160,000, over half the population participates in the recycling initiative. Recent estimates point to the collection of some 1,200 tons of cardboard, 250 tons of paper and 36 tons of textiles per year, using 70 drop-off centers for paper and textiles (106 bins) and 60 bins for corrugated cardboard. The municipality has recently initiated a pioneer project for chopping yard waste. The chopped waste is currently used for mulching with future plans to sell the logs to a plywood factory.

Several more pilot projects have been inaugurated this year, with the aid of numerous organizations. These include: separation at source in various neighborhoods in Jerusalem, Tel Aviv, Ra'anana, Kfar Sava, Hod Hasharon, Petah Tikvah, Kiryat Ono, and the Hadera and Ashdod town associations, under the responsibility of the municipalities and local environmental units; recycling centers in nine local authorities in the south of the country with the cooperation of the Society for the Protection of Nature in Israel; separation at source of plastics in Ramat Hasharon; and purchase of collection and compaction equipment for paper and cardboard and of yard waste choppers in several local authorities. These projects, serving tens of thousands of households throughout the country in more than 30 local authorities, constitute a significant breakthrough on the road toward wide-scale recycling.

Commercial recycling is continuing in Amnir's Afula plant (NAAM) in northern Israel which collects waste from several local authorities with a population of 150,000. The $2.5 million facility began operating in 1989 for

the purpose of separating and recycling compost, cardboard, paper, organic materials, plastics and metals. The plant currently recycles some 50% of the 110,000 tons of waste it collects yearly; this figure is expected to increase substantially (to 76%) if tentative plans to use refuse-derived fuel are implemented.

In yet another development, a new transfer station including a material recovery facility has recently begun operating in Petah Tikvah. This facility, located at the recently closed Segula landfill site, provides for sorting of the waste, transfer of paper, carton and plastic to the Amnir recycling plant, and transport of the rest of the waste, after compaction, to the Modi'in landfill. The station is the first such facility in the central part of Israel.

Recycling Facts and Figures

Today, 96% of Israel's domestic waste is buried in landfills, but it is expected that within a decade or two, recycling and incineration will increase significantly for the following reasons:

- Even the most well-planned and maintained sites are designed for use for only 20-30 years;
- Inadequate land reserves will further diminish the availability of new landfill sites, thereby increasing the distance between sanitary landfills and the source of the waste;
- The opening of new sites will become much more costly as technological means are undertaken to avoid contamination risks.

Comprehensive surveys on the composition of solid waste in Israel have not been conducted in recent years, but the estimated composition of domestic waste in Israel, according to weight, is as follows: 50-54% organic material, 16-21% paper and cardboard, 10-12% plastic and synthetic material; 3-5% metals; 3-4% textiles; 0-15% miscellaneous. Theoretically, all components of solid waste can be recycled. Practically, the current goal is to reach a 10% recycling rate in 1995 and approximately 25% by 2000.

Paper

One of the most successfully-recycled components of the waste stream worldwide—and one of the major components of municipal trash—is paper. Even prior to the passage of recycling legislation, paper was the only component of waste separated at source by Israeli households using special disposal containers. In recent years, some 505,000 tons of paper and cardboard were used in Israel, of which 300,000 tons were imported. The quantity collected for recycling by Amnir Recycling Industries, a subsidiary of American-Israel Paper Mills Ltd., is 140,000—28% of total consumption. An additional 25,000 tons of office waste paper and cardboard waste are

imported into Israel. In all, some 70% of the country's total paper and cardboard production originates in recycled fibers.

Since paper and cardboard comprise some 20% of the total weight and about 30% of the total volume of Israel's solid waste, efforts are being focused on encouraging paper collection, on the one hand, and purchase of recycled paper, on the other hand. A paper collection project geared at government ministries, accompanied by a guidebook on wastepaper recycling, has been in effect for over a year. In addition, an experimental wastepaper collection project for households has been initiated in the municipalities of Ra'anana and Givatayim, with the financial support of the Ministry of the Environment.

Special attention is now concentrated on encouraging the production and marketing of recycled products in order to boost both consumption and production of recycled writing and printing paper. Government offices and the school system are the initial targets of this new campaign, in the short term. In view of the fact that the last school year was officially designated the Year of the Environment in the educational system, the Minister of the Environment called upon school principals and teachers to aid in advancing wastepaper recycling by educating students to purchase notebooks from recycled paper and by encouraging separation at source. This will increase the demand for recycled goods, bring about increased collection and reduce the overall volume of the country's waste.

Plastic

Total plastic production in Israel is estimated at 320,000 tons/year, of which only 4.5% derives from recycled material. Some 35% of the total plastic production is designated for packaging, 28% for agriculture, 14% for construction, 10% for home utensils and the rest (13%) for other uses. The total quantity of plastic waste is estimated at 8-12% of the total weight of waste in Israel, divided almost equally between agricultural, industrial and domestic waste. Plastic consumption in Israel remains relatively low, some 64 kilograms per capita, as compared to 100 kilos in the USA and 130 kilos in Germany. However, in light of the development of the industry and the accelerated rate of population growth, this figure is expected to increase significantly in the near future.

The plastic industry now recycles about 15,000 tons of thermo-plastic materials. In the agricultural sector about 15% (some 5,000 tons/year) of the polyethylene sheets and pipes are recycled by Amnir—a quantity expected to increase with the coming into effect of a regulation obligating the collection of plastic sheets from agriculture for disposal at landfills or recycling plants.

The total quantity of plastic containers produced is 25,500 tons per year, of which 15,000 are P.E.T—a material not yet recycled in Israel. In light of

the fact that some 430 million liters of light beverages and water (out of a total of 650 million liters) are bottled in P.E.T containers, the country is now investing efforts in expanding the collection and recycling of these containers—which constitute some 5-6% of the total volume of waste in Israel. Industries are encouraged to manufacture each product from the least number of components, and legislation has been proposed calling for the marking of plastic containers with the appropriate codes and emblems to facilitate recycling.

In 1991, Amnir invested in a plastic recycling plant in Hadera. The plant currently processes some 7,000 tons of plastics a year and expects to reach 10,000 tons within four years. Larger-scale recycling is conditional upon the expansion of the recycled goods market. At present, the market is restricted to such uses as garbage bags, irrigation pipelines, detergent containers, injection materials, toys and boxes. One industrial plant in the Ramat Hovav area recycles mixed plastics as a substitute for wood (plastic wood), at a scale of some 2,000 tons per year. Other plants are expected to follow suit.

Scrap Metal

Israel's steel mills produce about 250,000 tons of different grades of steel annually, of which 177,000 tons are recycled. Additional recycling of metal should be facilitated in the near future as a result of a plan to collect, compact and shred wrecked vehicles. A comprehensive collection and recycling program will make it possible for Israel to supply all of its consumption needs while helping to rid the country of the visual blight of some 50,000 wrecked vehicles annually.

In a related area, progress in recycling used beverage cans is expected as a result of the recent turnover to production of all-aluminum cans by Caniel, Israel's sole producer of beverage cans. Previously, the cans contained different types of aluminum for the body, base and top, making them virtually non-recyclable. The new cans which entered the market in 1993 also feature push-in tabs, instead of the previously used pull-off rings.

Caniel produces about 250 million beverage cans a year, constituting some 1.5% of the total volume of waste in Israel. Since the economic value of used beverage cans is estimated at $3.5 million a year, collection and recycling are deemed to be economically viable.

Glass

Annual consumption of glass stands at about 100,000 tons—with a recycling potential of some 60,000 tons per year. In reality, however, less than 1% of the country's glass is recycled. Despite the high cost of transportation to the south of the country, where Israel's only plant capable

of glass recycling is located, feasibility studies have shown that recycling can be profitable, given the fact that the bulk of glass containers are concentrated in entertainment centers, thus facilitating collection.

A pilot program to study the collection of glass, mainly from entertainment centers, was initiated in the summer of 1993. One hundred 2-cubic-meter "igloo" containers were distributed in various locations in the central part of the country. The six-month experiment (which ended in December 1993) has provided valuable information on the feasibility of the project. Recommendations are to continue the experiment, to transfer the containers to areas in which both commercial centers and residential areas coexist and to increase the scope of education and information campaigns.

Local experience with returnable beer bottles shows that a glass container can last 10-15 years before reaching the landfill. Today, about 30 million liters of beer in 62 million bottles are part of the deposit system with a 90% return rate.

Tires

According to a 1992 survey, the total number of cars in Israel in 1990 was about 1,100,000. These cars produced over 2,300,000 scrap tires with a total weight of about 38,500 metric tons or 32,000 tons/year, after deducting the renewed tires. Based on the results of the survey, it is estimated that scrap tires currently total about 40,000 tons/year and will reach over 65,000 tons by the year 2000. About 38% of the tires are generated in the Greater Tel Aviv area, 13% in the Haifa region, 8% in Jerusalem, 9% in Beersheba and the southern region, and 32% in the rest of the country.

The readiness of several companies to collect scrap tires from central locations in municipalities for recycling purposes has led the Ministry of the Environment to initiate a national bid for the collection and environmentally-safe disposal of scrap tires. Local authorities will be required to establish sites for scrap tire collection, and used tire producers will convey their waste to these central sites for collection. The results of the tender offer are currently being assessed.

Oil

Used oil is a hazardous substance; its unregulated use and discharge threatens water and air quality. The quantity of motor oil used in Israel, mostly by garages and industrial plants, is estimated at 50,000 tons, of which over 15,000 tons are recyclable. Today, only 7,000 tons are recycled largely due to the high cost of buying and transporting used oil, tax requirements and, until recently, the lack of legislation requiring safe disposal and treatment of used oil. As a result, some 3,000 tons are collected

illegally for unregulated fuel use or incineration, and additional quantities find their way to the sewage system, to the soil and to water sources.

It is possible to treat used oil for clean burning or for oil products or to recycle it for reuse as a base oil through a process of separation, purification and rerefining. The renewed oil then serves as a substitute for imported crude oil products—saving foreign currency. A recently-promulgated regulation, prohibiting the pouring, burning or disposal of waste oil by garages and other producers and consumers, should bring an end to the environmental contamination caused by unsafe disposal of used oil. The regulations require the collection of the oil for disposal at a recycling facility or at the hazardous waste site at Ramat Hovav.

Yard Waste

About 550,000 tons of yard waste, including brush, leaves, grass clippings and small trunks, are produced in Israel yearly. Chopping of this waste to reduce volume, and research on alternative uses (energy production, plywood, substitute for sawdust and straw for animal bedding, compost, and mulching) are currently on the agenda. To promote the idea, several local authorities have been granted financial aid to purchase chopping equipment (e.g. Rishon Lezion, Karmiel, Hadera, Lake Kinneret Authority, and the regional councils of Jezreel, Menashe, and Sha'ar Hanegev). It is hoped that their accumulated experience will aid in the promulgation of regulations prohibiting the burning of yard waste and requiring chopping.

The use of yard waste for mulching is especially attractive because of its water-saving capacity, savings in herbicide use and soil cultivation, and contribution to vigorous growth, moderate temperature changes and prevention of soil erosion. The Jewish National Fund has begun experimenting with mulching using chopped yard waste in a four-hectare area in its forests to check the efficiency and benefit of this use.

Table 3: Estimates of Recycling in Israel

	Total	Post-Consumer
	Metric Tons	
Paper and cardboard	130,000	70,000
Compost	20,000	20,000
Plastic	20,000	5,000
Misc. (metal, glass textiles etc.)	20,000	10,000
Total	190,000	105,000
% Recycled	7.0%	3.9%

Battery Collection

It is estimated that each Israeli uses about 17 batteries per year, or 1.4 kilograms of batteries per family on average. The annual quantity is estimated at 1,500-1,800 tons. About 50 million batteries find their way to waste dumps, threatening groundwater quality or, in case of incineration, polluting the air. In Israel, only car batteries are recycled; the relatively small quantity of household batteries has thus far prevented the development of a viable industry for the collection and recycling of batteries. Therefore, present efforts are being focused on the separation of household batteries from ordinary trash, prevention of their disposal in landfills and promotion of disposal at the Ramat Hovav hazardous waste site.

A national battery-collection campaign, organized by the Ministry of the Environment, in cooperation with local authorities and environmental units, was launched in 1993, to coincide with the inauguration of the Year of the Environment. The Ministry of the Environment has already provided local authorities with over 43,000 specially-designed battery-collection containers. Local authorities are then responsible for distributing the containers in convenient locations and collecting them when full for disposal at the central hazardous waste site at Ramat Hovav. The project is accompanied by a national information campaign featuring posters, stickers, media coverage and special service announcements on television. A follow-up survey will be funded by the Ministry of the Environment in order to draw conclusions from results during the first year.

Cleanliness in the Public Sector

Since the Maintenance of Cleanliness Law was enacted in 1984, special efforts have centered on involving the general public in implementing the law. An innovative—and effective—enforcement feature of the law enables the appointment of cleanliness inspectors from government and public agencies and cleanliness trustees from the general public, empowered to report on littering violations. Special training seminars are organized for these volunteer law enforcers to familiarize them with the provisions of the law. Over the past decade, the number of volunteers who have joined the ranks of Israel's cleanliness trustees has risen from several hundred to 100,000. The goal by the end of 1995 is to further increase their numbers to 250,000. Enforcement efforts, both by police and volunteers, have increased littering reports from hundreds of tickets per year to about a thousand per month.

The Ministry of the Environment, in conjunction with other organizations, also organizes annual anti-litter campaigns, which feature press releases, radio programs, televised special service announcements,

beach cleanups, and distribution of cleanliness stickers and posters in both Arabic and Hebrew.

Legal Framework for Solid Waste Management

The storage, collection and disposal of solid waste are primarily within the jurisdiction of municipalities and are largely governed by municipal by-laws which determine the legal and administrative arrangements for collection and disposal. Regulations promulgated under the Planning and Building Law set out requirements for the size and type of waste containers as well as the size and type of structures for housing these containers.

Siting of landfills and other waste disposal locations is within the authority of municipalities and subject to the Planning and Building Law and its regulations as well as the National Outline Scheme for Solid Waste Disposal.

The Maintenance of Cleanliness Law, 1984, forbids the throwing of waste, construction debris and vehicle scrap into the public domain, or from the public domain into the private domain. It obligates local authorities, either individually or jointly, to establish sites for the disposal of building debris and vehicle scrap. Owners and drivers of public and commercial vehicles are required to affix signs indicating that discarding waste from the vehicle is prohibited. Producers and importers of beverage containers must print or affix a prohibition on improper disposal on the containers. A 1991 amendment to the law broadens its applicability to waste thrown from a vessel and to illegal pasting or hanging of notices and announcements.

The law establishes a Cleanliness Maintenance Fund, administered by the Ministry of the Environment, aimed at concentrating the financial means for maintenance of cleanliness, prevention of littering and sponsoring of educational and enforcement programs. Funds derive from the imposition of a cleanliness fee on manufacturers and importers of disposable beverage containers and from fines paid by violators of the law. In 1993, the Cleanliness Fund budget totalled some $365,000, of which $233,000 were derived from the imposition of the cleanliness fee and the rest from fines.

Within the framework of the Abatement of Nuisances Law, 1961, regulations for the prevention of odors and air pollution from solid waste disposal sites were promulgated in 1990. The regulations prohibit the burning of waste in solid waste disposal sites and require operators to take all necessary means to prevent burning.

Public Health Regulations, in effect since March 1993, prohibit the burning of plastic films used in greenhouses and as plastic covering in agricultural fields and require their collection at the edge of the field for recycling or their transport by the owner to a landfill.

Abatement of Nuisances regulations which prohibit the burning and improper disposal of used oil were promulgated in 1993. Sellers, users and

consumers of motor oil must collect used oil in specially-designated receptacles and must transport it for final disposal to the hazardous waste site in Ramat Hovav or to a recycling facility.

The Collection and Disposal of Waste for Recycling Law was passed in June 1993. The law provides the principles and framework for recycling. It authorizes local authorities, and obliges them when so required by the Minister of the Environment, to allocate sites for recycling centers and to install recycling facilities and containers. Municipalities are authorized to pass by-laws specifying procedures for the collection and disposal of waste for recycling, and business and home owners within a municipality operating recycling centers are required to install and maintain recycling containers in accordance with municipal directives. In order to facilitate the adoption of relevant by-laws by local authorities, the Ministry of the Environment has drafted a model by-law on the collection and disposal of waste for recycling. The model by-law was distributed to all local authorities in Israel.

The Minister of the Environment is authorized to promulgate regulations on the implementation of the law, including types of waste for recycling, types of containers, etc. Regulations, at various stages of preparation or consideration, include: a waste recycling obligation requiring local authorities to prepare at least 10% of their waste for recycling by the beginning of 1995, rising gradually to 25% by the year 2000; a requirement to have manufacturers mark products with the accepted universal code indicating the type of material as well as the appropriate emblem for recyclable or recycled material; bans on the introduction of scrap tires and unchopped yard waste into sanitary landfills; and a deposit program for returnable containers and bottles.

HAZARDOUS SUBSTANCES

Safe management of hazardous substances is one of Israel's most pressing environmental concerns. Appropriate safety and control procedures for the import, manufacture, storage, use and transport of hazardous substances and their wastes must be viewed as an integral element in the day-to-day management of the country.

Management of Hazardous Substances

It is widely acknowledged today, in Israel and worldwide, that the management of hazardous substances is one of the most difficult and complex of environmental problems. Hazardous substances, which encompass thousands of materials, pose a grave risk to human health and the environment—but they are to be found in almost every field of activity: industry, agriculture, commerce, hospitals, research facilities and the home itself. The substances cover a broad range—toxic, explosive, flammable, corrosive, radioactive, chemical-reactive, pathogenic, carcinogenic, and other materials which endanger the environment.

Provisions for the handling of hazardous substances are under the authority of over ten government ministries with responsibility for the implementation of over 100 laws and regulations. While the Ministry of the Environment is the main body responsible for the management of hazardous substances, it coordinates its activities with myriad other bodies. Following is a short survey of the division of ministerial responsibilities in the area of hazardous substances:

- **Ministry of Health**: Extensive authority through the Licensing of Businesses Law, the Pharmacists Ordinance and the Public Health Ordinance to regulate hazardous substances (especially pesticide residues) in food products, as well as in medical and pharmaceutical products and cosmetics. The ministry operates a medical information center on poisons.
- **Ministry of Agriculture**: Complete jurisdiction over the registration and application of pesticides.
- **Ministry of the Interior**: Direct responsibility for firefighting and rescue services during accidents involving hazardous substances and responsibility for the evacuation of the population during such events.

- **Ministry of Labor and Welfare**: Overall responsibility for regulating occupational exposure to hazardous substances through the Safety at Work Ordinance and additional labor laws.
- **Ministry of Transport**: Regulation of the transport of hazardous substances and wastes in air, sea and land according to the relevant legislation, including responsibility for ports and trains.
- **Ministry of Defense**: Control of hazardous substances in military installations and industries and overall responsibility for emergency disaster response through the Civil Defense Law. The Home Front Command (Civil Defense Corps) operates an information center on hazardous substances in conjunction with the Ministry of the Environment.
- **Ministry of Industry and Commerce**: Indirect involvement through the regulation of industry and direct responsibility through the regulation of import and export and as administrator of the Israel Standards Institute.
- **Prime Minister's Office**: Responsibility for regulation of radioactive facilities and wastes.
- **Ministry of Energy**: Responsibility for Israel's petrochemical industry, for electric and fuel utilities and for the supply of fuel and Liquified Petroleum Gas (LPG).
- **Ministry of the Police**: Direct responsibility and command during accidents involving hazardous substances.
- **Ministry of the Environment**: Responsibility for overall management of hazardous substances, including the handling and treatment of hazardous wastes.

Industrial Use of Hazardous Substances

The Hazardous Substances Law, in force since July 1993, provides the Ministry of the Environment with the long-awaited authority for the control of hazardous substances, including licensing, regulation and supervision of the various aspects of their production, use, handling, storage, marketing, import, export and transport. The administrative means for enforcement established by the law include a licensing requirement, in accordance with the Licensing of Businesses Law, for any premise engaged in the sale of hazardous substances, and a poisons permit requirement for any person dealing in toxic substances. Furthermore, authority is granted to the Customs Bureau to stop the delivery of imported toxic substances to anyone not holding the proper permit, and restrictions are placed on the sale of toxic substances by manufacturers, wholesalers and retailers. The holder of a poisons permit, which must be renewed annually, is required to maintain a toxic substances register in which all sales and purchases of poisons are recorded. The law enables an authorized representative of the Minister of

the Environment to enter any premise dealing with hazardous substances, with the exception of pharmacies, for purposes of inspection, investigation or the collection of samples of hazardous substances. This authority provides the Ministry of the Environment with a powerful tool for the control and supervision of hazardous substances.

The Ministry of the Environment is now investing major efforts in preparing the infrastructure for both implementation and enforcement of the law—establishment of the permit system, discovery of the facilities requiring a permit, computerization of data and contacts with customs officials and chemical suppliers to ensure that hazardous waste is not delivered to industries which do not maintain the requisite permit. To deal with the task, the ministry's professional staff, both in the national office and at the district level (where the actual field work is done) has been doubled. It is estimated that some 7,000 businesses are subject to the requirements of poison permits; in the past, within the framework of the Pharmacists Ordinance, only a few hundred permits were issued despite the same requirements.

Still another link in the chain of hazardous substances control was completed with the recent promulgation of Licensing of Businesses Regulations on industrial plants handling hazardous substances. The regulations require owners of industrial plants in which hazardous substances or hazardous wastes are stored, sold, processed or produced (even when the final product is not in itself hazardous) to undertake all necessary measures to treat these materials according to the best available technology and in accordance with manufacturer directions. Owners of plants which handle hazardous materials, in quantities exceeding those defined in the regulations, are required to prepare a file on the treatment of hazardous substances in cases of accident. Owners are also required to present an annual report to the licensing authority, including, *inter alia*, full and up-to-date information on the types, quantities and uses of the hazardous substances in their possession. The regulations, which entered into force in February 1994, should go a long way toward improving safety and emergency response capabilities in industrial plants.

Even prior to the passage of the law and the regulations, the ministry's district offices along with environmental units in local authorities and town associations for environmental quality, worked in accordance with Environment Ministry guidelines—both with regard to the discovery of plants dealing with hazardous substances and with regard to instructions on appropriate methods of storage, handling and disposal. In addition, environmental conditions, requiring, *inter alia*, reports on types and quantities of hazardous substances, storage, monitoring and safety precautions, were imposed on industries by means of the Licensing of Businesses Law. For several new industrial plants, environmental impact statements were required along with programs for environmentally-safe storage, treatment and transport of the hazardous materials.

Today, mammoth efforts are being invested in law enforcement. Some fifty major industrial plants, handling large quantities of hazardous materials, have been identified and targeted for priority treatment. It is expected that ongoing inspection and supervision of these plants will not only improve environmental conditions within these specific sites but will serve as an example to other industries throughout the country.

Pesticide Use

Pesticides used for agricultural and public health purposes constitute a significant percentage of all chemicals found in Israel. These pesticides are hazardous substances, and proper supervision of their use is imperative.

The registration process for pesticides for agricultural use, under the responsibility of the Plant Protection and Inspection Department of the Ministry of Agriculture, begins with intensive investigation and testing. When toxicological data have been gathered, an advisory committee composed of representatives of several ministries, including the Ministry of the Environment, decides whether or not to approve the product for final registration.

While a comprehensive inspection system of pesticide use in agriculture does not yet exist, progress has been attained in one area. Poison permit requirements, under the Hazardous Substances Law, have greatly enhanced the Ministry of the Environment's inspection and supervision capabilities in the case of pesticide storehouses.

The registration process for insecticides for the protection of public health is separate from the registration process for the agricultural use of pesticides. As of 1992, every insecticide permit for domestic and public health purposes must be approved by a statutory committee, headed by a representative of the Ministry of the Environment, and including representatives of the Ministries of Health and the Environment. A recently-signed regulation, under the Hazardous Substances Law, transfers authority for registration from the Ministry of Health to the Ministry of the Environment.

(Further information on the management of pesticides for agricultural use and insecticides for public health purposes is found in the chapters on Agro-Ecology and Pest Control, respectively.)

Transport of Hazardous Substances

The transport of millions of tons of hazardous substances annually is an especially grave problem, since Israel's rail system is not well developed and many of the country's main roads pass through densely-populated areas.

Responsibility for the transport of hazardous substances rests with the Ministry of Transport which has promulgated regulations on the subject. The regulations impose emergency preparation measures, as well as specific packing, labeling and vehicle marking requirements (including the United Nations symbol for hazardous substances). Special licenses must be obtained for both drivers and vehicles. "No Entrance" road signs have been posted to prohibit vehicles loaded with hazardous substances from passing through densely-populated centers.

Contingency Plans and Emergency Procedures

Israel has thousands of plants which produce, use, store and transport millions of tons of hazardous and toxic materials, including fuels. An accident or mishap can bring catastrophic results, both in terms of human life and environmental damage. Improper treatment and disposal have already been responsible for the closing of some water wells in the coastal aquifer. Although studies on safeguarding environmental quality and public welfare during accidents in industrial plants date back to 1980, the Bhopal catastrophe of 1984, in which thousands were killed by a leakage of poison gas from a pesticide plant, precipitated preparations for a system to deal with hazardous substances incidents. Preparations were further expedited by various mishaps in Israel—accidents during the transport of bromine in the Aravah region, and fires in pesticide storehouses in Herzliya and in liquid petroleum gas (LPG) installations in Kiryat Ata.

In 1987, the ministerial committee on hazardous substances and natural disasters set up an interministerial steering committee to study the handling of hazardous substances in Israel, especially during emergencies and natural disasters. The committee's recommendations related to a wide variety of issues: the prevention of accidents in potentially dangerous plants; the supervision and follow-up of safety procedures; guidelines for action in emergencies; the allocation of responsibility among government ministries, local authorities, industry, army and police; plans for dealing with major accidents; and data collection and scientific research. As a first step in the implementation of the recommendations, an information center for hazardous substances was established. The center, which provides information on all matters relating to hazardous materials, operates within the framework of the Ministry of the Environment and the Home Front Command (see below).

Today, the committee continues to coordinate between ministries dealing with hazardous substances, reviews the activities of the information center, follows-up on government preparedness for treatment of hazardous substances and natural disasters, and recommends solutions to various problems in the realms of legislation, inspection and treatment of accidents.

Operational Plan for Hazardous Substances Accidents

While supervision has been enhanced in recent years, accidents along the production-transport route have continued to occur, although fortunately none have developed into major disasters. In recognition of the gravity of the issue, the Minister of the Environment commissioned a study, in January 1993, on the functioning and preparedness of the ministry in this area. It soon became apparent that in order to properly deal with the subject, a national system was needed—a comprehensive operational plan for dealing with hazardous substances accidents whereby each body in the system would have clearcut tasks and responsibilities, both individually and collectively, under the directing arm of a single headquarters.

An interministerial expert team was set up to consolidate the principles of organization and operation which would guide the bodies taking part in a hazardous substances incident. The team, comprised of representatives of the police, Home Front Command, fire and rescue services, Magen David Adom (Israel Red Cross), Ministry of the Environment and several other government ministries, drew up a preliminary model for presentation to the government. In response, the government, in a September 1993 decision, called for the establishment of a national system for handling incidents involving hazardous substances. The government called upon the team to determine realms of responsibility and action for each body during an accident, to decide on the necessary means to be allocated to each body to enable it to accomplish its task, to consider legislative changes to facilitate the work of the various organizations, and to ascertain the required budgetary framework for operation of the entire system.

On the basis of the government decision, a two-pronged contingency plan was prepared, consisting of an integrated action plan specifying the tasks of each body within the framework of the entire system, and a specific action plan for the Ministry of the Environment. The plan relates to the structure, organization and activation procedure of each organization and specifies the responsibilities of all bodies within the integrated system. Its underlying principle is to facilitate optimal response to a hazardous substances incident in order to attain the central aim: rescue of human life and reduction of property and environmental damage.

Broadly speaking, the Home Front Command is responsible for the treatment of incidents involving hazardous materials during emergency or wartime periods; the Israel Police is responsible for commanding and coordinating treatment during normal, non-emergency periods; the fire and emergency services are responsible for dealing with the initial activities at the site of an accident until the arrival of Ministry of the Environment emergency response teams; and these teams are then responsible for detection, monitoring, risk assessment and transfer of the hazardous materials to the Ramat Hovav hazardous waste site.

The system is based on the division of the country into ten central risk

areas; immediate response teams are activated in each area in case of a hazardous substances incident. The country's emergency bodies (police, fire-fighting services and Magen David Adom) are required to arrive at the scene within ten minutes of notification; professional response teams of the Ministry of the Environment are obliged to arrive within 30 minutes of notification.

The report specifies the roles of each of the bodies within each of the risk areas. In the case of the Ministry of the Environment, the six district offices of the ministry are responsible for the ten risk areas as well as for accidents in plants, sites, and on roads within the jurisdiction of each district. Each district will have a response team and an environmental patrol and will be aided by local environmental units, all under the professional guidance of the Hazardous Substances Division of the Ministry of the Environment. The response team will include two branches: one responsible for detection and identification; the other for risk assessment. The national hazardous substances patrol will fulfill the functions of response, calibration, supply of equipment, maintenance, guidance and field advice to the response teams while the ministry's information center on hazardous substances will provide ongoing data, help with risk assessment and coordination among the various forces.

The plan outlines five stages of activity for each of the bodies—preparation (including preventive action such as enforcement and training), three levels of response (immediate, primary and complementary) and rehabilitation. In the case of the Ministry of the Environment, the preparatory stage includes inspection, supervision, law enforcement and training. Immediate response includes arrival of the response teams, initial assessment, and provision of advice to the police headquarters. Primary response includes initial detection, identification and risk assessment, advice to the police command, recommendations on the treatment of the hazardous substances, advice on guidelines to the population and risk assessment. In the next stage, complementary response, monitoring in the affected area is undertaken along with dynamic risk assessment and continued advice to the command headquarters on treatment and neutralization. In the final stage, rehabilitation, the nuisance is removed, damage control is completed, investigations ensue and lessons are learned.

The Hazardous Substances Division of the Ministry of the Environment is responsible for implementing these decisions and is currently completing the purchase of hazardous substances patrol vehicles, protective gear and sophisticated detection and identification instruments. Training courses for the emergency response teams, both theoretical and practical, are already being carried out.

Information Center for Hazardous Substances

In order to implement the wide range of tasks required during emergencies involving hazardous substances and to facilitate enforcement of laws and regulations, up-to-date information must be available on hazardous materials which are used, produced, imported, exported, transported and disposed of in Israel. Such data must relate to quantities, types, characteristics and concentrations of materials found at all levels—industry and institutions on the local, regional and national levels.

For this purpose, an information center on hazardous substances was set up within the Ministry of the Environment's Hazardous Substances Division, in coordination with the existing information center of the Home Front Command. Plans are currently being completed for the unification of these information centers into one centralized Information and Response Center for Hazardous Substances which will supply data on a 24-hour-a-day basis. The unified center will consist of two extensions, civilian and military, with the latter operating during emergency and wartime periods.

The center, which serves the multitude of bodies now dealing with hazardous substances as well as the general public, is first and foremost designed to support the activities of the ministry.

The center collects both quantitative and qualitative data (e.g., toxicity, explosiveness, risk levels) data on hazardous materials in every sector, as well as data on safety, detection, identification, alert, treatment and neutralization procedures. Information is received from importers, suppliers, users, producers and transporters of hazardous substances as well as from the agricultural sectors, government ministries, customs officials, local authorities and licensing authorities.

In addition, the center follows up on all new developments in the area of legislation, regulation and restrictions, both worldwide and in Israel. Such information is vital to support decision making and to improve supervision of the use, transport and disposal of hazardous substances and wastes in Israel.

In order to enable efficient enforcement of both the Hazardous Substances Law and of hazardous waste regulations, information is currently being collected on every facility which uses, produces or stores hazardous substances; all relevant data, including information on key persons and facility layout, are being collected to expedite response capability. Computerized industrial plant files are being prepared, in cooperation with industry, with data on types and quantities of substances in each plant, environmental impacts, and treatment in case of accidents.

Currently, the center uses information sheets in Hebrew on 2,000 substances, an English language data and response system with 4,300 substances and a data file on pesticides including 700 substances. It is connected to international databases and to the computer of the Customs Bureau. Since the center will serve as the focal point of response during

hazardous substances incidents—providing essential information, support and coordination services—efforts are currently being invested in setting up databases on hazardous substances accidents in Israel and elsewhere, on risk assessment and on potential scenarios. Future plans call for computerizing the poison permit system (required by the Hazardous Substances Law) and for computerizing and mapping hazardous substances and hazardous waste locations in Israel.

Materials with Adverse Health Effects

Israeli authorities are increasingly concerned over the long-term health effects of a number of substances. Within the framework of the Ministry of the Environment, a separate division deals with harmful dust, particles and fibers (including supervision of industrial plants handling beryllium and asbestos).

In view of the health hazards associated with exposure to asbestos, measures are being taken to minimize exposure of both workers and the general public to this substance and to monitor concentrations of asbestos fibers in both the workplace and in specific non-occupational environments. The legal aspect of the use of asbestos and other harmful dust is handled by the Ministry of the Environment and the Ministry of Labor and Welfare, within the framework of Regulations on Safety at Work (Industrial Hygiene and Public Health for Workers and the Public at Large Exposed to Asbestos, Talc and Crystalline Silicon Dioxide). These regulations, which cover the subject from both the occupational and public health aspects, were first issued in 1984 and were subsequently amended in 1985, 1988 and 1990 in light of new developments in medical research and technology. An additional draft amendment, further reducing import levels, was recently prepared.

The regulations set a series of requirements relating to hazardous dust in Israel including establishment of standards and safety procedures, requirements for medical checkups, specification of prohibited and permitted substances, and environmental monitoring obligations. A 1990 amendment to the regulations restricts the quantity of imported asbestos and its byproducts to 5,780 tons a year of crude asbestos and 2,500 tons of products containing asbestos cement; broadens the prohibitions on selling asbestos or asbestos components in such products as flower pots, ornamental products, clutches and brake bands of motor vehicles; and prohibits asbestos textile products. The most recent workplace standards for all kinds of asbestos were set at: 0.4 fibers/cm^3 averaged over an eight-hour period (TWA) and 2 f/cm^3, averaged over a 15-minute period (STEL).

Within the framework of the law, the ministry is responsible for the work of a technical committee on asbestos and harmful dust, which is charged with updating the regulations. As part of its routine work, the

committee prepares criteria for the licensing of contractors and other workers dealing with asbestos; authorizes laboratories and examiners dealing with asbestos testing and monitoring; provides guidelines on the removal and disposal of asbestos waste; responds to queries from the general public on possible risks from asbestos exposure; prepares guidelines for the public on means of dealing with substances and products containing asbestos; and collects data on asbestos, within the framework of the national center for information on asbestos and harmful dust. The committee has established a guideline value of 1,350 fibers/cm^3 for ambient exposure to asbestos.

Crude asbestos was introduced into Israel in 1952 when the first and only asbestos cement plant in the country was set up in Nahariya in the north of the country. Monitoring is routinely undertaken in the environs of the plant and thus far, violations have not been recorded. In recent years, special efforts have been invested in locating buildings in which asbestos spraying was used in acoustic walls and ceilings; in risk assessments in schools, kindergartens, plants and other sensitive structures; in removing and disposing of deteriorating asbestos cement; and in providing guidelines on removing and disposing of asbestos-containing insulation material. One of the major projects undertaken in recent years was supervision of the removal of asbestos, applied for acoustic purposes, in the new central bus station in Tel Aviv. In addition, the list of laboratories authorized to test asbestos, talc and crystalline silicon dioxide has been updated, training and study days were organized and quality control testing was initiated to compare test results in different laboratories.

The Ministry of the Environment compiles information from various sources on materials which may adversely affect public health and provides consultation and guidance services to public and private bodies with regard to the long-term impacts of exposure to these materials. The ministry is also an active member of the interministerial committee on carcinogenic, mutagenic and teratogenic materials which identifies substances and chemical processes with long-term health risks. The committee consolidates and updates lists of materials known to be carcinogenic to man and to animals. Recently, it recommended that the use of potassium bromate, a suspected carcinogen, be prohibited as an additive in bread and other baked products.

Treatment and Disposal of Hazardous Waste

Until the mid-1970s, Israeli industries improvised their own methods of hazardous waste disposal—from storage on their own grounds to discharge into municipal waste sites, sewage systems, watercourses, the sea, vacant lots and abandoned quarries. The cumulative quantity of hazardous waste discharged into the environment without supervision or control since the creation of the state is estimated at tens of thousands of tons.

In 1977, Ramat Hovav, located about 12 kilometers south of Beersheba, was chosen as a national disposal site for hazardous waste. Geological, hydrological and demographic factors led to the selection of this location. The original plan for Ramat Hovav envisaged its operation as a treatment plant and not merely a dumping ground. However, from the time of its opening in 1979 until 1987, wastes that arrived at the site were haphazardly received, stored and treated. Facilities for the neutralization of heavy metals, cyanides, acids and inorganic material began operating in 1988, but no satisfactory solution was ever found to the fuel industry's sludge nor to the ever-increasing quantities of organic substances.

The quantities of hazardous wastes which reached the site increased from 7,000 tons in 1985 to 25,000 in 1988 to 48,500 in 1993. The 48,500 figure is really much higher since in-house recycling was undertaken in recent years by a large manufacturer of pesticides, fungicides and agrochemicals in the area. The company, which previously disposed some 20,000 tons of hazardous waste annually at the Ramat Hovav site, now sells its purified acids to a major fertilizer plant for use as raw materials in the production of phosphate fertilizers.

Israel's hazardous waste regulations require that all hazardous waste be properly treated, recycled or deposited in Ramat Hovav. While these regulations are now implemented by the majority of Israel's large-scale industries, solutions have not yet been found to the problems encountered by hundreds of small-scale industries, some producing only a few tons of hazardous substances a year. Efforts are currently being invested in finding economically-feasible methods of transporting the hazardous wastes produced by these plants to the Ramat Hovav site.

The waste which arrives at Ramat Hovav is classified into several major groups, each destined for a specific kind of treatment:

- Acid and alkaline solutions—neutralization.
- Toxic chemicals and metals—detoxification.
- Sludges—storage in sealed collection pools until solidification and incineration.
- Organic substances and outdated and used cytotoxic drugs—storage in a temporary landfill site until incineration.
- Insoluble materials and precipitates—landfilling.

In recent years, serious problems, related both to siting and operation of Ramat Hovav, have resurfaced. An expert committee, appointed to study the problems in 1990, pinpointed several deviations from accepted procedures. To help remedy the problem, the Ministry of the Environment issued special conditions, within the framework of the Licensing of Businesses Law, calling for measures to ensure environmentally-safe operation of the site. However, studies continued to reveal that hazardous leachates from the Ramat Hovav area, including both the hazardous waste site and the industrial area, percolate through the cracked rock above which the site is situated and are slowly transported westward in the

direction of the southern part of the coastal aquifer. A recent research study has confirmed the contamination of both groundwater and the Besor River, the largest of the Negev's rivers. In light of the findings, the Minister of the Environment allocated a special budget earmarked for the implementation of a comprehensive survey on water and soil pollution in the area. Furthermore, the minister took a landmark decision: to close Ramat Hovav and to open a new site to serve as Israel's central site for the disposal and treatment of hazardous waste.

Currently, five alternative sites in the south of the country are being examined. The final decision on siting will be taken after careful consideration and review by a hydrogeologic committee of the Ministry of the Environment. An international tender will then be published to select the company which will establish and operate the new site.

Establishment of the new site is envisioned as a three-year process. The project itself will be accompanied by a special steering committee to ensure that the site is planned and operated in accordance with the strictest international environmental standards. Current plans call for the purchase of an incinerator for the present site, operated by the Environmental Services Company. The incinerator, which will be capable of burning about 15,000 tons of organic materials per year, will gradually rid the area of the large amount of organic material which accumulated at the site over the years, estimated at 40,000 tons. These organic wastes have been stored for years in barrels, "ecological time bombs," which threaten the Besor River and groundwater and are a potential fire risk which could necessitate the evacuation of Beersheba and nearby settlements. After the opening of the new site, an incinerator will be purchased to serve its needs, and activities will be undertaken to clean, neutralize and cover the existing Ramat Hovav site.

Additional Types of Hazardous Waste

Israel is currently reviewing disposal and treatment options for other types of problematic wastes, which are not necessarily defined as hazardous. For example, plans are currently on the table to solve the problem of infectious medical waste. A joint committee of the Ministries of the Environment and Health, working according to guidelines on biological waste set by the World Health Organization, has called for the establishment of 15-20 regional disposal centers at main hospitals throughout the country. These will provide services to all the medical institutions and laboratories in the area, in accordance with a regional service map.

The national system of regional biological waste treatment centers will be based on the development of a model for disposal and treatment in one specific area. Efforts are being concentrated on reviewing means of disposal

and identifying the types of institutions that will be required to dispose of their wastes in these centers, including laboratories, dental clinics and veterinary laboratories. A survey of institutes in each area will be carried out and methods of collection will be studied. One possible solution is the use of autoclaves together with a shredder as a preliminary step to disposal in a sanitary landfill. Biological waste composes the bulk of the average 2,000 tons of non-radioactive hazardous waste produced by hospitals each year. Currently most of it lands up in garbage dumps where it poses environmental and health hazards. The waste includes bandages, syringes, test tubes, infected cotton wool, incontinence pads and sanitary towels.

Another issue currently being reviewed is the disposal and treatment of sludge. It is estimated that some 600 kilos of sludge per thousand people are produced each day, all over the country. An Environment Ministry team has consolidated a policy which would require sewage treatment plants to treat the sludge to a point where it will not cause odors nor attract insects. Some 30%-50% of the sludge will then be used for fertilization and stabilization of soils, with the rest earmarked for landfill disposal. Land application of the sewage will be conditional upon the receipt of an annual permit from the Ministry of the Environment. Approval will be contingent on proof that the local authority in whose jurisdiction a sewage treatment plant operates has fulfilled its obligations with regard to the treatment of industrial effluents.

Recognition of the threat posed by used oil to water and air quality led to an important breakthrough in 1993: the promulgation of Used Oil Regulations which prohibit the burning and improper disposal of used oil. Under the terms of the regulations, sellers, users and consumers of oil (for lubrication, insulation and similar uses) may only dispose of used oil through its collection in specially-designated receptacles and their subsequent transport and disposal to the hazardous waste site in Ramat Hovav or to a recycling facility.

Another important breakthrough was achieved in the area of separation of hazardous waste from domestic waste. A nationwide battery-collection drive, backed up by a massive public information campaign, was launched within the framework of the Year of the Environment in Israel. The campaign is encouraging the public to discard used batteries in specially-designated containers dispersed in convenient locations throughout the country. Local authorities are then responsible for the transport of the batteries to the hazardous waste site in Ramat Hovav.

Legal Framework for the Management of Hazardous Substances

Hazardous substances management is still controlled by a variety of legal provisions, under the responsibility of different enforcement

authorities. To provide for the safe management of hazardous materials, a comprehensive hazardous substances control law is required to unify the regulatory framework, restrain or eliminate potential dangers to health and the environment, and provide the necessary authority for inspection, supervision and enforcement. In addition, a central authority must be established to deal in a comprehensive manner with the "cradle to grave" management of hazardous substances. The recently-completed contingency plan for the integrated organization and operation of all bodies taking part in hazardous substances accidents may serve as a model for the establishment of a central coordinating authority on hazardous substances.

Today, the Hazardous Substances Law of 1993 is the central legal tool for the management of hazardous substances in Israel. The law originated from the separation of existing authorities within the framework of the Pharmacists Ordinance and is based upon the government decision to transfer responsibility for hazardous substances from the Ministry of Health to the Ministry of the Environment, with the exception of medical drugs. The Hazardous Substances Law, with its attached listings of toxic substances and hazardous chemicals, provides the Ministry of the Environment with authority for more comprehensive management of hazardous substances, including licensing, regulation and supervision of various aspects of their production, use, handling, storage, marketing, import, export and transport. The law establishes a licensing requirement, in accordance with the Licensing of Businesses Law, for any premise engaged in the sale of hazardous substances and a permit requirement for any business dealing in poisons.

The law authorizes the Minister of the Environment to promulgate regulations on the classification of poisons and on the treatment, use, production, import, export, packaging, commerce, transfer, storage, maintenance and use of hazardous substances.

Israel is expected to ratify the International Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention) in the very near future. In order to conform with the requirements of the convention, the Ministry of the Environment has recently completed draft regulations, under the Hazardous Substances Law, which deal with the import and export of hazardous wastes.

A major step forward occurred in 1990, when the Ministry of the Environment promulgated regulations pursuant to the Licensing of Businesses Law and the Public Health Ordinance, which require industrial plants to dispose of hazardous wastes at the Ramat Hovav site no later than six months after production. Procedures for inspection and supervision, manner of packing, transport and disposal to Ramat Hovav, are specified in these regulations. Any disposal elsewhere, for purposes of recycling, reuse or other treatment, must be approved in advance by the Ministry of the Environment.

A recent amendment to the law identifies a hazardous substance as a

material listed in the UN's Recommendations on the Transport of Dangerous Goods. The amendment also broadens the definition of "industrial plant" to include any place, which is not a household, in which hazardous materials are dealt with, transported or stored.

A 1991 amendment to the Commodities and Services (Control) Order on pest control provides for an equal number of representatives from the Ministry of the Environment and Ministry of Health on the committee empowered to grant licenses for insecticides used in public health and domestic use. A recently-signed regulation under the Hazardous Substances Law provides the Ministry of the Environment with responsibility for the registration of insecticides for the protection of public health.

Licensing of Businesses Regulations on hazardous industrial plants were promulgated in 1993 and require owners of industrial plants in which hazardous substances or wastes are stored, sold, processed or produced to take all necessary measures to treat these materials according to the best available technology and to manufacturer instructions. Owners of industrial plants handling hazardous materials are required to prepare and maintain a file on the treatment of hazardous substances in case of accident. The regulations, which entered into force in February 1994, should go a long way toward improving safety and emergency response capabilities in plants.

Used Oil Regulations, under the Abatement of Nuisances Law, the Licensing of Businesses Law and the Water Law came into effect in December 1993. The regulations call for the collection of used oil in specially-designated receptacles for eventual disposal either to the Ramat Hovav hazardous waste site or to a recycling facility.

The Safety of Workers Law covers the handling of harmful substances in the workplace, while the Public Health (Foods) Ordinance provides for the establishment of standards for maximum permissible levels of harmful substances—pesticides, for example—in food.

A 1991 amendment to the Regulations on Safety at Work (Industrial Hygiene and Public Health for Workers exposed to Asbestos, Talc and Crystalline Silicon Dioxide) reflects Israel's increased concern with the improper use of asbestos and its byproducts. The amended regulations restrict the import of asbestos, set strict standards on worker exposure, broaden the prohibitions on the marketing of asbestos and its compounds in various products, and prohibit textile products containing asbestos. The Ministries of the Environment and of Labor and Welfare are responsible for implementing the regulations.

MARINE WATER AND COASTS

Israel's Mediterranean and Red Sea coastlines are among the country's most valuable natural assets. Their protection from pollution and from the often conflicting demands of urbanization, industrialization, agriculture, recreation and tourism, is of utmost importance.

The Mediterranean Coastline

Israel's Mediterranean coastline stretches some 195 kilometers from north to south. This generally sandy coastline can be divided into four morphological sections according to physical characteristics and sedimentological properties:

1) Rosh Hanikra to Acre—a sedimentologically isolated region with abraded rocky platforms and narrow beaches;
2) Haifa Bay—a region of wide sandy beaches bounded by the Acre promontory on the north and the Carmel mountain range on the south;
3) The Carmel coastal plain—a region consisting of three low parallel ridges of calcareous sandstone, parts onshore and parts offshore, with relatively narrow sandy beaches;
4) South of Caesarea—a region of sandy beaches occasionally interrupted by sections of calcareous sandstone cliffs up to 40 meters high.

The major ecological feature of the Mediterranean coast of Israel is that it constitutes the northernmost sector of the Nile littoral cell, which extends from the coastal zone of the Nile Delta to the end of Haifa Bay at Acre. This cell is composed of quartz Nilotic sand which is transported along the coasts of Egypt, Sinai and Israel until Haifa Bay. The net yearly sand transport within the surf zone decreases from about one million cubic meters at the Nile Delta to about 250 thousand cubic meters at Ashkelon and to zero somewhere between Hadera and Haifa. Beyond the surf zone, the sediment transport is estimated to be about one order of magnitude larger at the Nile Delta, decreasing to about 500 thousand cubic meters at Ashkelon and about 100 thousand cubic meters off Haifa.

About 70% of Israel's population of 5.3 million lives within 15 kilometers of the Mediterranean coastline, and the country's major economic and commercial activity is concentrated here. During the warm months, hundreds of thousands of Israelis and tourists flock to 80 authorized bathing beaches (about 25 kilometers) and to other coastal stretches which are open to the public (about 125 kilometers).

Other activities which affect the coastal environment are the industry, refining and commerce that take place in the ports of Haifa, Ashdod and Ashkelon and power generating facilities along the coast which use Mediterranean waters for cooling. These facilities account for another 15 kilometers of coastline. The remainder of the coast is closed to the public.

The coastal strip also contains Israel's most fertile agricultural land. Severe conflicts have arisen between the expansion of urban settlements along the coastline and the preservation and protection of this agricultural land.

The Gulf of Eilat

The 14-kilometer-long Gulf of Eilat, internationally known as the Gulf of Aqaba, can be divided into three sections: a gently sloping sandy shore along the northern shore; narrow, coarse sand and pebble beaches along the central shore; and a narrow shore with coral reefs at the southernmost edge.

The Gulf of Eilat, at the northern end of the Red Sea, offers a clear example of the often conflicting demands of tourist, industrial and environmental interests along a limited coastline. Eilat is both an international tourist center and an industrialized port town with a major oil terminal. Its wide sandy beaches slope gently underwater to 100-150 meters offshore, from where the sea floor abruptly drops to 600-1,500 meters. The climate is typically desert: very low precipitation and over 340 clear, sunny days a year.

The Gulf of Eilat is the world's northernmost tropical sea ecosystem. Its oxygen-rich water has a constant temperature of 21°-24°C, and it supports a dense population of more than 100 species of coral, 800 species of fish, and hundreds of species of crustaceans and molluscs. Established as a nature reserve in 1965, the coral reef is a major tourist attraction with its underwater observation chamber, dolphin park, glass-bottomed boats, tourist submarine, and swimming, snorkeling and scuba diving activities.

Most of the northern section of the western shore is occupied by port facilities. Deep water adjacent to the shoreline in the protected waters of the Gulf enables anchorage without the need for offshore breakwaters. The port facilities handle bulk cargo, oil and vehicles.

Marine Pollution Control

Israel deals with all aspects of marine pollution: accidental and emergency oil and chemical spills from ships or terminals; polluting discharges from industrial or municipal land-based sources; dumping of waste at sea; airborne pollution into the marine environment; and litter in the sea or on beaches. The scope of activity includes prevention, abatement, law enforcement, and scientific research and monitoring. The Marine and

Coastal Environment Division of the Ministry of the Environment is the national authority responsible for these activities.

The division has adopted a multi-faceted working plan consisting of the following:

- Detection of environmental problems along Israel's marine coastlines and territorial waters;
- Prevention and abatement of all types of marine pollution;
- Enforcement of national laws related to protection of the marine environment;
- Updating of relevant legislation in accordance with international conventions and modern environmental criteria.

Marine pollution prevention along Israel's coasts is carried out by highly-skilled professional inspectors equipped with a boat, vehicles and other instruments for monitoring and enforcement. Inspectors carry out marine and coastal surveillance and make routine inspections of vessels calling at ports, shore installations handling oil, industrial plants and wastewater treatment plants in local authorities. In 1993, 410 inspections of ships and tankers arriving at Israeli ports were made along with hundreds of observations of fueling procedures. Some 95% of the vessels checked maintained oil record books, held an international oil pollution prevention certificate and complied with regulations on the loading and unloading of oil.

In addition to serving a deterrent function, Israel's marine pollution inspectors investigate violations of the law by vessels or coastal facilities and file legal charges where warranted. In 1993, thirty investigations of pollution events were opened.

Dozens of reports on marine oil pollution reach the Ministry of the Environment each year, involving anywhere from a few liters to dozens of tons of oil. Pollution incidents on the Mediterranean coast are generally attributed to oil discharge from vessels and tankers, oil leakage from marine fueling facilities and oil discharge from land-based sources. Pollution in the Gulf of Eilat generally results from oil discharged by tankers, ships and smaller vessels such as yachts. In most cases, response time is quick and treatment proceeds efficiently. Cleanup operations are carried out either directly by marine pollution inspectors or by means of contractors working under their direct supervision. In 1993, 13 cases of pollution were dealt with by the marine pollution staff in Eilat or by subcontractors, under their supervision, in the Mediterranean. Cleanup costs are imposed on polluters in accordance with the "polluter pays" principle.

In recent years Israel has made significant progress in pollution prevention and protection of the marine environment. Funds for combating marine and coastal pollution and for cleanup operations are generated by the Marine Pollution Fund, totalling $700,000 annually. Income is derived from fees imposed on all oil terminals and ships calling at Israeli ports and from fines collected from violators of marine pollution prevention laws and regulations.

Pollution Control in Eilat

Following the reopening and deepening of the Suez Canal in 1979, a dramatic decrease in the volume of oil unloaded at Eilat terminal occurred. While in the 1970s, up to 35 million tons of crude oil per year were unloaded at the terminal for transfer via the Eilat-Ashkelon pipeline for refining or trans-shipment from the Mediterranean coastal plain, today the quantity has decreased to about 3-4 million tons. Present quantities, however, may increase once again as progress is achieved in the Middle East peace talks, and new sources of oil supply are opened up to Israel. Today, the fragile ecological system of the Gulf of Eilat is endangered by intensive development. A single major oil or chemical spill can severely damage this unique area. Small operational spills have not been uncommon at the Eilat terminal; to date, the most serious incident, which occurred in the mid-1980s, resulted in a loss of 120 tons of oil. Yet, concern remains high because of the close proximity of the highly sensitive coral reef which is situated to the south of the terminal. Since the prevailing winds and currents are predominantly from the north, the coral reef is at high risk.

The threat to this sensitive ecosystem is compounded by the extreme depth of the water within the Gulf of Eilat which makes the salvaging of cargo, in case a loaded tanker sinks, virtually impossible. Furthermore, the entrance to the Gulf at the southern tip of the Sinai peninsula is prone to collisions, while the nearby busy commercial port at Aqaba adds yet another pollution threat.

The major sources of risk to the area include: spills from maritime activity and oil transport in the Gulf, chemical pollutants entering the Gulf during transport and loading of phosphates, potash, bromides and other cargoes, microbial pollution from municipal wastewater discharge, unregulated mariculture, litter thrown from vessels or left on beaches, and physical damage to the coral reef by anchors and by scuba or snorkel divers.

Eilat's capacity for marine pollution control was dramatically improved with the inauguration in 1991 of a newly-expanded pollution control and response center. The center is manned 24-hours-a-day by professional marine pollution inspectors.

The station's principal goals are:

- To serve as a logistical base for marine pollution control and prevention activities in the Gulf;
- In case of a spill, to protect the coral nature reserve by quick deployment of mechanical containment and recovery equipment;
- To treat spills in the northwestern part of the Gulf;
- To serve as a base or "core" for large-scale operations.

The station is located on the shore, north of the coral reserve, so as to prevent oil spills from reaching the reserve by the prevailing northerly winds. Because of the oceanographic and meteorological conditions of the bay, time is of paramount importance, and the unit has a response

capability of half-an-hour at most. The moment a spill occurs, the unit mobilizes to intervene and contain the spill with booms so that it can be skimmed offshore. The center, the only one of its kind in the area, is capable of dealing with spills as large as a few hundred tons.

Over $500,000 were invested in new equipment for the station in 1990-1. A pier, slipways, working and rinsing platforms, sheds and modern housing and storage facilities were constructed to serve the station. A small swift vessel was purchased for year-round inspection and emergency marine pollution control equipment. Pollution abatement equipment includes various types of skimmers, pumps, booms, tanks, oil separators, containers and absorption materials. Supplies slated for acquisition in 1994 include additional booms and sorbents and new-generation dispersants and spraying equipment. Heavier equipment, such as tug boats and barges, are currently mobilized upon request from Eilat Port and the oil terminal.

The use of older type chemical dispersants is strictly prohibited in the Gulf due to its special ecologic sensitivity. Advanced dispersants, however, are now being evaluated for use in deep water only, the major concern being to avoid contact of the oil with the coral and its associated fauna and flora. Primary reliance remains on containment and recovery techniques in order to deflect the oil to shore where it can be collected by skimmers, vacuum trucks and a number of manual and mechanical methods supplemented by the use of advanced sorbents.

The Gulf of Eilat's pollution control capabilities will be further expanded in the near future as a result of progress achieved within the framework of the multilateral peace talks on the environment. In view of the sensitivity and importance of this area, Israel, Jordan and Egypt have agreed to cooperate in combating pollution in the Gulf of Aqaba. A contingency plan for the area has already been prepared whereby the three parties will place pollution control equipment at each other's disposal in case of an oil spill. The equipment will be placed in marine pollution prevention stations in Aqaba, Eilat (within the framework of the existing station) and Nueiba in order to enable quick response and cooperation in protecting this fragile environment.

Non-oil sources of pollution in Eilat are also being addressed with considerable success. An especially welcome development is the anticipated halt (in September 1994) of sewage discharge by the municipality into the Red Sea, a practice which has plagued the city's beaches for decades. Criminal charges filed against the municipality have led to a court order obliging the city to discharge its effluents through a 40-kilometer-long pipeline to the north of the bay where the reclaimed wastewater will be used for the irrigation of date fields.

Yet another issue which has begun to manifest itself in recent years is mariculture development. The culture of marine fish and shellfish is at an advanced stage of development and promises to develop into a major food production industry. Since 1992, several developers have requested

guidelines on means of preventing marine pollution from farming technologies based on sea cages. While such issues as the geochemistry and ecology of sediments under commercial fish farms are being studied, supervision at this stage is insufficient. New efforts are being invested in the formulation of guidelines for mariculture control at this time.

Oil Pollution Control in the Mediterranean

The threat of oil pollution on the Mediterranean coast stems from the operation of ports and oil facilities. The ports of Ashkelon and Haifa are oil refining, trans-shipment and commercial centers, while Ashdod port serves as the major center for cargo traffic in the country. Several relatively small offshore mooring-buoy systems at the Hadera, Tel Aviv and Ashdod power stations and the Haifa and Ashdod oil refinery complexes also present a threat of accidental spills. Since the number of cargo and passenger ships arriving in Haifa and Ashdod ports is on the increase, as is the loading and unloading of oil near coastal installations, the risk of major spills is considerable.

In other areas of the coast, there is less danger of a major oil spill. The sandy nature of the bottom along most of the coast reduces the chances of a major disaster as a result of grounding. However, a major accident in the heavy traffic area at the northern entrance to the Suez Canal could cause extreme damage to the long and straight coastline of southern and central Israel.

All Israeli ports have reception facilities for oily bilge and ballast waters. In the event of a major spill, these facilities could be utilized to store "clean" recovered oil prior to its transfer to refineries for treatment. Oily sand would then be moved to the backshore to await treatment by bioremediation techniques while other debris recovered from cleanup operations would be directed to quarries used for municipal waste disposal, which are considered safe with regard to groundwater contamination.

Due to the lack of sufficient resources, stockpiles of equipment along the Mediterranean coast do not exist. Consequently, the methodology thus far has been to wait until the spill reaches the shore where it is cleaned using manual and mechanical recovery techniques. Equipment for beach cleaning largely consists of tractor-drawn machinery, owned by coastal municipalities and private contractors, and used in routine beach cleanups of trash and tar lumps. An inventory of available equipment and its location as well as existing disposal sites for oil, oily water and oily sands has been prepared for incorporation into contingency plans.

Bioremediation has been successfully used for shore cleanup in a few cases in recent years. In 1991, bioremediation was successfully used to treat some 270 tons of heavy oil which contaminated an eight-kilometer area in Haifa Bay. The accident occurred as a result of a tear in an underwater

flexible pipeline of the open sea terminal of the Haifa oil refineries. Soon after the incident, it was decided to allow Tel Aviv University and Makhteshim Chemical Works researchers to undertake cleanup and treatment by means of oil-eating bacteria. The Israeli development degrades oil into harmless carbon dioxide and water through the simultaneous use of six active components—oil, oil-eating bacteria, oxygen, water and two nutrient-fertilizers, nitrogen and phosphorus, essential for the bacteria's growth. The non-dissolving fertilizer adheres to the oil and when the oil is consumed, the bacteria die off. The method constitutes an important breakthrough in oil-spill cleanup, preventing the removal and dumping of tons of precious sand from the coastal environment. Bioremediation will continue to constitute the treatment method of choice in all future cases of oil-contaminated coastal stretches.

Concern over the impact of large-scale pollution has recently led the Ministry of the Environment to issue guidelines on the use of advanced (third and fourth generation) dispersants. Use of such dispersants requires the prior, written authorization of the director general of the Ministry of the Environment and must be carried out under the supervision and guidance of the ministry's marine pollution control inspectors.

Requirements for dispersant use include:

- Performance of tests for toxicity, efficiency, biodegradation and non-inhibition of biodegradation of oil by the dispersant;
- Prohibition of dispersant use in water shallower than 30 meters offshore of coastal national parks, marine reserves, bathing beaches or specially protected areas;
- A minimum distance of one nautical mile near threatened marine or island nature reserves;
- A minimum water depth of 20 meters in other areas.

In cases which present a threat to human life or in emergency conditions, a permit for dispersant use may be approved by the Ministry of the Environment.

Contingency Plans for Large-Scale Oil Spills

While Israel is equipped to effectively combat small and medium-scale oil spills in the Mediterranean, the country still lacks the capability to effectively respond to large-scale oil spills. According to a contingency plan, formulated by the Shipping and Ports Administration of the Ministry of Transport, an *ad hoc* emergency headquarters will be set up in case of an oil spill emergency. The headquarters, commanded by the director of the Shipping and Ports Administration and including representatives of the Ministry of the Environment, Ports Authority, Israel Defense Forces, Coast Guard, local authorities and other relevant groups, will give first priority to saving the lives of the crew and saving the ship. Once these operations

are completed, the same headquarters will continue to operate under the command of the head of the Marine and Coastal Environment Division of the Ministry of the Environment. In practice, most operations at sea are directed and supervised by the Shipping and Ports Administration while spill abatement at sea (if any) and shoreline cleanup are directed by the Ministry of the Environment. Operations have thus far been conducted according to *ad hoc* judgement on a case by case basis.

Further progress in the preparation and implementation of a national contingency plan is anticipated as a result of regional efforts. Within the framework of the Regional Marine Pollution Emergency Response Center for the Mediterranean Sea (REMPEC) and the International Maritime Organization (IMO), neighboring coastal states have been assisted in preparing cooperative operational agreements. Cyprus, Egypt and Israel have already prepared a subregional agreement for preparedness and cooperation in response to medium and large-scale oil spills. According to the contingency plan, each state will have a stockpile of marine pollution abatement equipment which would be put at one another's disposal in case of a spill in open waters. Using their joint forces, the states (which will also join forces in a cooperative task force, common exercises and common training) will be able to deal with a spill of up to 15,000 tons.

Based on the recommendations of a UNEP and IMO expert mission to Israel in the summer of 1993, Israel's own oil combating capability will be significantly boosted with the establishment of two oil pollution combating centers in Haifa and Ashkelon, capable of dealing with spills of up to 4,000 tons. Purchase of equipment, with the aid of the European Union, is slated to begin in 1994.

Dumping of Waste

The dumping of waste into the sea from a vessel or aircraft is regulated through a strict permit system instituted in 1984. The regulations list categories of substances prohibited or permitted to be dumped into the sea and establish procedures and considerations for issuing permits. Thus far, only three types of dumping have been authorized: the dumping of coal ash by the Israel Electric Corporation, the dumping of industrial sludge by Haifa Chemicals and, to a lesser degree, the dumping of saturated saline solutions by Frutarom in Haifa Bay. Even when permitted, dumping must comply with detailed regulations specifying the maximum level of heavy metals in the residue, the distance from shore, the sea depth and rate of sedimentation at the dumping site, and the type of vessel used to transport the waste. In addition, a monitoring program must be implemented around the dumping site. Severe penalties are imposed for unauthorized dumping.

Until recently, ash produced at the Hadera power plant was used extensively by the cement industry and by the power plant for building a

ramp around the facility. The remaining unused ash was dumped at sea, under controlled conditions. The Israel Electric Corporation is currently examining several other applications of the coal ash. In the meantime, the amount of coal ash dumped into the Mediterranean has been drastically reduced due to an agreement between the Ministry of the Environment, the Electric Corporation and the Hadera municipality which would allow the use of coal ash in the landscape planning of the long overdue Hadera River Park.

Land-Based Sources

Major progress has been made in the prevention of pollution from land-based sources, including domestic and industrial waste, agricultural runoff and river discharges, due to the enforcement of the Prevention of Marine Pollution (Land-Based Sources) Law and its accompanying regulations. The regulations, which entered into force in 1990, prohibit the discharge of any waste or wastewater into the sea without a permit. As a result of increased law enforcement, the discharge of waste from a number of polluting plants was halted; binding plans, replete with timetables, for stopping waste discharge into the sea were drawn up for industrial plants and municipalities; discharges which are not damaging to the marine environment (e.g. salts or cooling water of power plants) were approved, in exceptional cases, by an interministerial permits committee pending installation of appropriate pollution abatement facilities; and microbial pollution was reduced in coastal areas as a result of the operation of modern wastewater treatment plants, especially in the Tel Aviv metropolitan area.

This year, the oil refineries, major polluters of the Haifa coastal area in the past, have totally stopped discharging their effluents following the successful operation of their new oil separators. Another ten industrial plants, deemed to be major polluters of the marine environment, have either halted the discharge of their wastes completely or now discharge their effluents in accordance with strict international standards. The most recent breakthrough occurred in June 1994 with an agreement to connect Israel Military Industries, a major polluter of the Carmel beaches, to the sewage system of the municipality of Tirat Hacarmel, following treatment of the plant's wastewater to the requisite level. At present, four major industrial polluters and a number of smaller plants still discharge their effluents into the marine environment under a temporary permit, pending full stoppage of the discharge or regulated discharge within two years.

In addition to efforts directed toward the industrial sector, law enforcement is currently being focused on local authorities, most notably Nahariya and Acre, which still discharge untreated or minimally-treated sewage into the sea, and Ra'anana which discharges its sewage through

the Poleg River. During the past year, several investigations against offenders of the law were initiated, and in some cases, legal charges were pressed. The results have been encouraging. Legal claims have led to the installation of treatment facilities and to higher effluent standards. In order to fully stop all discharge of sewage into the sea, either routinely or due to an operational failure in treatment facilities, high priority is being accorded to the establishment and/or improvement of sewage treatment plants in local authorities.

Chemical pollution—deriving from industrial effluents, port chemical terminals and ships transporting chemicals—is carefully controlled. Significant reductions in the quantities of treated or partially treated industrial effluents reaching the sea have occurred. Handling procedures for chemicals shipped to and from Israel are designed to ensure maximum safety to the environment, thus preventing many chemical spill incidents from occurring. Furthermore, all tank washing activities are carried out according to regulations issued by the International Maritime Organization, and no significant pollution from this source is expected.

Bathing Water Standards

Routine microbial tests at Israel's authorized beaches are conducted by the regional public health laboratories of the Ministry of Health. Local authorities are required to sample water quality at the authorized beaches under their jurisdiction and to transfer the samples to the Ministry of Health.

In 1992, an updated modern standard for seawater quality was published by the Environmental Health Department of the Ministry of Health. With very few exceptions, Israel's authorized beaches comply with the requirements incorporated in the standard, which are based on some of the most stringent criteria worldwide. At the beginning of the 1994 bathing season, only one bathing beach remained closed—the Poleg beach in Netanya. The beach has been closed to the public for three seasons due to the discharge of sewage from Ra'anana to the Poleg River and from there to the sea. The problem will be solved with the operation of Ra'anana's new wastewater treatment plant, now in its planning stages.

While in the past, many local authorities shirked their responsibilities with regard to the frequency of testing required by the Ministry of Health, a significant improvement in the frequency of sampling was noted in recent years. Samples are taken once each week during the bathing season (May through October) and once a month during the winter. When contamination is deemed to pose danger to the health of bathers, the public is notified immediately.

According to the new standard, public bathing is prohibited in the following circumstances: epidemiological evidence of infectious disease

connected with bathing in the beach; discharge of sewage in the vicinity of the bathing beach; detection of excrement on the beach or in the sea; presence of conditions which may endanger the health of bathers; and water which does not meet the following water quality standards:

- The geometric mean of tests taken during the season at the bathing beach must not exceed 200 fecal coliform bacteria per 100 milliliters of sea water; individual samples must not exceed 400 fecal coliform bacteria in more than 20% of all the samples;
- If more than 400 fecal coliform bacteria are discovered in a single sample, a follow-up test is required within 24-48 hours. The follow-up test must include three water samples taken from three different locations along the bathing beach;
- If one or more of the follow-up samples shows a result in excess of 400 fecal coliform bacteria, an inspection must be performed to locate the source of the contamination.
- If the results indicate danger to public health, the Ministry of Health must prohibit bathing at the beach until completion of the inspection and cessation of the contamination. The resumption of bathing will be determined on the basis of inspection results.

Litter

Solid waste, including nylon, plastic, bottles and driftwood, contributes significantly to the aesthetic degradation of the shores. While current and wind regimes in the eastern Mediterranean are responsible for the deposition of significant quantities of waste from other states on Israel's shores, at least half the litter on the beaches is left behind by recreationers and bathers.

While local authorities are responsible for the regular cleaning of all authorized bathing beaches in Israel, these beaches constitute only a small percentage of the Mediterranean coastline (25 kilometers). Since 1984, the Ministry of the Environment (through the Marine Pollution Prevention Fund and later through the Cleanliness Fund) has financed the cleaning of all open beaches twice during each bathing season. The cleaning itself is conducted by local authorities under the supervision and guidance of marine pollution inspectors.

In recent years, several large-scale volunteer cleanup campaigns have been undertaken, both to clean beaches and to increase education and awareness. In June 1993 and 1994, in conjunction with Israel Environment Week, thousands of volunteers—children, soldiers, government officials, diplomats, the general public and staffers of the Ministry of the Environment and Society for the Protection of Nature in Israel (SPNI)–flocked to some 40 kilometers of shoreline to take part in massive cleanup campaigns. Last year, in Israel's largest-ever volunteer beach cleanup, some

6,000 volunteers collected about 13,000 garbage bags, weighing over 100 tons, in one day alone. This year, over 20 tons of trash were collected in 2,800 garbage bags by over 1,500 volunteers, most of them students. Plastic constituted the largest component of the litter in both years (nearly 70%), followed by metal (mostly beverage cans), wood, glass and other articles.

The cleanups, which won wide media coverage, were accompanied by a lovable mascot, courtesy of HELMEPA, the Hellenic Marine Environment Protection Association. The friendly seagull (named Hofi a nickname meaning "beachy") was featured on stickers, posters and information pamphlets—as well as on the T-shirts and hats donned by the volunteer cleanup squads as they worked to rid Israel's coastlines of unsightly litter.

·HELMEPA·

To facilitate the maintenance of cleanliness throughout the entire year, the Ministry of the Environment has distributed some 1,800 waste collection receptacles along the country's 125 kilometers of unauthorized beaches. Volunteers from the SPNI's youth clubs regularly distribute garbage bags to bathers during every weekend of the summer season, calling for the public's help in maintaining clean beaches. Within the framework of International Beach Cleanup Day in September, some 45 states, including Israel, launch volunteer coastal cleanups.

This year, a unique innovation was introduced into the beach cleanup campaign: an underwater cleanup project in Eilat. The campaign, organized by the Ministry of the Environment and the Israel Diving Federation, with the active cooperation of Eilat's diving clubs, included the participation of

200 divers along a 4-kilometer stretch. The aim of the underwater cleanup: to rid the water of unsightly and environmentally-harmful waste. About two tons of underwater litter were collected—more than 70% composed of beer cans and wine bottles.

There has been an enormous reduction in the amount of tar along Israel's Mediterranean beaches—from 3.6 kilograms per meter in 1975 to less than 20 grams per meter today. The decrease is attributed to improved maritime enforcement, implementation of international conventions, better enforcement and inspection, technical developments in fuel container ships and coastal installations, a significant reduction in the amount of oil transported along Israel's coasts and rapid action when spills occur.

International and Regional Conventions

Israel is an active participant in the Mediterranean Action Plan (MAP) which provides an important forum for regional environmental activities. The plan was adopted in 1975 under the auspices of the United Nations Environment Programme and is widely acclaimed as a model of regional cooperation.

Israel has signed and ratified the 1976 Barcelona Convention for the Protection of the Mediterranean Sea against Pollution and its related protocols, and has actively participated in all components of the plan (the Blue Plan, the Priority Actions Programme and the monitoring and research program known as MEDPOL). Israel has also signed and ratified the MARPOL 73/78 Convention and Annexes 1 and 2 of the convention.

Efforts are currently being made to sign, ratify and implement Annexes 3, 4 and 5 of the MARPOL 73/78 Convention as well as the 1990 Oil Pollution Responsibility and Cooperation Convention (OPRC) and international agreements for compensation in case of large-scale accidents—Civil Liability Convention and the IOPCF (Funds) Convention.

Israel was one of the first Mediterranean states to sign a long-term national monitoring agreement within the framework of MEDPOL. Studies include systematic monitoring of heavy metals along the Israeli coastline, microbial pollution in bathing beaches, and monitoring of atmospheric pollution input into the Mediterranean in Ashdod and Hadera. These surveys have shown that the level of pollution along the Israeli coastline is relatively low compared to other industrialized countries, with the exception of Haifa Bay where higher concentrations of mercury and cadmium were detected. Nevertheless, all Israeli coastal waters meet international standards for chemical and bacterial pollution.

Marine Pollution Research

Israel's research institutes take an active part in the research component of MEDPOL. This program is designed to provide a better understanding of the processes and phenomena involved in the complex mechanisms of pollution. Research proposals submitted by Israeli scientists in 1994 include:

- Transport of nonspherical particles in time-periodic shear flows—expected to contribute to the understanding of pollutant dispersion processes in the sea and the atmosphere;
- Monitoring of the spatial and temporal distribution of phytoplankton pigments and suspended matter in the southeastern Mediterranean—expected to contribute to the development of a remote sensing monitoring system for phytoplankton and suspended matter;
- Transport and inventory of mercury from point sources in Haifa Bay—expected to improve the understanding of the fate of mercury emitted by two point sources into Haifa Bay;
- Marine vegetation of Habonim Nature Reserve—expected to serve as an indicator for environmental changes and to contribute to the knowledge of the eastern Mediterranean algae population;
- Feeding biology, reproduction and intraspecific associations of the recent migrant to the southeastern Mediterranean, scyphomedusa, *Rhopilema nomadica*—expected to help explain the massive swarming of jellyfish along the eastern Mediterranean during the bathing season;
- Estimation of mixed function oxygenase (MFO) activity by immunochemical and molecular biology methods for detection of toxic organic pollutants in a coastal Mediterranean habitat—expected to help establish an MFO system based on a bio-monitoring system for early detection of organic pollutants in marine organisms;
- Benthic foramenifera response to coal pollution–expected to study the efficiency of using benthic foramenifera for monitoring coal pollution.

Legal Framework for Marine Pollution Prevention

The Prevention of Sea Water Pollution by Oil Ordinance, 1980, provides the legal basis for,controlling marine oil pollution. The ordinance forbids discharge of oil or oily water into Israel's territorial and inland waters by any shore installation or vessel, and makes any such act a criminal offense. The law provides for the appointment of inspectors authorized to conduct investigations and searches to prevent or discover violations of the ordinance or its regulations. Other salient features of the Ordinance and its regulations include: the obligation to keep oil record books on vessels; measures to be taken in case of discharge of oil; maximum fines for oil spillage; and liability for cleanup costs.

Regulations promulgated within the framework of the law require Israeli harbors to provide adequate reception facilities for oily wastes and require vessels to use these facilities. Other regulations provide for the operation of a Marine Pollution Prevention Fund to concentrate the financial resources for preventing and combating marine and coastal pollution and a Marine Environment Protection Fee imposed on all ships calling at Israeli ports and on oil terminals. These fees, along with fines imposed on violators of the marine pollution prevention laws, constitute the major sources of income for the fund which is utilized for operations such as purchase of equipment, law enforcement, beach and shore cleanup, etc.

The Prevention of Sea Pollution (Dumping of Waste) Law, 1983, controls dumping of waste at sea. It complies with the Dumping Protocol of the 1976 Barcelona Convention. The law prohibits the dumping of any waste from vessels and aircraft into the sea, except under a permit which may be issued by a special committee. A court convicting an offender under this law may require, in addition to the fine levied, payment of expenses for cleanup operations. The regulations include lists of substances which may or may not be dumped at sea as well as conditions for the issue of permits.

The Prevention of Sea Pollution from Land-Based Sources Law, 1988, which entered into force in 1990, deals with the major source of marine pollution. Under the law, industrial and municipal wastewater discharge into the sea is prohibited or regulated through a strict permit system. As in the Dumping Law, courts may impose severe fines and even imprisonment on the offender. Inspectors carry out investigations whenever a violation occurs. Regulations under this law include conditions for issuing permits and lists of substances which may or may not be discharged into the sea. The law complies with the Land-Based Sources Protocol of the 1976 Barcelona Convention.

The Maintenance of Cleanliness Law, 1984, is implemented through inspectors, the police and voluntary specially-designated cleanliness trustees. The law prohibits the disposal of any refuse in public areas, including litter left on the beach or thrown overboard from a vessel into the sea within Israel's territorial waters. With regard to vessels, the law holds the skipper and owner of the vessel responsible for violations, and fines are imposed on them. Money collected from fines and penalties is deposited in a Cleanliness Fund and is used for specific projects including beach cleanup campaigns and environmental education.

The Ports Ordinance, 1971, provides for the operation and management of ports in Israel. It contains a specific section on the handling of hazardous substances in ports. Regulations promulgated under the law cover environmental matters such as the collection of waste, bilge and ballast water from vessels.

Regulations concerning the Loading and Discharging of Oil, promulgated in 1975 under the Ports Ordinance, control all procedures for safe loading and discharging of oil, and contain specific instructions regarding: entry into

territorial waters and ports; vessel operations during their stay in terminal; measures for fire prevention and fire fighting; conditions of oil terminals; transfer of oil from road tankers; and other regulations aimed at ensuring environmentally-safe practices. While most of the regulations are supervised and enforced by the Ministry of Transport, provisions concerning environmental issues are administered by the inspectors of the Ministry of the Environment.

The Bathing Places Law of 1964 permits local authorities to formulate by-laws for maintaining the cleanliness of beaches. It empowers the Minister of the Interior, in consultation with the Minister of Health, to close bathing beaches for the protection of bathers.

Other laws are enforced by the Nature Reserves Authority to protect endangered species and areas at risk, such as Eilat's coral reef ecosystem.

NOISE

Noise, a by-product of urbanization and industrialization, is increasingly recognized as an environmental nuisance which affects human health and wellbeing. In order to prevent noise nuisances from arising in the first place, noise considerations are incorporated in the assessment of development proposals and in the preparation of land-use plans in Israel. Prevention and abatement efforts also encompass the use of simulation and forecast models for traffic and aircraft noise, regulatory measures and education.

The Environment Ministry's noise prevention policy rests on three foundations: development of emission and ambient standards; collection of data and mapping of existing and potential noise sources; and treatment of existing noise sources side by side with prevention of potential sources. Environmental policy seeks to balance two legitimate needs—infrastructure development and environmental protection—ensuring that environmental concerns are taken into consideration in development planning.

Since most noise problems manifest themselves on the local level, municipalities play an important role in the prevention and control of noise within their jurisdiction. Local authorities are authorized to set noise limits within the framework of business licenses while local environmental units are instrumental in handling noise complaints. The Ministry of the Environment assists local units in the purchase of noise measuring equipment and in the training of personnel. A guidebook on noise assessment and abatement methods has been distributed among all of Israel's municipal environmental units—as well as among planners and developers—to provide them with the necessary tools for incorporating noise abatement measures in the early stages of planning. Land transport, air transport, stadiums, playgrounds, industrial installations and quarries—all are covered in the guidebook.

Motor Vehicle Noise

By far the greatest source of noise in urban areas is the motor vehicle. Traffic noise is chronic rather than acute. It reaches levels high and persistent enough to disturb concentration and relaxation, but not high enough to cause physical damage to hearing.

New vehicles purchased in Israel must meet noise standards (comparable to those set by the European Union), but once they leave the showroom, cars are not subject to noise requirements. Efforts are now being

made to incorporate noise tests within the framework of obligatory annual inspections using appropriate equipment. As a first step, it is anticipated that noise inspections will be carried out by the registration institutes for public transportation to ensure that noise levels emitted by buses do not exceed set standards.

In recent years, progress has been achieved in the abatement of one particularly disturbing noise source: the motorcycle. Cooperation between the Ministry of the Environment and the police has yielded positive results in the enforcement of noise standards. Motorcycles which exceed the standard (some 25% of those checked on the road) are fined or taken off the road until a retest reveals compliance with the regulations.

The type, age, maintenance level and quantity of vehicles also affect noise levels. The problem of automobile noise is exacerbated by the relatively old age of vehicles used in Israel and by the high price of spare parts, which cause car owners to postpone maintenance.

In a socio-acoustic study of noise pollution conducted in 1986 in the Tel Aviv area, 52.5% of respondents considered noise to be the major disadvantage of their residential area, significantly higher than any other single disadvantage. However, only 20.1% of those questioned pinpointed noise as an environmental problem they would seek to rectify, and only 9.3% had ever taken steps to complain about vehicular noise. In recent years, the readiness of the population to organize against noise nuisances has risen dramatically. A prominent example is the response of residents of the Tel Aviv metropolitan area to the development of a major road network (Netivei Ayalon). Their demands led to the construction of thousands of meters of acoustic barriers. In busy urban areas, where residential units are adjacent to traffic arteries, complaints concerning noise frequently reach 80% of total complaints regarding environmental nuisances.

Prevention of Vehicular Noise

Regulations setting maximum noise levels for roads constitute one means of diminishing traffic noise. While the Ministry of Transport has published regulations limiting noise from automobile engines, horns and mufflers, the regulations are not specific enough to be effectively enforced.

To fill the void until the establishment of an obligatory standard for roadside noise, the Ministry of the Environment has adopted the standards set by the U.S. Federal Highway Administration as criteria for road planning and adjacent land uses. These recommendations, which set a maximal noise level of 67dB(A) for roads planned near residential areas, are incorporated within the framework of environmental impact statements prepared for road construction. They have been fully adopted by planning authorities responsible for the approval of road plans. The Public Works Authority estimates that some six kilometers of acoustic barriers, spanning

an area of 25,000 square meters at a cost of $5 million, will have been constructed in 1993/4 alone.

An advisory committee on noise standards has recently submitted its recommendations for a maximal noise level of 64 dB(A) for new roads and adjacent land uses. The proposed standard, adapted to conditions specific to Israel (e.g. greater use of open spaces, open windows), will not totally prevent noise nuisances, but should help close the gap between the ideal and the possible. The standard has already been adopted in the planning for the proposed Trans-Israel Highway, Israel's largest-ever transportation project. (Further details on the Trans-Israel Highway are presented in the Environmental Planning chapter).

While noise is invariably taken into consideration in the planning of new roads, noise reduction on older, existing roads remains problematic. Recent results of road monitoring in the Tel Aviv area have revealed noise levels in the 75-80 dB(A) range in several busy intersections. Since the proposed standard does not apply to existing traffic arteries, other means must be undertaken to minimize the noise—reduction of noise at source, proper traffic management and control at the receptor level. Proper traffic management (e.g. changes in transportation patterns, reduced speed, restrictions on the entry of heavy vehicles, changes in the number and location of traffic lights and stop signs, encouragement of mass transport) along with wise land-use planning, acoustic barriers and acoustic insulation in buildings can significantly decrease noise levels.

On the planning front, the Ministry of the Environment advises the national, district and local planning authorities on the use of noise abatement measures in land-use planning and building. Environmental impact statements are generally presented to the district planning and building commissions along with plans for roads or junctions. The ministry employs a model which forecasts the distribution and intensity of noise impacts from predicted traffic flow, and evaluates the effectiveness of alternative measures to reduce noise impact. Even minor changes in the routing of a proposed road may alleviate noise problems from the outset; after the route is fixed, acoustic screens (based on U.S. Federal Highway Administration models) or treatment of residences may be required.

Air Traffic Noise

Unlike traffic noise, aircraft noise impacts wide areas well beyond the airport itself, both in terms of nuisances and conflicting land uses. Its effect is much more drastic than vehicular noise, and it has traditionally elicited stronger reactions and activism on the part of the affected population. To effectively deal with the problem, several measures must be taken, including establishment of noise standards, control of flight patterns and procedures, land-use planning, and acoustic treatment of exposed buildings.

Israel's major airport, Ben-Gurion International, is situated in the midst of the densely-populated coastal plain, encompassing 23 communities, including the metropolitan area of Tel Aviv, various sized towns and small rural areas. The noise-impacted area is estimated at 160 square kilometers with a population numbering in the hundreds of thousands.

Eilat airport, which is located within the city limits, constitutes a noise nuisance for local residents and tourists alike. Plans have been approved to remove the airport, which serves charters for domestic and international flights, from its current location to Ein Evrona, some 11.5 kilometers northwards.

At Herzliya's domestic airport, which serves as a flight school and maintenance field for agricultural aircraft, noise problems have precipitated regulations forbidding use of the airport before 6:30 a.m.; pilot training is still conducted in the airport, but crop dusting, which once constituted a large portion of the airport's activity, is based elsewhere.

Sde Dov, serving the metropolitan Tel Aviv area, constitutes yet another noise source due to its ever-increasing civilian activities and the location of the terminal a mere 50 meters away from residential areas in northern Tel Aviv. This airport, which serves as a military airfield as well as a civilian airport, is now subject to various restrictions. These include restrictions on nighttime activity (9:30 p.m. to 6 a.m.) and prohibitions on running engines and towing airplanes between the terminal area and the takeoff/landing path. The Ministry of the Environment and the municipality of Tel Aviv have called for the prohibition of all nighttime operations in the airport (from the early hours of the evening until the morning). In addition, a decision in principle has been made to transfer the civilian terminal to another location in the near future.

Relative to its size, Israel has a large number of military airfields, some situated near densely-populated areas. Noise maps for military airports serve as a foundation for land-use planning. Increased awareness on the part of the Israel Air Force of the need for noise prevention has led to two significant decisions: to appoint an environmental quality officer to deal with noise issues resulting from the operation of military aircraft, and establish a noise monitoring system around one of Israel's noisiest military airports.

Prevention of Aircraft Noise

Sophisticated models exist for the evaluation of aircraft noise. The Ministry of the Environment, as well as the Israel Airports Authority, employs the model developed by the U.S. Federal Aviation Authority (Integrated Noise Model) which uses three parameters to measure the level of exposure: noise level in decibels; number of flights during the day; and number of flights at night (the latter weighted more heavily than the

former). The resulting unit of measurement is called Day-Night Leverage (LDN). The ministry's guidelines recommend that construction be limited in areas exposed to noise levels exceeding 60 LDN, and that alternative sites be located for aviation facilities in areas where sound levels exceed this figure and noise-sensitive residential or institutional areas are affected. Only when alternatives are unavailable is acoustic treatment of buildings considered.

These guidelines have largely been adopted in the National Outline Scheme for Airports, recently submitted to the National Planning and Building Board for approval. The masterplan includes directions on planning, building and sensitive land uses in areas exposed to aircraft noise based on cumulative exposure contours. It establishes restrictions on land use in the environs of 24 existing and planned airports (excluding Ben-Gurion International Airport and Sde Dov Airport which are included in separate masterplans). Restrictions are imposed in accordance with the sensitivity of various land uses to noise levels. For example, sensitive land uses in regions exposed to noise levels between 60-65 dB(A) require acoustic measures; and sensitive land uses in regions exposed to noise levels above 65 dB(A) are prohibited.

The masterplan delineates noise contour maps which estimate the extent of exposure anticipated for each airport; categorizes land uses according to their sensitivity to aircraft noise; classifies the planning processes which may be utilized to implement noise abatement regulations; and establishes the means which may be taken to reduce conflicts between sensitive land uses and airport noise (e.g. guidelines for acoustic building and building restrictions).

Following approval of the plan, a special committee on noise issues, including a representative of the Ministry of the Environment, will be established. Its functions, *inter alia*, will be: to advise the planning agencies in implementing planning and building regulations in areas exposed to aircraft noise; to deliberate on requests for special permits by the planning bodies; to adapt acoustic guidelines to new technological developments; and to update land uses in accordance with their sensitivity to noise.

Noise Prevention in Ben-Gurion Airport

In view of its size and unique problems, a separate masterplan was drawn up for Ben-Gurion International Airport, originally constructed in 1936. The plan, to be submitted to the National Planning and Building Board along with an environmental impact statement in 1994, has received added momentum following the Israel Airport Authority's request for approval of a new terminal to accommodate increased tourism. While airport capacity now stands at 4 million passengers, the number of

passengers passing through the airport has increased from some 4.3 million in 1992 to 5 million in 1993. The current plan calls for the development of the airport in stages (5 million in the first stage, 9 million in the second and 16 million in the third stage).

The Ben-Gurion masterplan includes an abatement of nuisances plan with specific directives on land uses in the areas surrounding the airport and recommendations on the adoption of regulations for noise restriction according to the guidelines of the International Civil Aviation Organization. The regulations concerning noise abatement are enforced by means of a monitoring system—as is eligibility for noise abatement solutions for existing land uses. The noise monitoring system, initiated in 1991 but fully operational only as of 1993, is designed to monitor and prevent excessive noise levels in the populated areas under the westerly departure corridors. The system includes seven remote noise monitoring terminals with real-time data collection capability and a central control and monitoring system to correlate noise violations with flight data.

Maximal noise levels are set for each locality in dB(A). Monthly reports, including details on aircraft and flight companies violating the standard, are received by the relevant local authorities and the Ministry of the Environment. At present, the Airports Authority has decided not to press charges against pilots who contravene the law, but warnings are issued and, in most cases, flight companies make the necessary efforts to comply with the standards.

To further improve the monitoring system and to identify deviations from the flight path, the number of monitoring stations will soon be increased and a radar-based path enforcement system will be installed. Improvements will enable the Ministry of the Environment to receive data from the system online and to establish a center for citizen complaints.

While regulations defining unreasonable noise from aircraft have not been promulgated within the framework of the Abatement of Nuisances Law, Ministry of Transport regulations on noise from aircraft establish noise standards in accordance with international conventions. A recent amendment to the 1986 Aviation Regulations on the operation of aircraft and flight procedures authorizes the imposition of penalties on pilots or flight companies responsible for noise levels exceeding the maximal limits established for each community located beneath the takeoff corridor. Furthermore, first-generation aircraft are prohibited in Israel. By the year 2002, all aircraft allowed to operate in Israel will be third-generation aircraft.

Other Noise Sources

Industrial noise is controlled through the regulation of ambient noise levels in the workplace and the provision of protection to workers exposed

to excessive noise. Maximum noise levels are set by the Safety at Work Ordinance at 85 dB(A) for an eight-hour exposure period. However, no law exists requiring factory equipment to meet noise specification standards. The 1990 Abatement of Nuisances Regulations on unreasonable noise provide ambient standards for noise at various places, including industrial and commercial enterprises (Table 4).

Construction noise, particularly in urban areas, is also a major problem. Regulations setting standards for performance and design of construction machinery to limit noise have been promulgated. Unreasonable noise is defined as noise exceeding 80 dB(A).

Finally, residential noise generated by televisions, stereos, air conditioners, alarms and conversations constitutes an important factor in noise pollution. In Israel's mild-Mediterranean climate the problem is exacerbated, since families spend a great deal of time outdoors and leave the windows open when at home. Israel's noise pollution legislation is primarily directed toward neighborhood noise sources (e.g. musical instruments, radios, noisy repairs, and sirens). In case of violations, individuals file charges or call upon the relevant authorities to help abate the noise.

Israel's ambient standards for noise at various places and at different times of day are described in Table 4.

Legal Framework for Noise Prevention

Section 2 of the Abatement of Nuisances Law, 1961, states that "a person shall not cause any considerable or unreasonable noise, from any source whatsoever, if it disturbs or is likely to disturb a person in the vicinity." Regulations were issued pursuant to this law in 1966 to restrict noise levels in residential neighborhoods at night and during the afternoon siesta. The regulations also prohibit the use of a siren when unnecessary or the running of a vehicle without a muffler. In 1977, additional regulations were promulgated, defining unreasonable noise as "permanent or changing noise whose duration and measured level exceed the level specified in one of the appended charts." The charts establish permissible noise levels by type of neighborhood, time of day and duration of noise. New regulations were added in 1990 to include types of noise not covered by the initial regulations—background noise, impulsive noise, infrequent explosive noise and pure tones in the spectrum. The regulations provide clear guidelines on criteria and methods for the measurement of noise.

In 1992, additional regulations were promulgated to control noise caused by air conditioners and alarms. The regulations set a six-minute time restriction on the operation of security alarms. The sound levels generated by such alarms must not exceed 87 dB(A) in a residential area and 95 dB(A) in a non-residential area. Illegally operating alarms must be shut down as

Table 4

Israeli Ambient Noise Standards
Noise Level According to the dB(A) Scale
(as defined by the International Electronics Commission)

	Structure A		Structure B		Structure C		Structure D		Structure E	
Duration of Noise	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
1. More than 9 hours	45		50		55		55		70	
2. More than 3 hours, and less than 9 hours	50		55		60		60		75	
3. More than 1 hour, and less than 3 hours	55		60		65		65		80	
4. More than 30 minutes		35		40		40		40		70
5. More than 15 minutes, and less than 1 hour	60		65		70		70		85	
6. More than 10 minutes, and less than 30 minutes		40		45		45		45		75
7. More than 5 minutes, and less than 15 minutes	65		70		75		75		90	
8. More than 2 minutes, and less than 5 minutes	70		75		80		80		95	
9. Less than 10 minutes		45		50		50		50		80
10. Less than 2 minutes	75		80		85		85		100	

Noise Level According to the dB(C) Scale
(as defined by the International Electronics Commission)

Noise from infrequent explosions (less than 4 times per week)	109	109	114	114	114

Structure A: any building used as a hospital, convalescent home, old age home, or school.
Structure B: any residential building planned according to the Building and Planning Law.
Structure C: any building in an area used for residential and one or more of the following purposes: commerce, small-scale production, entertainment.
Structure D: any residential apartment in an area that is used for the purposes of industry, commerce or small-scale production.
Structure E: any building used for the purposes of industry, commerce or small-scale production in an area used for the purposes of industry, commerce or small-scale production.

soon as possible (within 30 minutes at most). If not shut off, a policeman or a person authorized by the Minister of the Environment may shut off the alarm. The duration of a car alarm must not exceed one minute or three cumulative minutes within a five-minute period. The noise generated by a car alarm may not exceed 87 dB(A). A 1992 amendment to the Abatement of Nuisances Law authorizes the police to take reasonable measures to shut off car alarms sounding for over 20 minutes.

New air conditioners must be clearly marked with maximum sound levels and must be accompanied by information sheets on proper installation and use in compliance with the law. It is prohibited to operate air conditioners in a manner which will cause unreasonable noise as defined in the regulations.

Abatement of Nuisances (Unreasonable Noise from Construction Equipment) Regulations, 1979, deal with construction noise by setting standards for the performance and design of construction machinery.

Vehicle noise is regulated pursuant to the Road Transport Ordinance. Regulations under this law set a standard comparable to that of the European Union for new vehicles.

Airport noise is regulated under the Aviation Law. Aviation regulations on aircraft noise prohibit the operation of an aircraft without a noise certificate, while regulations on the operation of aircraft and flight procedures require adherence to established noise levels in areas covered by noise monitoring systems. Violations of these regulations are subject to penalty.

Draft standards for railroad noise have been prepared setting the limit at 65 dB(A) during the day and 55 dB(A) at night during peak hours in a residential neighborhood.

Draft standards for roadside noise have also been prepared setting the limit at 64 dB(A) during peak hours in residential neighborhoods. The proposed new standards provide procedures for noise surveys and noise abatement measures to help protect public health and welfare, to supply noise abatement criteria and to establish requirements for the provision of information. The draft standard calls for noise abatement measures to be undertaken not only when predicted traffic noise levels approach or exceed the recommended standard, but also when such levels are expected to substantially exceed (by more than 14 dB(A)) existing background noise levels.

RADIATION

Radioactive materials and various ionizing and non-ionizing radiation-producing devices are extensively used in Israel in many areas and applications—medical diagnosis and therapy, industry, agriculture, research and development, and others. In order to avoid unnecessary exposure, a radiation protection infrastructure consisting of legislation, education, licensing and supervision was developed in Israel.

Supervision of Radioactive Elements

Supervision of radiation safety in the realm of radioactive materials and the environment is based on the Pharmacists Regulations (Radioactive Elements and Products Thereof). The regulations were first promulgated in 1980 and amended in 1991. They prohibit the purchase, distribution, transport and application of radioactive materials and other radiation sources unless a special license has been issued by an authorized radiation officer, appointed by the Minister of Health, with respect to radiation for medical purposes, or by the Minister of the Environment with respect to "cradle to grave" control of radiation in all other sectors. The regulations encompass all components of radiation—both ionizing and non-ionizing—including radioactive isotopes, environmental radiation, radon, ultra-violet, infra-red, lasers and electro-magnetic waves in micro and radio frequencies. Special conditions may be attached to the permit to ensure environmental safety and individual and public health; a permit may be canceled if these special conditions or the conditions stipulated by the regulations are not kept.

Those responsible for medical and environmental radiation are authorized to grant permits, to supervise the implementation of the regulations and to recommend safety standards. They are advised by an expert committee, composed of representatives of the Ministry of Health and the Ministry of the Environment.

Supervision of Radioactive Isotopes

Work with radioactive materials can pose a grave risk to those who handle them, to the general population and to the environment. To reduce this risk, international standards were established and adopted in Israel as a basis for regulations and as guidelines for policy. The Ministry of the

Environment is responsible for the granting of permits to users of radioactive elements in the civil sector, and its radiation inspectors carry out inspections in all radiation facilities—over 300 institutions employing about 8,000 workers with about 3,000 installations.

The ministry's Radiation Division is responsible for supervision of radioactive materials and facilities and of radioactive waste; monitoring of environmental radiation by means of a monitoring network comprising five stations; and risk assessment of environmental radiation from radon.

Radioactive Waste

Israel's primary concern in the management of low-level radioactive waste (radwaste), produced by hospitals, research laboratories and institutions, and industrial and agricultural premises, is population safety and environmental protection. During the course of work with radioactive isotopes, a variety of materials—from rubber gloves to equipment parts—become contaminated and require safe disposal.

The authority for radwaste management in Israel is the radiation officer appointed by the Minister of the Environment under the Pharmacists Regulations on radioactive elements. The regulations authorize the officer to issue a license for waste disposal services, after consulting with the Israeli Atomic Energy Commission.

Each radwaste-producing facility in Israel is required to obtain a license for its operation. The license limits the amount of radioactive material purchased by the institute and approves the nomination of an internal radiation official—responsible for the appropriate handling of radwaste inside the institute.

The Nuclear Research Center in the Negev operates and monitors Israel's only national disposal site for radioactive waste. With regard to short-lived radioisotopes, the disposal of the waste to a regular municipal site is permitted provided the activity is reduced to a level below 74 Bq per gram (0.002 μCi/gram).

The Ministry of the Environment operates a computerized database management system on radioactive materials, with data on licensing, import and distribution, waste disposal and transportation. The waste disposal module of the database system will soon include a theoretical model for the estimation of the volume of radwaste production by large institutions—necessary in order to validate the reports on quantities of waste produced by large users of radioactive materials.

Supervision of the disposal of radioactive waste has deepened recently, and a report was prepared based on the number of drums containing radioactive waste which were transferred from all institutions in Israel to the national disposal site in the Negev. Within the framework of the advisory committee on radiation, a report on waste disposal and treatment procedures was also prepared.

Environmental Radiation

Public awareness of the problems associated with radioactive radiation grew in the aftermath of the Chernobyl disaster in 1986. Recognition of the need for routine assessments of background radiation levels led to the establishment of the first monitoring stations in 1987. Today, five radiation monitoring stations operate in Israel—located in Haifa, Tel Aviv, Jerusalem, the Negev and, as of April 1994, in Dimona, adjacent to the Nuclear Research Center. The establishment of the monitoring station at this site is an integral part of the ministry's policy of freely providing environmental information to the public. Information from all of the stations is relayed, in real-time, to the central control station of the Ministry of the Environment. Each station has the capability of real-time alert to a beeper and the control center, which operates on a 24-hour-a-day basis.

In addition to these monitoring activities, the Ministry of the Environment conducts a representative random sampling of produce—seasonal vegetables, fruits, milk and meat—in three areas of the country, as well as testing water samples derived from the National Water Carrier. Samples of food, settling dust and suspended dust are analyzed using gamma-ray spectrometry.

The Radiation Division of the Ministry of the Environment has recently begun to collect soil, flora and water samples up to the fenceline of Israel's nuclear research centers and is currently preparing to broaden its supervision of nuclear ships anchored in Israel's ports.

Still another important function of the division is supervision over natural radiation including radon. The ministry has prepared guidelines for citizens on radon exposure—explaining the health hazards associated with radon, defining the types of structures which are likely to be exposed to radon, and providing information on measurement methods and on authorized commercial companies dealing with radon monitoring. Radon surveys have been conducted in various parts of the country and the ministry has assisted a number of bodies, especially local authorities, in carrying out tests and analyzing the results of radon exposure risks, especially in educational institutes.

The authorized radiation officer is responsible for the granting of permits for radon inspection to commercial companies, according to criteria and conditions established by the professional staff of the Radiation Division. Results of measurements conducted by private companies are transferred to the Ministry of the Environment to facilitate the development of a database on radon concentrations in Israel.

As part of a continuing program of monitoring natural radiation in the environment, radiocesium distribution in the nearshore eastern Mediterranean Sea is being studied. A preliminary report on radiocesium

isotopes in marine sediments from Haifa Bay in northern Israel and Iskanderun Bay in southeast Turkey was recently published. The samples investigated in this study comprise the top two centimeters of the sea-bottom sediments, sampled by box corer and analyzed by gamma-ray spectrometry. The spectrometric data obtained from fifty samples show the presence of a long-lived isotope of cesium, Cs-137, in all samples, but the presence of a short-lived isotope of cesium, Cs-134, in only fifteen samples.

These data could be useful in determining the magnitude of Chernobyl-related contamination in the region since the short-lived Cs-134 (2.06 year half-life) is identified with this event. The data could also be useful for estimating the rate of land denudation and weathering, and the behavior of radiocesium as a new contaminant factor in the marine environment.

Non-Ionic Radiation

Public awareness of exposure to radio wave radiation from different sources has grown dramatically in recent years—mostly as a result of plans (now canceled) for the establishment of a Voice of America transmission station in the Aravah region which raised fears of excessive electromagnetic radiation.

Since no standard restricting population exposure to radio waves exists in Israel, the Ministry of the Environment has published a policy paper on the subject, based on the standard set by the International Radiation Protection Association (IRPA), recognized as one of the most stringent standards worldwide. The radiation flux density permitted according to IRPA is determined to be 1/50 of the density flux which might be manifested in health effects.

In order to set guidelines which enable the existence of a technological society, on the one hand, and provide for maximum population protection, on the other hand, it has been decided to adopt the ALARA principle (As Low as Reasonably Achievable) and to restrict new facilities emitting radio waves to 1/3 of the IRPA standard and existing facilities to 2/3 of the IRPA standard.

In addition, the ministry has been involved in restricting exposure to electrical and magnetic fields in the network frequency from high voltage lines and transformer stations. In this case, the IRPA standard has been adopted, restricting public exposure to electromagnetic fields in the network frequency for 24 hours a day to 1000 mG and to 5kV/m, accordingly. The ministry provides the district offices with guidelines and environmental opinions on the radiation safety of existing and planned facilities which may cause significant electromagnetic fields in their environs.

The ministry also supervises companies which monitor microwave radiation, both for home microwave ovens and in radar and communication systems. The supervision is aimed at ensuring a high professional level,

reliable service to the public and data collection to enable identification of sites with potentially dangerous radiation levels.

Finally, in light of growing concern over the adverse biological effects of ultraviolet radiation (UV), the ministry has prepared standards and procedures on equipment emitting such radiation. All artificial sources of UV radiation (with emissions in the range of 200-400 nm) which are designated for cosmetic tanning and/or medical treatment (phototherapy) must be registered. Detailed safety procedures with regard to ultraviolet radiation from tanning facilities were published, requiring, *inter alia*, that the cumulative yearly dose does not exceed the 50 minimal erythema dose (MED).

Legal Framework for Radiation Protection

The Pharmacists Regulations on radioactive elements and their products, under the authority of the Ministry of Health and the Ministry of the Environment prohibit the purchase, distribution, transportation and application of radioactive materials, except under a license. The regulations specify the conditions under which a license is to be granted, including basic facility and equipment requirements, such as floor and working surface coatings, washing facilities, sewage, ventilation and shielding arrangements.

Draft regulations on the disposal of radioactive waste from research institutes, hospitals, medical laboratories and other institutions are being prepared. They will include instructions on the disposal of solid and liquid radioactive waste as well as radioactive gases or vapors.

Regulations regarding the medical application of radiation machines, under the authority of the Ministry of Health, require the registration of radiation machines intended for diagnosis and/or therapy.

Safety at Work Regulations (Persons Engaged in Ionizing Radiation) are enforced under the authority of the Ministry of Labor and Welfare. They set guidelines for control in facilities where employees handle radioactive materials or radiation equipment.

AGRO-ECOLOGY

Israel, a world leader in agriculture, depends on irrigation and fertilization to increase its crop yields. Since Israel attained its independence in 1948, the total area under cultivation has increased by a factor of 2.6 to approximately 445,000 hectares, and irrigated land has increased by a factor of 8 to 240,000 hectares. During the same period, the number of agricultural communities grew from 400 to 750.

Israel meets most of its food requirements through domestic production, using some one million cubic meters of water and 90,000 tons of fertilizers annually. The result—over one million liters of milk, 1.33 million tons of fruit (900,000 of which are citrus) and 892,000 tons of vegetables in 1993 alone.

Awareness of the potentially negative repercussions of agricultural practices has only recently emerged—and with it the new discipline of agro-ecology. The Ministry of the Environment's Agro-Ecology Division deals with the prevention of environmental degradation arising from improper agricultural practices in Israel's rural sector. By means of monitoring, legislation, enforcement, education and guidance, and in cooperation with the farming community, agricultural organizations, research institutes, regional councils and government ministries, the division is helping to address the challenge of cultivating high-quality produce which meets both agricultural and environmental and health standards.

Pesticide Pollution

Agricultural pesticides are hazardous substances; proper supervision of their use is imperative. Pesticide residues all too frequently find their way into food, water and soil; cases of pesticide poisoning are recorded in Israeli emergency rooms each year; and rural and urban populations are at times subjected to unnecessarily high levels of pesticides due to overspraying, improper storage, and burning or burial of pesticide-laden agricultural wastes.

The Ministry of Agriculture's Plant Protection and Inspection Department is in charge of the registration, regulation and supervision of pesticides. Pesticide use is monitored by three bodies: the Ministries of Agriculture, Health and the Environment. There are 790 registered pesticides in Israel. Of these, about 32% are insecticides, 17% fungicides, 23% herbicides, and the remainder molluscicides, rodenticides, bird and

mammal repellents, fumigants, materials for post-harvest treatments, wound sealing materials, plant growth regulators, micronutrients, pesticides for home gardens and adjuvants.

Chemical control is applied to roughly 95% of Israeli crops. Recent figures indicate that about 40 kilograms of pesticides are applied to the average irrigated hectare (down from 75 kilograms in the 1970s), of which the polluting potent materials amount to some 15 kilograms per irrigated hectare. A drop in pesticide usage has been noted in recent years, due to more efficient use, changes in cropping patterns, awareness of the environment and introduction of integrated pest management systems.

The pesticide registration process begins with testing and investigation over a period of months or years, followed by provisional approval for limited use. When comprehensive toxicological data have been gathered, an advisory committee, composed of representatives of several ministries including the Ministry of the Environment, decides whether or not to approve the product for final registration. Materials are assessed with regard to their environmental impact, endurance, risk to groundwater and other factors. If data indicate substantial environmental risk, the Environment Ministry can withhold its support for approval.

The Ministry of Agriculture supervises and regulates quality and health requirements of exported agricultural produce and cooperates with international bodies on standardization of pesticide tolerance regulations.

In light of decisions on methyl bromide, within the framework of the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer, the Minister of the Environment appointed an interdisciplinary task force in 1993 to study possible emission reduction methods and potential alternatives and substitutes for methyl bromide. The task force's report, issued in February 1994, includes recommendations on the reduction of doses, use of alternatives, and research and development to significantly reduce methyl bromide emissions. Israel, a major exporter of methyl bromide, uses some 2,800 tons a year of the material, mostly in agriculture.

Aerial and Ground Spraying

The Ministry of the Environment is actively enforcing water pollution prevention regulations, under the Water Law, designed to prevent water contamination by pesticides. A 1991 regulation, which forbids aerial spraying of biological and/or chemical substances for agricultural purposes near water sources has resulted in investigations and legal actions against spraying companies which circumvent the regulations. In 1993, 170 inspections of aerial spraying sites were undertaken, 100 complaints regarding aerial and ground spraying were received (compared to 38 in 1992) and forty investigations were opened (compared to seven in 1992).

In light of objective difficulties in implementing the regulations in some areas of the country, a draft amendment was recently prepared which would permit the spraying of non-toxic biological agents and of granulated fertilizers at shorter distances than those originally required (50 meters from the water source as opposed to 300 meters previously). The draft amendment also calls for the establishment of a special permits committee to deliberate upon exceptional cases in which full compliance with the law is impossible.

Another 1991 regulation prohibits the emptying or rinsing of pesticide application equipment into a water source, directly or indirectly, and requires the installation and operation of rinsing installations. Enforcement of the regulation has led to major improvements, especially in the Lake Kinneret drainage basin. A comprehensive program of enforcement and education has been undertaken to change entrenched practices, including the rinsing of sprayers in structures adjacent to water wells.

A welcome sign is growing citizen awareness and activism. Complaints from residents living in urban communities interfacing with farmland and from residents of agricultural settlements themselves regarding pesticide inhalation or skin contact as a result of aerial and ground spraying are spurring action. The Ministry of the Environment has already prepared draft regulations on the use of pesticides near residential areas. A 1992 amendment to the Pharmacists Regulations prohibits aerial spraying at a distance of 120 meters from a dwelling or 12 meters from a road. It allows the Minister of the Environment, after consultation with the Ministers of Health and Agriculture, to establish areas in which aerial spraying is absolutely prohibited.

Pesticide Residues in Agricultural Produce

While all pesticide containers in Israel are labelled with specific instructions on frequency and manner of spraying, usage directions are inadequately enforced. Many farmers simply do not adhere to recommended quantities nor to the final dates for use before harvesting which are set out on the label.

While pesticide residues in agricultural produce earmarked for export are regularly tested by the Ministry of Agriculture (about 5,000 crop analyses were conducted in 1992) to ensure that export produce meets stringent environmental and health standards, lack of manpower and budget prevents the routine testing of produce designated for local consumption. As a result, a portion of the produce which reaches local markets is known to exceed permitted levels for pesticide residues.

The Food Service in the Ministry of Health is responsible for regular monitoring and testing of food quality for local consumption, but testing in the past has been sporadic. While the Health Ministry has the necessary budget for testing the produce which reaches the marketplace in its central

laboratory, it does not have the necessary manpower to test produce on site, at the farm. Fortunately, the situation is now improving. In accordance with a 1993 agreement between the Ministry of the Environment and the Ministry of Health, pesticide monitoring inspectors of the Nature Reserves Authority, under the responsibility of the Environment Ministry, have begun to collect samples of fruits and vegetables ready for marketing, while still within the jurisdiction of the farmer. The Ministry of Health then tests the samples in its laboratories. Test results are reviewed by representatives of the two ministries, and when pesticide residues are discovered, the team decides on appropriate measures, whether publicity in the mass media, warning, or destruction and confiscation of the contaminated produce.

Crops which have been recommended for monitoring by the Ministry of Health include strawberry, lettuce, carrot, mint, spinach, parsley, garlic, onion and dill. The agreement, currently implemented at a scope of 600 tests a year, is expected to bring about major improvements. It has already catalyzed the Ministry of Health to allocate extra funds and a new division to check pesticide residues in food.

Storage and Disposal of Pesticides

The problems associated with the use of pesticides begin with improper handling, usage and storage, and continue to the final stages of disposal. Until recently, awareness among farmers was so low that some cases of pesticide storage in well-pumping stations were discovered.

Some 1,600 pesticide warehouses in rural areas are supervised by pesticide monitoring inspectors, under the responsibility of the Ministry of the Environment. In 1993, 720 inspections of pesticide warehouses were conducted (compared to 500 in 1992) in order to examine the compliance of warehouses with environmental guidelines and laws. This increase is attributed to the recent passage of the Hazardous Substances Law which requires pesticide warehouses to hold poison permits. Of the warehouses visited, 9.7% received poison permits in 1993, 10.2% were found to be unsuitable for pesticide storage in terms of structure, and 56.3% were found to be defective. The remaining warehouses were closed in 1993.

Pesticides whose date of use has expired present yet another problem. While expired pesticides are unsuitable for use, they are extremely toxic and require disposal at the Ramat Hovav hazardous waste disposal site. The Ministry of the Environment is granting financial aid to a number of regional councils for setting up regional collection and disposal networks.

Empty pesticide containers pose yet another hazard. They are discarded throughout the country in fields, roadways, near wells and water sources, near irrigation outlets and in approved and illegal waste disposal sites. While label guidelines currently permit their disposal by burial or

incineration, bury or burn options are gradually disappearing from instruction labels as a result of cooperation among the Ministries of the Environment, Labor and Agriculture. The Ministry of the Environment has drafted regulations calling for environmentally-safe collection and disposal of empty pesticide containers at Ramat Hovav, approved waste disposal sites and recycling plants.

The principles for dealing with pesticide packing are similar to those dealing with solid waste disposal. Their efficient disposal must be based on separation and classification, crushing and compaction, regional collection and finally, centralized transport to the disposal site. In addition to the draft regulations, other ideas are being considered, including the imposition of a deposit fee as an incentive for the collection of empty containers, and temporary storage in regional transit stations. The Agro-Ecology Division is currently cooperating with regional councils on finding a temporary solution whereby rinsed and crushed pesticide packing will be transported to approved sites and/or to a plastic recycling plant. Testing for residues will be undertaken before either burial or recycling.

Fertilizer Contamination

The relatively low price of both synthetic fertilizers and organic manures, coupled with the desire of farmers to improve the output of their cultivated plots have led to excessive fertilization. A Hydrological Service survey on the presence of nitrates and other compounds in water wells has revealed that a third of the country's wells (and over half of the wells in the coastal aquifer) contain nitrates at a level which would exclude them from drinking purposes according to the European standard (45 mg/l). Studies have also shown that on the coastal plain, above the main aquifer, intensive use of nitrogen fertilizers in agriculture has contributed to nearly 70% of the nitrate burden in the groundwater.

The development of greenhouse agriculture in Israel has had its down-side as well. Recent literature reveals that greenhouse agriculture contributes significantly to groundwater contamination, as greenhouse crops are intensively irrigated and fertilized, and excessive salts are washed out by periodic irrigation. The excessive water drains outside the greenhouse and leaches into the groundwater.

A Ministry of Agriculture survey estimates the total area of greenhouses in Israel at 2,200 hectares, the total annual irrigation in greenhouses at 1,500-2,000 cubic meters of water, the rate of leaching of fertilizer water at 30-50%, and the total of fertilizers leached every year at 8,400-18,700 tons.

To deal with the problem, the Ministry of the Environment has proposed draft regulations on the prevention of groundwater pollution by greenhouse leachate. The proposed regulations would forbid farmers from draining the excess water and fertilizer to the ground and groundwater. The

alternatives: recycling or disposal through the sewage system. The approach today is to disconnect the greenhouse from direct contact with the soil, so as to avoid groundwater contamination and to promote reuse.

While improper fertilizer use can contaminate the environment, raise the salt level in soils and actually reduce agricultural growth, controlled fertilization, using drip irrigation methods and slow-release fertilizers, can ensure a minimum discharge of nitrates to the soil and maximal utilization by the plant. High on the agenda is the re-education of farmers to reduce the use of concentrated fertilizers and to substitute alternative and newer fertilizers. Other recommendations include regulatory measures such as fees on purchased materials, restricted use of fertilizers, manures and effluents in sensitive areas, reduction of the permitted concentration of nitrates in groundwater from 90 mg/l to 50 mg/l and fertilizer application as a function of soil and plant monitoring.

Agricultural Wastes

Agricultural activity creates significant amounts of different types of waste—solid, slurry and liquid—produced by farm animals, crops and synthetic products. Livestock farms produce substantial amounts of animal sewage which usually finds its way to cesspools and from there to groundwater. Proper treatment, disposal and recycling of the solid and liquid wastes of the cowshed and chicken coop require the establishment of appropriate facilities. An interministerial committee on the treatment of animal sewage and waste has recently been set up to propose solutions to these problems and to formulate conditions for the licensing and operation of livestock farms within the framework of the Licensing of Businesses Law. Within this framework, business licensing conditions are being formulated for the poultry and water fowl industries.

Such ill-advised practices as the accumulation of cow manure and slurry on the ground and the improper disposal of waste from Israel's 130 goose-raising farms are especially problematic; they result in stench, groundwater contamination and visual blight. Experts are hard at work finding innovative solutions—disposal into sealed pools and recycling and reuse technologies, utilizing additives along with the wastes themselves. The advantages of waste and wastewater recycling, when undertaken in accordance with strict environmental guidelines, are clear: agricultural irrigation, savings in the purchase and use of synthetic fertilizers, enrichment of the soil with organic material and a low-cost solution to environmental nuisances.

Environmentally-safe operational procedures for cowsheds have already been established, in cooperation with the Ministry of Agriculture, and are soon to be enforced within the framework of the Licensing of Businesses Law. In addition, enforcement of the Water Law in geese farms

has been upgraded and, in some cases, geese farmers have been prosecuted for the contamination of water sources.

Solid Agricultural Waste

Poultry and cow manure, carcasses and abattoir waste, yard waste, plastic materials and crop residues—all constitute agricultural waste. While all of them are sources of groundwater, air, landscape and nature pollution, they can be converted into environmentally and economically profitable products provided regional collection, transport, compaction and disposal systems are set up.

The quantity of carcasses and abattoir waste in Israel is estimated at over 100,000 tons per year. Proper treatment of this waste is imperative in order to prevent air, soil and water pollution as well as the spread of diseases such as rabies. Today, only one plant is authorized to render both carcasses and slaughterhouse waste; the others handle slaughterhouse waste only. In view of the high economic value of this type of waste, an interministerial committee is working on solutions to minimize the number of rendering plants to two or three, in different parts of the country, pending the results of feasibility studies and environmental impact statements. In the interim, collection, transport and regulated burial in approved sites will be encouraged. Various initiatives for the collection and transport of carcasses and abattoir waste on the part of the private sector have already begun, most notably in the north of the country. Additional improvements are expected as a result of new legislation, including a draft amendment to the regulations on abattoir waste which currently permit unregulated burning, and business licensing conditions for rendering plants, which were drafted in collaboration with the plants themselves.

The existence of a compulsory insurance fund for cows, a fact which is relatively unknown in the farming community, is expected to provide a positive incentive for farmers to dispose of carcasses in environmentally-safe ways. Farmers are paid $160 per dead cow, over six months old, on condition the carcass is examined by a veterinarian and then transported to a site approved by the Ministry of the Environment. The ministry is exploring ways of encouraging the set up of a similar fund for poultry, so as to make safe disposal attractive economically as well as ecologically.

Integrated Pest Management

Agricultural activity may be transformed into environmentally-friendly activity through changes in work processes and procedures. The establishment of good agriculture practices, the advancement of integrated pest management, low-input sustainable agriculture and bio-organic agriculture present the agricultural community with promising challenges.

Equipment for the mechanical pumping of insects, rapidly decomposing substances, crop-specific and slow-release fertilizers, plastic containers to prevent the infiltration of manure and silage to groundwater, farm kits for monitoring soil and water, and environmentally-sound approaches to pest and weed management are only some examples. The Agro-Ecology Division, in cooperation with the Extension Service of the Ministry of Agriculture, is working to increase the environmental awareness of farmers and to encourage research and development.

Although still in its infancy, integrated pest management (IPM) offers an effective way of dealing with insect control problems and relies heavily on protection and conservation of natural enemies, parasites, predators and diseases that regulate or balance populations of pests. By encouraging natural enemies, the need for chemical insecticides can be reduced dramatically when compared to conventional spray programs. In cases where chemical pesticides are ineffective in solving pest problems due to the development of increased resistance by the pest to the poison, natural enemies provide an effective solution which is safe for user, crop and environment.

Biological control, largely pioneered in Kibbutz Sede Eliyahu in the Beit She'an Valley, is currently being implemented in several agricultural areas in Israel. The development and introduction of beneficial natural enemies (e.g. predatory mites, predatory beetles, parasitic wasps) is proving to be a superior alternative to conventional chemical pesticides in terms of long-term effectiveness, cost and safety. Projects include isolation and synthesis of pheromones secreted by insects to trap males and thus reduce the need for chemical control; use of pheromone traps to monitor the number of males as well as the egg-laying period in order to pinpoint the ideal time for spraying; commercial production of the *Bacillus t. israelensis* (BTI) to control water-breeding insects; use of fungal products to control fungi that cause plant diseases; and release of barn owls to effectively control rodent populations in farming areas.

The development of organic agriculture promises further reductions in environmentally-harmful agricultural practices. In 1983, some twenty farmers banded together to form the Israel Bio-Organic Agriculture Association (IBOAA). Today the association is some 200 growers strong and is a full-fledged member of the International Federation of Organic Agriculture Movement. Produce supplied by certified IBOAA growers is cultivated according to rigorous bio-organic principles: soil fertility is maintained through balanced organic nutrition and monitored plant rotation; insects, pests and disease are controlled solely by biological means, such as laboratory-bred natural enemies; produce is never treated after harvesting; and natural resources are carefully conserved. Furthermore, greenhouses are heated only by the sun's rays and water is strictly rationed, using Israel's advanced irrigation techniques. Nearly 1,500 hectares of land are currently used for bio-organic production in Israel, and a number of high-

quality organically-grown products, such as carrots, already account for a sizable portion of Israel's agricultural export.

Legal Framework for Pollution Control in Agriculture

Pesticide control is governed by several legislative tools under the responsibility of different enforcement authorities.

The Plant Protection Law, 1956, grants the Minister of Agriculture authority, following consultation with an advisory interdisciplinary committee, to regulate the import, sale, distribution and packaging of pesticides, fertilizers and other materials. The law authorizes the Minister of Agriculture to regulate the use of pesticides, to require a permit for their use, to promulgate regulations on the safe use of pesticides and to forbid or limit the use of pesticides deemed dangerous to human health and the environment.

The Animal Diseases Ordinance, designed to prevent the spread of animal diseases, is under the responsibility of the Minister of Agriculture. Regulations dealing with chemical preparations for the control of animal diseases were promulgated under this law in 1982.

Public Health Regulations dealing with pesticide residues in food were promulgated in 1991. The regulations, under the responsibility of the Minister of Health, establish standards for maximum permissible levels of pesticides in food products.

The Hazardous Substances Law, 1993, which establishes, *inter alia*, poison permit requirements for all businesses dealing with hazardous materials, has paved the way for more efficient supervision of pesticide storehouses throughout the country.

Water Regulations promulgated in 1991 prohibit the rinsing of sprayers of chemical and/or biological substances into water sources and forbid aerial spraying of such substances for agricultural purposes near a water source.

The Public Health Ordinance of 1940, which authorizes the Ministry of the Environment to eliminate nuisances from the confines of a local authority, and the Licensing of Businesses Regulations, which incorporate conditions on the environmentally-sound operations of cowsheds and rendering plants, provide additional legislative tools for the control of pollution arising from improper agricultural practices.

PEST CONTROL

The Ministry of the Environment has been granted statutory responsibility for the control and surveillance of pests harmful to man, for licensing and supervising pest control operators and for registering insecticides for the protection of public health. Since the transfer of responsibility for health-related pest surveillance and control from the Ministry of Health to the Ministry of the Environment in 1991, intensive efforts have been invested in encouraging environmentally-responsible behavior. Efforts are now beginning to bear fruit in nearly every area—use of environmentally-friendly materials and biological control in river rehabilitation, advancement of research studies on pest control, improved training of pest control operators, introduction of integrated pest management, and most importantly, institution of preventive measures. Since the custom of frequent and indiscriminate spraying over large areas is relatively widespread in many communities, attention is currently being focused on the source of the problem and preventive action is encouraged. Consumers and pest control operators are being taught that pest control can be practiced both effectively and safely, without harm to nature reserves, rivers or human beings.

Pest Control Operators

Regulations under the Licensing of Businesses Law restrict those authorized to work as pest control operators to holders of special permits. Operators are required to pass a special qualification examination, given by the Public Health Instruction Center of the Ministry of Health, in order to be licensed by the Ministry of the Environment. Course material has been revised and adapted to accord with Environment Ministry requirements. The ministry organizes study and instruction days for pest control operators and undertakes administrative measures against operators who contravene the regulations. Inspection and supervision of illegal pest-control operations will intensify as a result of the recent addition of manpower recruited expressly for this purpose.

It is estimated that some 800 licensed operators work in Israel today; their activities encompass the control of mosquitoes, flies, sandflies, wasps, ticks, fleas and cockroaches as well as rats and mice. All have been issued new registration certificates replete with photograph to ease their identification by the public. The registration system is now computerized, thus facilitating more efficient follow-up and transfer of information,

including updating of personal details, participation in study days and permit expiration dates.

Insecticides for the Protection of Public Health

The registration process for insecticides for the protection of public health is separate from that for agricultural use. As of March 1992, every insecticide permit for public health purposes must be approved by a statutory professional committee which is composed of six representatives, evenly divided between the Ministry of the Environment and the Ministry of Health. Registration is granted for a period of three years; every renewal presents an opportunity to withdraw substances which are discovered to be carcinogenic or otherwise unsafe. The committee deliberates on every case regarding matters of application, use, storage and disposal. Maximal efforts are being made to advance alternative methods of pest control and the use of environmentally-friendly materials, within the framework of guidelines, courses and study days.

In accordance with an agreement between the two ministries, a regulation has recently been signed, within the framework of the Hazardous Substances Law, transferring authority for registration from the Ministry of Health to the Ministry of the Environment.

Mosquito Control

Combating malaria was once the province of the Ministry of Health; it now constitutes the bulk of the activity of the Pest Surveillance and Control Division of the Ministry of the Environment. The division is responsible for monitoring mosquito breeding sites (both *Anopheles* and *Culex*), guiding local authorities, and enforcement. Today, the monitoring and inspection system is separate from the mosquito-eradication system: local authorities are required to exterminate mosquitoes when discovered by the monitoring teams of the Ministry of the Environment. Nevertheless, the Ministry of the Environment is equipped with pest control kits for emergency use.

Mosquito surveillance is undertaken by regional mosquito control inspectors of the Ministry of the Environment who routinely visit all potential *Anopheles* breeding sites and search for larvae, which are then submitted for identification to the Entomological Laboratory of the Ministry of Health. The Ministry of the Environment's surveillance program encompasses monitoring, once to three times each month, in some 1,000 potential *Anopheles* breeding sites throughout the country. Since more than half of the water reservoirs which are potential breeding grounds for the *Anopheles* mosquitoes are in the north of the country, monitoring activities are concentrated there. In 1993, 194 natural and other water

sources (e.g. fishing pools and rainwater reservoirs) were monitored in the northern region.

When mosquitoes are discovered, the responsible authorities are notified and instructed to undertake immediate control activities, in accordance with guidelines on prevention and treatment issued by the Ministry of the Environment. Wherever possible, recommendations call for the use of natural enemies and biological insecticides. In contrast to past practices, pest control activities are increasingly being undertaken on the basis of monitoring results rather than arbitrary calendar days.

Until the 1950s, malaria was prevalent in Israel. As in other temperate zones, successful control of malaria was achieved without complete elimination of *Anopheline* mosquitoes (the vectors of malaria) using a variety of direct and indirect control measures. While the country has been free of indigenous malaria for decades, increased tourism and the immigration of malaria carriers have raised concern over the potential of malaria resurgence. Furthermore, since the early 1980s, several important malaria vectors have expanded their geographical range in Israel. In the exceptionally rainy winter of 1992, for example, monitoring revealed four *Anopheles* species in two wadis in the northern Negev. In these, as in other cases, species identification was immediately followed by appropriate control measures on the part of the relevant local authorities.

Although a significant resurgence of malaria in Israel is unlikely, the risk of a localized outbreak of introduced malaria cases due to infection of local *Anopheline* mosquitoes by imported cases does exist. Therefore, a national computerized surveillance system of breeding sites of *Anopheles* mosquitoes and imported malaria cases was established in 1992 using the Ministry of the Environment's geographical information system (GIS). Distances between population centers and breeding sites were calculated, and maps associating epidemiological and entomological data were generated. Risk of malaria transmission was assessed with consideration of vectorial capacity and flight range of the *Anopheles* species. Breeding sites within flight distance of locations with imported malaria cases are targeted for enhanced surveillance and intensive vector control activities. The GIS-based surveillance system ensures that if a localized outbreak does occur, it will be associated rapidly with a likely breeding site, a specific *Anopheles* vector and a probable human source, so that prompt control measures can be efficiently targeted.

Alongside monitoring activities focused on the *Anopheles* mosquito, monitoring of the breeding sites of the *Culex* mosquito is also actively pursued. For example, reports concerning an outbreak of Reef Valley Fever in northern Egypt in 1993 catalyzed preventive action on the part of all relevant authorities. The viral disease, which attacks sheep and cattle, may be transferred to humans, *inter alia*, by the mosquito known as *Culex pipiens*. All potential breeding grounds for the *Culex* mosquito, such as reservoirs, oxidation ponds and sewage-ridden rivers, were therefore

mapped, and surveillance was undertaken together with local authority personnel.

Integrated Pest Management

Environmentally-safe pest control requires a holistic approach. All too frequently, a specific solution to an environmental problem may bring about a long chain of additional nuisances. The case of river rehabilitation provides one such example. Discharge of sewage to rivers causes mosquito breeding which has traditionally resulted in the dispersal of environmentally-unfriendly products (e.g. pyrethroid and organophosphorus insecticides or malariol). While mosquitoes are eradicated, so is the natural life of the river—including the natural predators of the insects.

Today, the Ministry of the Environment guides relevant bodies to undertake integrated activities, such as prevention of sewage discharge, free-flow of the water stream, use of natural enemies such as gambusias (*Gambusia affinis*) and use of environmentally-friendly materials such as BTI (*Bacillus thuringiensis israelensis*) and mono-layer oil (MLO), which eradicate mosquitoes without harming fish and other natural life in the water.

While prevention of sewage discharge is an essential element in river rehabilitation, clean water can also be a source of mosquito breeding. Each water source is associated with its own unique mosquitoes; each requires its own pest control activities. River rehabilitation requires continuous follow-up of the development of habitats which enable the breeding of *Anopheles* and *Culex* mosquitoes, application of selective insecticides which minimally harm the environment, and use of natural enemies, such as fish, wherever possible.

Predatory fish will also be used in the reflooded area of the former Hula wetlands, a classic case whereby an attempt to solve one environmental problem has led to a host of others. The Hula was drained forty years ago in order to reclaim the land for agricultural use and to rid the area of vectors of malaria in the swamps. The result: disappearance of the valley's unique wildlife, erosion and sinking of the peat lands, rising of the water table, spontaneous fires and rodents, as well as extensive nitrification and leaching of nitrates, endangering the quality of Lake Kinneret water. The area is now being partially reflooded in an effort to "correct" the ecological mistake and develop the region for eco-tourism—working in harmony with nature rather than against it. Forty years ago, DDT was widely used to control malaria in the area; today, biological controls, such as natural enemies and controlled use of environmentally-safe pesticides, will be used to ensure that malaria does not return. Since reflooding may bring about renewed mosquito breeding, the project administration will undertake

routine monitoring in accordance with guidelines submitted by the Ministry of the Environment, and will send samples to the ministry for identification.

Legal Framework for Pest Control

The Public Health Ordinance provides the basis for mosquito control. According to the law, authority is vested in the Minister of the Environment to impose measures for the prevention and control of mosquito breeding and for the application of anti-malaria provisions. The law requires tenants or owners to undertake measures for the prevention of mosquito breeding and obliges holders or owners of irrigated lands to prevent mosquito breeding in wells, and in drainage, irrigation and other canals. The Minister of the Environment is authorized to require holders or owners of land, which are transversed by rivers or water conduits, to undertake the necessary means to prevent mosquito breeding.

A 1992 amendment to the Commodities and Services (Control) Order, which deals with pesticides for the protection of public health, changed the composition of the advisory committee on insecticides. The committee is now chaired by a representative of the Ministry of the Environment and is composed of an equal number of representatives from the Ministries of Health and the Environment. A regulation signed in 1994, within the framework of the Hazardous Substances Law of 1993, transferred responsibility for registration of insecticides with medical importance from the Ministry of Health to the Ministry of the Environment.

A 1993 amendment to the Licensing of Businesses Regulations on pest control calls for increased supervision of pest control operators and further control of the use of insecticides. The regulations oblige pest control operators to maintain record books with full details of each extermination and provide a revised listing of preparations approved for use.

NATURE AND DESERTIFICATION

In juxtaposition to its small land area, Israel is characterized by a wide range of physical conditions and by a rich variety of flora and fauna. Therefore, it is not surprising that the nature conservation movement preceded organized environmental activity by decades.

The roots of Israel's nature protection movement are traced back to the organization of a small group of nature lovers and scientists around a specific issue: the draining of Lake Hula and its surrounding swamps. This small but dedicated group of conservationists, who fought for the preservation of a small area of swampland as a nature reserve, formed the nucleus of what was to become Israel's oldest and most powerful non-governmental conservation body—the Society for the Protection of Nature in Israel (SPNI). The SPNI along with other bodies, such as the Nature Reserves Authority, National Parks Authority, Jewish National Fund and Ministry of the Environment, have been responsible for a wide-ranging and successful program of nature conservation in Israel. As a result of their efforts, about one-quarter of the land area of the country has been set aside for protection, at various levels, within the context of national and district masterplans.

Nature Protection in Israel

The small land area of the country, the diversity and wealth of its natural, landscape and heritage values, and its location in a semi-arid region combine to make Israel's landscapes unique, sensitive and especially vulnerable.

Recognition of the need to protect Israel's precious natural and landscape resources led to the enactment of the National Parks and Nature Reserves Law in 1963. The law, which was updated in 1992, provides the legal structure for the protection of natural habitats, natural assets, wildlife and sites of scientific and educational interest in Israel. Pursuant to this law, two authorities were created: the Nature Reserves Authority (NRA) and the National Parks Authority (NPA).

Passage of the nature protection legislation in 1963 spurred the preparation of a national masterplan for the preservation of sites which are of special natural, landscape and historic value. The National Outline Scheme for National Parks, Nature Reserves and Landscape Reserves was approved by the Israel cabinet in 1981.

Protection of Natural Assets

The Nature Reserves Authority (NRA) was established in 1964, pursuant to the National Parks and Nature Reserves Law. The NRA preserves and cultivates nature reserves and natural assets, protects wildlife, safeguards the quality of the environment in open areas, protects the beauty, diversity and integrity of Israel's landscapes and open areas, and provides visitor services in the reserves.

In a small country, with a high rate of industrialization and urbanization, nature reserves help secure the biodiversity of the natural environment. A nature reserve is an area with characteristic and unusual fauna, flora or minerals which need to be protected against destruction or change in appearance or composition. Israel's reserves vary in size, character and use. Some encompass less than one square kilometer while others span thousands of hectares; most are open to the public while some offer special visitor services. Together, they represent the entire spectrum of Israel's natural heritage, including Mediterranean forests, seaside landscapes, sand dunes, water landscapes, desert and crater landscapes, and oases.

The NRA fulfills its nature protection goals through various departments and with the aid of regional rangers and managers. It has developed a computerized database on protected natural assets, sites, species, endemic plants and fungi. NRA scientists study different habitats in nature reserves, explore the relationships between flora and fauna and their environment, collect data on plant and animal behavior and examine potentially harmful influences. Their findings are used to determine how to best preserve, cultivate and rehabilitate the natural assets found in nature reserves.

A lengthy process is necessary before an area can be declared a nature reserve. It begins with identification based on observations and in-depth surveys and studies, continues with deliberations by government offices and planning authorities, and ends with declaration by the Minister of the Interior. In 1994, there were 197 declared nature reserves in Israel spanning an area of 348,564 hectares. With the proclamation of another 214, now in various stages toward declaration, the total area of the reserves will reach 552,956 hectares.

The NRA has developed both local and regional visitor centers for the comfort and enjoyment of travelers. The visitor centers provide detailed information on the landscape, history, geology, archeology, botany, zoology and anthropology of a given area by means of creative displays, maps and pamphlets. Local visitor centers are established in particularly interesting reserves, such as the Eilat Coral Reserve and the Hula Reserve. Regional visitor centers serve a larger geographical area. The center at Yotvata is the gateway to Eilat and its environs; the center at Arad provides

information about the Judean Desert; the center at Mitzpe Ramon introduces the visitor to the Ramon Crater and the Negev mountain range.

Outside the confines of nature reserves, hundreds of plants and animal species, including ferns, wildflowers, shrubs, trees and fish, as well as minerals (rock formations), have been declared "protected natural assets." The NRA, along with other national agencies, works to protect these natural assets wherever they may be. Animals such as the leopard, gazelle, ibex and vulture have been declared protected species, and special rescue operations, including establishment of feeding stations and nesting sites, have been initiated to protect endangered species. At two special wildlife reserves—the Hai Bar biblical reserves in the Aravah and on Mount Carmel—an experimental project to reintroduce animal species, which once roamed the hills and deserts of the Land of Israel, into their former natural habitats, has been initiated. Species now being bred, and slated to be set free at a future date, include ostriches, Persian fallow deer, oryxes, Somali wild asses and onagers. Recently, a modern breeding center for predators such as foxes, wolves, hyenas and wild cats was added.

In the center of the country, the biblical landscape reserve of Neot Kedumim has established gardens with flora native to various geographical areas of the Land of Israel in ancient times. Neot Kedumim, in the Ben-Shemen forest area of the Modi'in region, serves as a living museum of the "green archeology" of biblical Israel.

Botanical gardens have been established by the Hebrew University of Jerusalem and by Tel Aviv University. A germplasm bank with germplasm of wild wheat, barley and oats is operated by Tel Aviv University while the Israel Gene Bank for Agricultural Crops is run by the Agricultural Research Organization.

The Carmel Park and Nature Reserve

While none of Israel's reserves is large enough to preserve entire ecological systems which encompass a variety of habitats, an exciting initiative is currently underway which may pave the way toward the declaration of the Carmel National Park and Nature Reserve as a biosphere reserve. Monitoring and research activities are being implemented by the NRA, within the framework of a three-year agreement between Germany and Israel.

The devastating fire that hit the heart of the Carmel National Park in September 1989 initiated a rethinking process on major long-range planning issues regarding the management of the park. A specially-appointed expert committee, chaired by the chief scientist of the Ministry of the Environment, studied issues regarding the development and restoration of the park. During the course of workshops and deliberations, the concept of a biosphere reserve was first raised, and an attempt was made to introduce

long-range planning considerations related to climate change and the sensitivity of Mediterranean ecosystems to desiccation.

A biosphere reserve is defined as an area in which nature conservation and development are managed sustainably in cooperation with users of the area. This is achieved by dividing the reserve into several zones: a core, with strict conservation regulations; a buffer where active conservation management practices, outdoor leisure, educational activities and scientific research take place; and a transition zone where the infrastructures for tourism, education and scientific research are located and where the human population is concentrated.

The proposed size of the Mount Carmel Biosphere Reserve is envisioned as nearly 50,000 hectares encompassing the mountainous area of the Carmel, the coastal plain and the seashore. The major objectives of the proposed reserve include:

- Conservation of natural biological resources;
- Provision of channels for environmentally-compatible sustainable development;
- Use as a living, outdoor laboratory in reconstruction ecology;
- Development of a model for a new global concept—a climatic transition zone biosphere reserve.

The characteristics of Mt. Carmel, an area clearly demarcated from its surroundings, create a unique and harmonious landscape, compatible with the aims of biosphere reserves. The area boasts geological and geomorphological diversity, contrasting landscapes, rich biodiversity, a mixture of agricultural practices, a wealth of prehistoric, historic and archeological sites, and diverse human activities and settlements. Furthermore, Mt. Carmel is situated within a regional climatic and biotic transition zone: the Mediterranean scrub land extends to its north; the arid zone to its south. It is anticipated, therefore, that the proposed biosphere reserve will conserve the biota of transition zones, as part of an international concerted effort to manage the global biosphere by reducing the scope of adverse ecological impacts due to global warming.

National Parks

While nature reserves are predominantly concerned with the conservation of nature in its pristine state, national parks are mainly concerned with the development of open spaces for recreational purposes. Under the National Parks, Nature Reserves, Memorial Sites and National Sites Law, a national park is defined as an area of natural, scenic, historic, archeological or architectural value which is protected and developed for recreational purposes. The National Parks Authority (NPA), under the responsibility of the Ministry of the Environment, deals with the design, restoration, care and development of national parks.

The NPA was created in order to protect the country's natural beauty from rapidly-encroaching urbanization and to restore and maintain antiquities that have been lost or neglected for centuries. The NPA, often in cooperation with local councils, now operates 43 national parks, criss-crossing the country and catering to over 7 million visitors every year. Three of the parks, situated in Jericho, were recently transferred to the Palestinian authorities within the framework of the peace process.

Masada, the fortress from where Jewish warriors defied the Legions of Rome, remains the most frequently visited national park. Others include archeological remains of ancient cities such as Hazor and Megiddo; Jewish sites such as the mosaic-tiled synagogues of Hamat Tiberias and Beit Alpha; the remains of Nabatean-Byzantine towns such as Avdat and Shivta; Crusader sites such as Caesarea where a Roman theater was excavated and reconstructed; and sites of high landscape value such as the Hurshat Tal woodland and the Carmel Park, spanning 8,400 hectares.

In its early years, the NPA placed special emphasis on the development of archeological sites (26 national parks are archeological sites). With the passing of time, however, increasing demands for recreation and a growing awareness of natural and historic values spurred the development of both recreational and historic sites. Today, increasing emphasis is being placed on the preservation of open spaces, especially near densely-populated urban areas in the center of the country. An NPA team is currently working on revising the masterplan for national parks—proposing the expansion of existing parks, especially alongside rivers, and calling for the development of additional parks in the center of the country.

The National Council on National Parks and Nature Reserves, chaired by a representative of the Ministry of the Environment and including representatives of government ministries, local authorities, nature protection bodies and the public sector, guides the NRA and NPA in their respective spheres, recommends sites for protection and advises the National Planning and Building Board on changes to the national masterplan. In the face of accelerated population, development and industrial growth, the council is currently investing special efforts in the formulation of a policy on open space management. The council has already called for the declaration of a national park in the Sharon area, for the expansion of the Carmel Park, for the prevention of building and development in the immediate environs of coastal streams, and for the prevention of urban and industrial encroachment on sensitive sections of the coastal strip.

Protection of Open Space Landscapes

While awareness of the need to protect natural and landscape resources has led to the emergence of a significant system of nature reserves and

national parks, the small size of the country and the heavy pressures on its limited land resources have left few land reserves. As a result, protected areas are insufficient to preserve the nature values, the ecosystems and the unique landscape image of this highly diverse country.

In order to secure the biodiversity and the visual resources of the country, an interdisciplinary "think team," organized by the SPNI, has formulated a new approach to development in open space landscapes which have not been designated as protected. This new approach seeks to direct development, both in terms of siting and features, to appropriate areas in ways which will not destroy the ecosystem, the wildlife and the landscape features of each of the small but diverse landscape units in Israel.

To provide developers with the necessary conservation information, a methodology for conducting nature and landscape surveys and evaluations was developed. A preliminary classification of the entire open landscape of the country was carried out and recommendations were made for appropriate levels of protection/development for each landscape unit. Open spaces throughout the country were classified into four categories according to their value, importance, sensitivity and vulnerability: protected areas, open space landscape areas, controlled development areas, building and development areas.

Protected areas are areas of special importance and high sensitivity in relation to nature, landscape and historic values. Open space landscape areas are characterized by landscape sensitivity and are important for the protection of natural landscape diversity and features and for recreational needs. Controlled development areas are areas of intermediate natural and visual sensitivity which are partly appropriate for building and development as long as landscape protection is taken into account. Finally, building and development areas are of low landscape sensitivity and are appropriate for building and development.

Woodlands and Afforestation

A National Outline Scheme for Afforestation was approved in principle by the National Planning and Building Board in 1993. The scheme designates 160,000 hectares for the development and conservation of forest lands in Israel—over 15% of Israel's total land area north of Beersheba, where most of the population is concentrated. The plan, implemented by the Jewish National Fund (JNF), seeks to integrate two legitimate, but conflicting demands: development and recreation along with conservation of natural vegetation and open spaces.

Long before approval of the masterplan, decades of planting by the JNF had resulted in the greening of barren areas throughout the country. The JNF was originally established in 1901 for the purpose of acquiring and developing land for Jewish settlement in Turkish Palestine. Immediately

after its establishment, the JNF set out to reclaim the soil, drain swamps, leach out salts, and plant forests on barren hills and in sandy and desert regions. By the time the State of Israel was reborn, five million trees had taken root. By the end of 1993, the JNF had planted 200 million trees in an area of 81,000 hectares. These plus 40,000 hectares of natural woodlands provide millions of residents with the opportunity for outdoor recreation and the enjoyment of nature.

Much of the JNF's work today is concentrated in its afforestation branch, which is responsible for tending saplings in nurseries, planting new trees, thinning and tending forest growth, preventing fires, protecting woodlands against pests and diseases, and forest recreation.

The JNF's early plantings were predominantly composed of evergreens in mountainous areas and of eucalyptus in the south. In later years, damage from pests and arboreal diseases led to a new policy of species diversification. This policy was reinforced by the desire to cultivate tree species which were once part of the natural landscape of biblical Israel, such as various kinds of oak. While two-thirds of JNF's afforestation efforts once focused on the Jerusalem pine, today's forests feature a wide variety of species: oaks and carobs, terebinths and cypresses, eucalyptus, Judas trees, acacias, olive, almond and many more.

Although diseases, pests and pollution cause damage to forests in Israel, the most serious destruction is caused by fires, whether accidental or intentional. In recent years, following years of devastation which saw the destruction of over 2 million trees, efforts have focused on the development of an effective fire-prevention and fire-fighting system. Fire-prevention measures now include forest roads that act as fire breaks and enable quick access to the source of a fire, an early warning system based on 45 fire observation watchtowers, a fleet of state-of-the-art fire engines and special alert squads, as well as training, research and public information campaigns.

The success of afforestation in Israel cannot be overemphasized. Forests contribute to soil conservation, prevent soil erosion, act as a barrier against dust, noise and air pollution, create shade and comfortable mini-climates for recreation, halt desertification on the border of arid zones and contribute ecologically and globally to reducing the greenhouse effect by releasing oxygen into the atmosphere and absorbing carbon dioxide. In the Negev desert, the JNF has planted some 20 million trees over an area of 16,000 hectares. Elsewhere in the country, tens of thousands of hectares of green forests grace previously barren land. Every year, about 2,000 more hectares are planted—some 3 million trees.

Combating Desertification

The sustainable management and restoration of degraded arid lands are pressing problems of global proportions. In Israel, the Negev desert, which

comprises over half of the country's land area, is inhabited by only 7% of the population. Yet this arid expanse once extended further north than it does today. Strategies implemented since 1948 have succeeded in pushing the edge of the desert southward, and actually reversing the process of desertification.

In the 1980s, about 25% of all of the JNF's plantings were carried out in the Negev; today, the percentage has risen to 50%. But the goal is by no means to forest this arid area, but rather to utilize the existing landscape and geographical resources to ameliorate conditions around Negev settlements, improve quality of life and the environment, and combat desertification.

In the northern fringes of the Negev, on the edge of the desert, Israel's largest man-planted forests (Lahav and Yatir Forests) serve as popular nature recreation venues. Trees here grow on an average annual rainfall of 280 mm, in areas where evapotranspiration rates may reach 2,000 mm. Further south, the JNF has been planting widely-spaced trees and natural grasses aimed at upgrading the quality and value of the soil and terrain. Their growth relies on advanced water harvesting techniques which capture runoff rainwater in ridges, depressions, terraces and limans (tree clusters planted in reinforced water catchment basins). Single tree planting is yet another technique used to combat desertification in areas with even harsher natural conditions. The results have made Israel a world-acclaimed leader in rolling back the desert.

The JNF's newest program for planting single trees or clusters of trees in areas where climatic conditions do not permit woodlands or shrubs to grow without substantial human intervention is known as savannization. This experimental project, initiated in 1987, is aimed at preventing desertification and increasing productivity and biodiversity without resource enrichment. The assumption of the savannization project is that biological production and diversity in semiarid regions are related to the patchiness of the landscape. Entire watersheds are managed as whole units encompassing runoff-contributing areas (cyanobacteria, unicellular algae, lichens and mosses) and runoff-collecting patches (clumps of annual plants and shrubs). By manipulating the patchiness at various sites in the Negev and by using water harvesting techniques, some of which were first employed two thousand years ago by the Nabatean inhabitants of the area, rainfall and runoff are redirected, and relatively highly-productive patches are created within the desert landscape.

The major features of the savannization concept are the digging of pits in which runoff accumulates and the planting of trees in these pits. Israeli scientists have found that the mere disturbance of the landscape, through the construction of pits and mounds, has tripled the species diversity of annuals and increased total plant productivity tenfold.

Three savannization field sites have been set up in the Negev along a precipitation gradient of 300-100 mm annual rainfall. The sites contain

both research plots and full-scale savanna areas, as well as undisturbed desert. A wide range of scientific disciplines are employed in an integrated effort to develop an ecosystemic scheme. Currently there are 12,000 hectares of established savanna in the desert, with 200-300 hectares added each year. The sites are fulfilling the objectives of the project by increasing the value of semiarid regions for recreation and conserving and promoting the biodiversity of these regions.

In light of the fact that less than 50% of rainwater in the Negev permeates into the underground water table, and most flows down gullies into the sea, new methods have been developed for flood prevention and water conservation. Dams and reservoirs have been constructed to improve the water balance, arrest the flow of flood waters, catch runoff water, replenish the underground aquifers and create tourism and recreation sites. Runoff and rainfall catchment basins have enabled the development of runoff agroforestry and farming in areas with less than sufficient rainfall. Recycled wastewater, which cannot be used for irrigating edible agricultural crops, has facilitated the planting of groves and parks in semi-arid areas, while brackish water has been used for salt-tolerant crops and for trees in recreation areas. Recent research efforts have led to the identification of crops and technologies that will allow agricultural production with water containing up to 4,000 ppm salts, thus opening new horizons for saline water-based agriculture in deserts of the Middle East and around the world.

Global Cooperation on Desertification

The high priority accorded by Israel to combating desertification has led to the establishment, in January 1994, of the Center for Desert Research and Restoration Ecology in Sde Boker, a joint project of the JNF and Ben-Gurion University's Desert Research Institute. The uniqueness of the center lies in the integration between the Institute's academic frameworks for basic and applied research and JNF's field experience in the development and management of open space systems.

The aims of the center are to foster understanding of desertification processes; to develop and implement sustainable development practices in arid lands aimed at halting desertification processes; to advance restoration ecology; to develop an interdisciplinary ecological approach to the scientific management of open spaces which are impacted by human activity; to serve as a focal point for international cooperation on research related to the development, conservation and management of arid lands; and to offer training and academic instruction.

Techniques developed in Israel for combating desertification have many implications for regional cooperation on desert issues. Savannization, for example, is by definition a technology for minimum-input management of

arid lands, structured around holistic, ecosystemic lines and employing low-levels of intervention. It presents a gradual way of reclaiming degraded desert lands, and can be adapted to site-specific needs and means. With good management, savanna patches can provide food, grazing, fuel and recreation to local populations. It is therefore a prime example of the potential benefit of regional data transfer and cooperation in combating desertification.

Israel is an active partner in current efforts to promote both regional and international cooperation in combating desertification. The subject constitutes a priority item in the multilateral peace talks on the environment and in efforts to draft an International Convention to Combat Desertification. In recognition of Israel's experience in this area, the first workshop of the International Arid Lands Consortium was convened in Israel in June 1994. The Consortium, an independent, non-profit organization dedicated to exploring the problems and possibilities of arid and semi-arid regions, includes several American universities, the JNF and the U.S. Forest Service. Israel, internationally renowned for its dramatic accomplishments in arid zone management, including afforestation, water harvesting, water and soil conservation, savannization and use of saline water, is the natural candidate for hosting this first workshop.

Legal Framework for Nature Protection

The National Parks and Nature Reserves Law of 1963 first provided the legal structure for the protection of natural habitats, wildlife and sites of historic and architectural interest in Israel. Under the law, two authorities were created: the Nature Reserves Authority, responsible to the Ministry of Agriculture and the National Parks Authority, responsible to the Ministry of the Environment. Sites designated for protection are declared by the Minister of the Interior, following consultation with the relevant ministers (Environment, Agriculture or Defense).

In 1992, an entirely updated version of the law was enacted—the National Parks, Nature Reserves, National Sites and Memorial Sites Law. The new version broadens the authority of the Ministry of the Environment within the National Parks and Nature Reserves Council which decides on policy issues. It provides for the protection of areas that are designated as national parks and nature reserves in the national masterplans but which have not yet been declared and developed as such, and prohibits damage, trade and commerce in protected natural assets.

The Wild Animals Protection Law of 1955 authorizes the Minister of Agriculture to restrict the hunting of wild animals, to issue hunting permits, and to appoint inspectors to enforce the law.

The Forests Ordinance of 1926 authorizes the Minister of Agriculture to declare forest reserves and closed forest areas and to declare certain trees protected.

The Antiquities Law of 1978 empowers the Minister of Education to protect historic and archeological monuments and sites predating the year 1700. Archeological sites are the concern of the NPA when they are developed for visitors. Otherwise, they fall under the control of the Antiquities Department of the Ministry of Education.

The Streams and Springs Authority Law of 1965 allows for the establishment of stream authorities, which, among other things, are responsible for the preservation of the landscape and nature along streams and the preparation of these areas for gardens, recreation and sports, as long as they are not included in an area protected under the National Parks, Nature Reserves, National Sites and Memorial Sites Law.

Environmental Management

ENVIRONMENTAL PLANNING

Given the rapid rate of development in Israel, the focus of environmental policy has always been on prevention rather than treatment. Since the early 1970s, attention has been focused on the incorporation of environmental considerations into all major development projects to ensure a path of sustainability. Environmental evaluation and assessment were introduced into planning at the national, regional and local levels, and a system of environmental impact statements was established for checking the environmental impacts of specific detailed plans and proposals. Consequently, Israel has successfully implemented policies for sustainable development within the planning process.

The Administrative Framework for Land-Use Planning

In developing its environmental management program, Israel used the land-use planning system established under the Planning and Building Law of 1965. The law establishes a comprehensive legislative framework which regulates all building and land-use activities in Israel, public and private, within a three-level hierarchy: national, district and local.

At the top level of national planning is the National Planning and Building Board (the National Board), chaired by the director general of the Ministry of the Interior, and composed of representatives of government ministries, local government, and public and professional organizations, including nature protection bodies. The National Board provides a broad and extensive forum for deliberation by all concerned bodies. Discussion at this level allows for the mobilization of professional input and expertise, representing many disciplines. The Ministry of the Environment is a member of the National Board and participates in many of its subcommittees.

The primary responsibilities of the National Planning and Building Board are to enact national outline schemes, review regional outline plans and serve as an appeal board for decisions of the district planning and building commissions. National outline schemes (mostly sectorial masterplans which lay down the planning structure for the entire area of the country) are prepared for issues of national planning significance or for land uses that serve national interests. Initially, the outline schemes are commissioned by the National Board; upon completion they are submitted to the government for approval. Once approved and announced in the official gazette, they have the status of legally binding plans.

The national level of the hierarchy also includes two additional statutory committees: the Agricultural Lands Committee, responsible for protecting lands of agricultural value and minimizing the loss of agricultural land to building, and the Territorial Waters Committee (in which the Ministry of the Environment is a member), responsible for approval of all offshore structures. No plan or building permit regulating agricultural lands or offshore projects may be endorsed without prior approval of these committees.

The regional level of the planning hierarchy is the responsibility of six district planning and building commissions. The district commissions are composed of regional representatives of government ministries, including representatives of the Ministry of the Environment and representatives of local authorities within the district.

District commissions serve as links between national planning and local implementation. They receive the national outline schemes for comment, prepare their regional outline schemes for approval by the National Board and assess plans submitted to them by the local level of the hierarchy. Israel's six districts have comprehensive regional plans (district outline schemes), either approved or in preparation. The objectives of these schemes are to determine the details necessary for the implementation of national outline schemes in each district, and to identify matters which are of general importance to the district (e.g. sites for urban development, industrial development, waste disposal, open spaces for protection and for recreation).

The local level consists of about a hundred local planning and building commissions, serving one or more local authorities and composed of the elected members of the municipal councils. The local commissions prepare outline and detailed schemes for their areas, showing planned land use allocations, and submit them for approval to the District Commissions. Local schemes set out conditions for land and building use in local areas in order to ensure, *inter alia*, appropriate levels of health, welfare and cleanliness, abate nuisances, preserve historical buildings, and protect and develop sites important from the point of view of nature and beauty. Such conditions may include regulations with regard to building density, setbacks, roads, etc. The local commissions are also responsible for decisions on development applications, building permits and action against illegal building.

Environmental Management in Land-Use Planning

For the past two decades, Israel has utilized the land-use planning system as an effective framework for implementing environmental policy. The incorporation of environmental considerations into the physical planning system began in the early 1970s with the introduction of one

environmental advisor to the National Planning and Building Board. Today, 20 planners represent the Minister of the Environment at the national and regional levels of planning, while on the local level, environmental planners actively participate in an advisory capacity in the deliberations of local commissions.

Most of the ongoing day-to-day integration of environmental considerations in the planning process is achieved by the participation of these environmental planners at the national and district level planning authorities, and increasingly at the local level as well. In large measure, due to their advice, outline schemes at the national, district and local levels now incorporate resource evaluation, technologically feasible alternatives and environmental impact assessment.

National Outline Schemes

National outline schemes are prepared for land uses and projects of national significance. Environmental aspects are integrated into all relevant national schemes; in some cases they are the dominant considerations. In 1993 alone, Ministry of the Environment representatives participated in the preparation of the following plans: power supply, airports, ports, roads and interchanges (including the Trans-Israel Highway); water and wastewater; afforestation; tourism and recreation; and storage of liquified petroleum gas (LPG).

With the exception of the National Outline Scheme for Immigrant Absorption, which was commissioned in order to coordinate development for the rapid absorption of immigrants from the former Soviet Union, national outline schemes generally fall into six different categories:

1. Infrastructure plans which are of national significance, such as plans for power stations, ports, and airports;
2. Infrastructure plans which are to be integrated within the framework of a national network, such as plans for roads, railways, and transmission lines;
3. Plans which define criteria and designate sites for the provision of essential goods and services, such as plans for quarries and building materials, waste disposal sites, water catchment basins and aquifer recharge areas, cemeteries, and prisons;
4. Plans which set standards and guidelines which are then interpreted into sites in regional and local plans, such as plans for population distribution, public institutions, tourism and recreation, and gas stations;
5. Plans which protect specific resources considered to be of high value as part of the national natural and cultural heritage, such as plans for nature reserves and national parks, natural and manmade forests, and memorial and historic sites;

6. Plans for particularly sensitive or problematic areas warranting special attention by the National Board, such as plans for the Mediterranean coastal area, Lake Kinneret (Sea of Galilee) shores, the Gulf of Eilat, and Haifa Bay.

Following are several examples of national outline schemes in which environmental considerations play a major role:

National Outline Scheme for Power Stations

This scheme deals with the location and operation of power stations for electricity production and supply throughout the country. Environmental considerations are incorporated in the plan's regulations on siting, construction and operation of the power plants. Siting considerations incorporate such subjects as the carrying capacity of the coastal airshed, the ability of the atmosphere to disperse pollutants, and impacts on the coastal and marine environments. Operational requirements specify the ongoing measures necessary to ensure that environmental impacts will be minimal. Such measures include: air pollution monitoring, threshold levels for pollutant concentrations, and inspection authorities.

The plan for the Hadera coal-fired power station included the first statutory example of "environmental compensation." It linked the construction of the plant to establishment of a park for Hadera residents as compensation for the siting of the power station adjacent to the town. This principle was followed with the next power station site at Ashkelon, where the town was compensated by funds for a marina project, to ensure that its tourist industry would not be damaged by the construction of the power station.

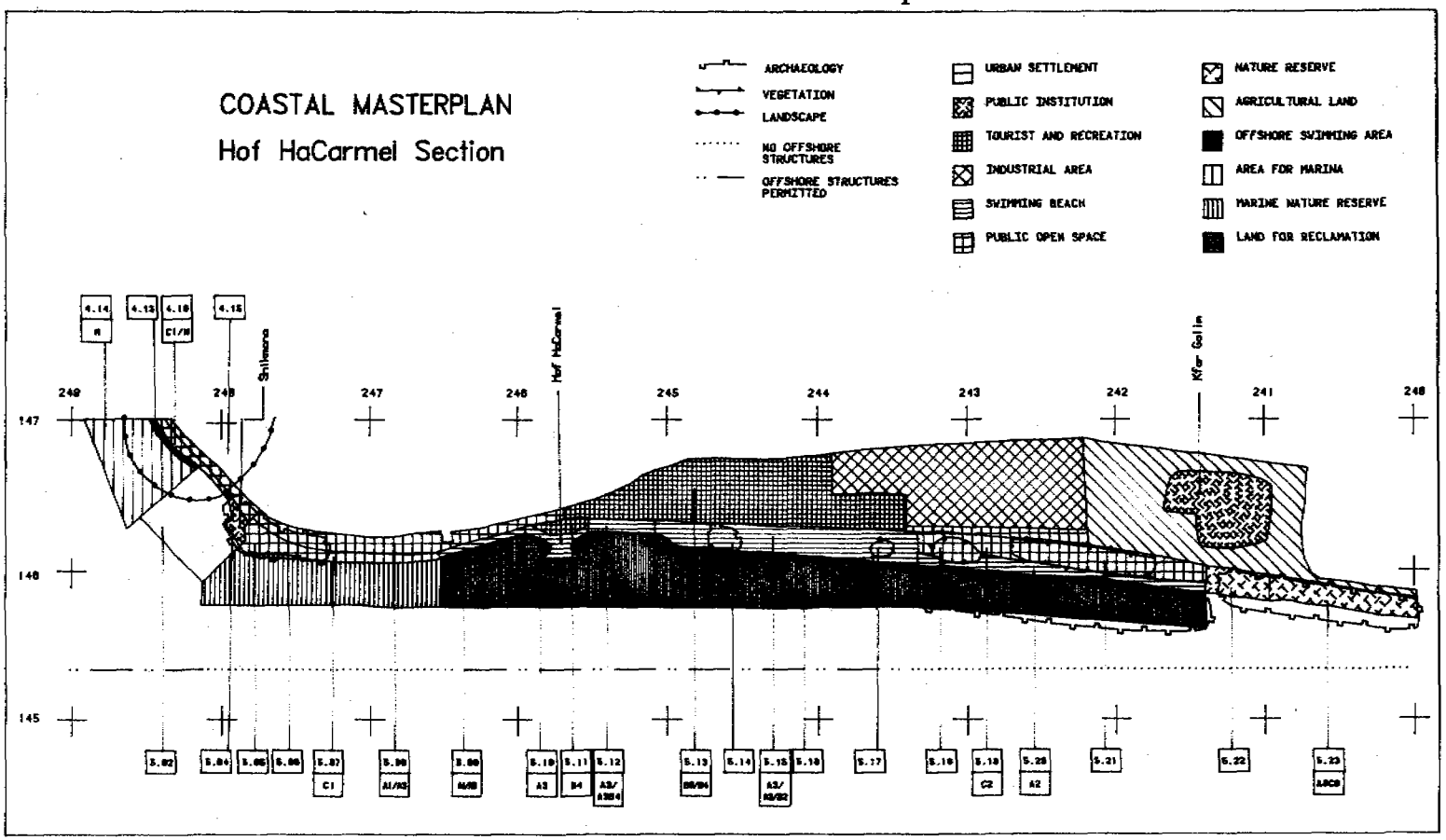
National Outline Scheme for Airports

All plans for airports, including the Ben-Gurion International Airport, include measures for noise abatement. Flight paths are determined not only by aircraft and safety requirements but also by alignments designed to reduce the number of residential units exposed to high noise levels. Wherever possible, residential or noise-sensitive uses are not permitted in areas exposed to noise levels above 65 LDN. Acoustic measures are required for new dwellings in areas exposed to noise levels just below 65 LDN. The plan includes ongoing monitoring and enforcement procedures and establishes the authorities responsible for implementation.

National Outline Scheme for the Mediterranean Coast

In recognition of the national value of Israel's coastline, the National Planning and Building Board ordered the preparation of national plans for all of the country's sea and lake shores in 1970. The first stage of the National Outline Scheme for the Mediterranean Coast was approved in 1983. Its main features included: prevention of development which is unrelated to the coast; protection of large sections of the coastline as nature reserves, national parks and coastal reserves; and allocation of coastal

Figure 12
Section of the Coastal Masterplan



areas for tourism and recreation activities. The masterplan includes a highly effective clause prohibiting development within 100 meters of the coastline.

To help provide a comprehensive long-term guide to planning policy, beyond the general guidelines in the approved masterplan, the National Board commissioned a more detailed document for the resource management of the Mediterranean coastline for tourist and recreation activities. The plan, prepared by the Ministry of the Environment and recently approved by the National Board, bases development policies on principles of suitability and sensitivity of coastal resources. Suitability for tourist and recreation development was assessed on the basis of geological, vegetation and landscape surveys; the allocation of the level of intensity of development for each site along the Mediterranean coastline was checked in relation to resource sensitivity. Four levels of development were subsequently defined for beaches and their immediate hinterland, four levels of intensity of accommodation, and three levels of development of hinterland day-visitor areas (Figure 12.)

The overall national policies proposed for resource management of the coast include:

- Development which is not for recreation or tourism should not be permitted along the coast and its immediate hinterland;
- Policies for resource protection should range from absolute protection within a designated reserve to the identification of sensitive resources to be considered within the detailed plan for site development;
- Highly intensive uses should be confined to existing urban centers;
- Offshore construction for recreation and water sport activities should be restricted to urban centers;
- A public footpath should be designated along the coastline to ensure public access by foot to and along the coastline.

National Outline Scheme for Immigrant Absorption

The most recently approved masterplan—a scheme for immigrant absorption—is noteworthy for its integration of substantial environmental management and resource protection measures. It sets a precedent for future plans by ensuring that the environmental implications of planning proposals will be considered as an integral part of the planning process.

Recognition of the need to coordinate planning efforts by all sectors of government in order to absorb the hundreds of thousands of immigrants which have poured into Israel since 1989 led the National Planning and Building Board to commission a National Outline Scheme for Immigrant Absorption in June 1990. This represented the first time that various subjects, previously addressed within the framework of sectorial masterplans, were integrated within one outline scheme. The scheme, approved by the National Board in August 1992 and by the government in

January 1993, sets out directives on development and management of the country's resources during a period of accelerated development and immigrant absorption.

It is to Israel's credit that despite the flurry of planning and building, environmental quality was recognized as a key component of the plan throughout all the stages of its preparation. An environmental guidelines map accompanies the plan as a statutory document. Based on an evaluation of the sensitivity of areas to development, the map displays environmental constraints and restrictions on residential development. It denotes areas in which building should not be permitted, namely areas of high natural and landscape value designated for protection, and areas exposed to environmental deterioration such as noise, air pollution or risks. It also designates areas where development would be permitted provided measures are taken to prevent environmental degradation, such as areas of high sensitivity to water pollution.

The planning documents give strong emphasis to environmental management principles, including:

- Development should be confined to existing urban settlements, using existing infrastructures;
- Rural development should be limited to minor expansion of existing settlements, within an overall policy of open space protection of rural agricultural landscapes;
- High quality areas of natural and landscape value should be strictly protected;
- Development should not be permitted in areas exposed to environmental degradation;
- Development must be accompanied by the adequate provision of facilities for sewage treatment;
- Development of industrial parks must include regulations to prevent environmental pollution.

The National Outline Scheme for Immigrant Absorption is accompanied by a non-statutory development plan designed to help guide the investment decisions of the various sectorial ministries. It includes investment priorities for sewage treatment facilities and for solid waste disposal sites.

National Outline Scheme for Transportation (Road #6)

To speed up the development of the national transportation system, the National Board decided to prepare a masterplan for roads, at a detailed level of planning, within the framework of the immigrant absorption masterplan. The approved plan relates to a large number of national roads outside built-up urban areas—the most controversial of which is the Trans-Israel Highway (Road #6). The road is envisioned as the major road artery in Israel, linking the Galilee and the Negev to the center of the country. It is to be the largest public works project in the country's history.

The proposed highway has raised a number of environmental objections:

- Rather than promoting public transportation, the road will give priority to the private car as the main means of transportation in coming years.
- The road will impact upon land-use planning in its environs. Accessibility to metropolitan areas and availability of land may lead to unwelcome development from the national and local points of view.
- The road will reduce the open space left in the central region of the country where demand for land is high and land reserves are few.
- The project is land-intensive. The width of the road strip along the planned area exceeds 100 meters; at least 10 hectares of land will be required for each kilometer of length; and between 20-100 hectares of land will be taken up by each interchange.
- Potential environmental problems may include noise and air pollution and visual blight.

While the Ministry of the Environment is convinced that an overall review of transportation policy, taking into account environmental considerations and mass transportation needs, is imperative, it is also cognizant of the vital need to improve the road system in Israel. Therefore, it has taken an active part in the planning of the highway from the outset under the conviction that the incorporation of environmental measures into the detailed planning of the road and its junctions can minimize damage to natural and landscape resources and reduce the exposure of nearby settlements to noise and air pollution.

Consequently, the ministry checked initial proposals and made recommendations to the planning teams; it called for the preparation of five environmental impact statements on particularly problematic sections; it required environmental studies for additional sections where potential landscape or noise impacts were anticipated; it reviewed the documents submitted by the road planning teams; and it participated in the decision-making process of the National Planning and Building Board.

Indeed, many of the recommendations made by the Ministry of the Environment were accepted by the National Board in its recent endorsement of various sections of the road. These included the ministry's demand that a comprehensive review of transportation systems and policy in Israel, including rail, subway and other forms of public transportation, be prepared, as well as the ministry's request for a land-use plan along the road corridor (5 kilometers along each side) to guide land-use changes. The National Board has not yet accepted the ministry's request for approval of the road in stages, in order to allow for decisions on further expansion of the road versus the development of alternative transportation means at various stages of construction. At the time of writing of this report, the ministry remains hopeful that the National Board will decide in favor of approval of the road in stages.

National Outline Scheme for Afforestation

Growing environmental awareness and concern over the fate of Israel's diminishing open spaces in the face of escalated development have accelerated the completion and approval in principle of a national masterplan on forests and natural woodlands. The masterplan seeks to balance the conflicting demands of development and recreation with those of conservation of natural vegetation and open spaces.

The plan relates to afforestation plans for the next 20-25 years. Criteria for the selection of locations and for the determination of types of forest are based on two main factors: general siting considerations (e.g. priority to areas unsuitable for cultivation) and suitability of selected sites to specific types of forest. The plan establishes eight categories of forest including: existing man-planted forests, natural woodlands for conservation, proposed man-planted forests, natural woodlands to be maintained and developed, existing park forests, proposed park forests, coastal park forests and riparian plantings.

Afforestation is proposed for sites throughout the country in accordance with existing conditions in each area, the regeneration potential of the natural vegetation in a specific ecosystem and geobotanic location, the restoration potential of existing forests, and requirements for new forests to meet growing recreation and tourism needs.

National Outline Scheme for Water, Sewage and Drainage

The National Board commissioned a masterplan for Israel's water system in 1993. Its goal: to designate sites and establish regulations on facilities for water use and supply, to protect water sources and prevent pollution, and to ensure appropriate sewage treatment, effluent reuse and drainage management.

The first stage of the plan, now in preparation, relates to sites for wastewater treatment and disposal; options for recharge areas, storage basins and pipelines for effluent reuse; constraints on land uses in areas sensitive to water pollution; restrictions on the expansion of settlements which do not have suitable wastewater facilities; and incentives for effluent reuse. A steering committee, including representatives of government and environmental bodies, is accompanying the preparation of the plan.

Israel 2020: A Long-Range Masterplan for Israel

Since the mid 1960s, Israel's population has nearly doubled, but, due to rising living standards, the built-up area has quadrupled. From a sparsely-populated country with 800,000 residents spread over 21,000 square kilometers in the late 1940s, Israel today has become a densely-populated nation, in which 92% of its 5 million inhabitants live in an area which covers only 40% of the land area.

Over the next thirty years, Israel may again double its present population and treble its built-up area. Increased stress will be placed on a diminishing pool of land resources.

Most national plans to date have been sectorial; the country lacks a comprehensive long-range plan to guide its development. However, the recent influx of Jews into Israel from the former Soviet Union and from Ethiopia, the peace process and the transformation of Israel into a post-industrial society have made the preparation of a long-range national plan imperative.

The call for the preparation of a long-range masterplan was given to the Israeli government by the nation's leading planners, architects and engineers in 1989. A professional team was assembled including leading professionals and researchers from the academic community and representatives of government bodies. The project officially began in May 1991. It aims to prepare comprehensive and non-statutory strategic documents which will form a framework for national plans for the next 30 years.

The project adopted a three-stage methodology. During the first stage (completed), a broad spectrum of forecasts for Israel's future was outlined and analyzed from various perspectives and disciplines. During the second stage (nearing completion at the time of going to press), the knowledge accumulated is being synthesized into a number of alternative integrated planning directions for the state's future development. Each alternative has a different focus—economic development, social issues, protection of open spaces, and an alternative based on the continuation of current trends. Special teams were set up to study environmental and transportation issues. During the third stage, these alternatives will be evaluated and the preferred alternative developed into a set of policy recommendations.

Ten projects formed the substantive and empirical foundations for the planning. They included: society and demography, land, energy and water resources, future technologies, environmental sustainability, transport and telecommunication, and security.

The environmental team identified the problems and conflicts likely to be of concern in the year 2020, taking into account anticipated population and economic growth:

1. The scope of the built-up area and density will increase, especially in the center of the country, making land a very scarce resource.
2. The scope of transportation, both inland and international, will grow with a major rise in motor transportation.
3. Water demand for non-agricultural use will grow.
4. Total emissions resulting from human activity will grow, including domestic and industrial waste and wastewater and air pollution, mostly from vehicular sources. This will further aggravate environmental problems in the realms of water quality, air quality, hazardous substances, solid waste and noise.

The report produced by the environmental team suggests means of approaching these problems, both from operative and conceptual viewpoints, harnessing regulative and market mechanisms.

District and Local Plans

Representatives of the Minister of the Environment are statutory members of the district commissions and active participants in many sub-committees as well. They present environmental opinions to the commissions, discuss environmental objections during the plan approval process, identify plans and projects which require the preparation of environmental impact statements, and follow-up on the fulfillment of instructions incorporated into the plan regulations. As members of the decision-making body, their input enables the integration of environmental considerations into the everyday decisions of the district commissions.

Regional masterplans in various parts of the country are currently being updated and amended to include environmental elements. The northern district (the Galilee), one of the most complex regions in terms of the composition of its residents, settlements, and landscape and environmental assets, provides one such example. While the principal objective of this regional masterplan is to engender a process of rapid and efficient socio-economic development in the area, the amendment to the masterplan (still in deliberation) includes important environmental considerations. Most importantly, it establishes the protection of nature, landscape and the environment as one of its six objectives.

The northern district masterplan is accompanied by four maps:

- A planning and development policy map which reflects, *inter alia*, environmental policies. It divides the district into strategic areas whose determination is largely based on environmental considerations.
- A land-use map, where regulations include environmental instructions.
- An environmental guidelines map which divides the district into land areas in accordance with six levels of sensitivity. The parallel chapter in the regulations specifies development restrictions for each sensitivity level.
- A map of engineering and infrastructure systems which includes, *inter alia*, waste disposal sites, airports, water reservoirs, a wind energy farm, roads and quarries.

The plan exemplifies the growing importance currently being accorded to environmental considerations in regional planning.

On the local level, adherence to planning schemes proceeds largely through permit requirements. No externally-visible work related to roads or buildings can be initiated without a building permit. The local planning

and building commissions decide on applications for development, building permits, and action against illegal building. Planners from local environmental units or town associations for environmental quality participate in most local commissions in an advisory capacity, providing opinions and suggestions on environmental issues.

Rapid Development and Environmental Planning

The challenges of immigrant absorption and the responsibility of providing a roof for each new immigrant stood at the center of planning in Israel in the early 1990s. While the National Outline Scheme for Immigrant Absorption provides a positive example of the incorporation of environmental aspects in planning decisions, environmental mistakes were not always avoided in other areas. On the district and local levels, environmental aspects were at times sidestepped as development pressures mounted.

The Planning and Building Processes Law, a two-year emergency order enacted by the Knesset in mid-1990, provides one example of the dangers of hasty decision making. Normally, environmental planning is based on the careful and detailed assessment of the environmental impacts of building and development proposals. However, the pressing need to provide housing and employment to a massive wave of new immigrants led the Knesset to enact the emergency order in order to accelerate the approval process for residential construction and to create new and less cumbersome planning institutions. Although provisions were made for the inclusion of a representative of the Minister of the Environment as a full member of both residential and industrial emergency building committees, hasty decisions allowed for the approval of some residential units at sites exposed to environmental nuisances or at sites lacking requisite public services. The most acute environmental problem generated by rapid development was the lack of sewage treatment facilities. The emergency order, extended in recent years as a means of coping with the country's housing shortage, has been opposed by all of Israel's green groups.

In June 1994, the government decided to significantly accelerate residential building throughout the country in order to better cope with rising housing costs and shortages. In light of past mistakes, however, the government acquiesced to a request by the Minister of the Environment to include an environmental clause in the housing program stipulating that building permits for new residential neighborhoods will not be granted until the completion of sewage and solid waste disposal facilities and public transportation systems. The ministry opposes residential building in areas exposed to environmental pollution and in areas of high natural or landscape value; it has recommended, instead, that new settlements be directed at sparsely-populated areas, such as the Negev, and that high-

rise building be introduced into the central region so as to avoid urban sprawl and preserve open space land reserves.

Throughout the years, various attempts have been made to shorten approval processes in Israel's planning authorities. A 1988 amendment, for example, sets a strict time limit on the approval of plans once they are declared for deposit. Another significant amendment requires planning authorities to state their policies in advance, so as to inform developers of requirements and to allow them to formulate permit applications in accordance with stated policies. While the amendment only refers to building permits at present, the same philosophy, if successful, will be extended to plans. Consequently, the environmental implications of projects will be anticipated in advance, and environmental planning policies will be issued to developers on request.

In the midst of accelerated development, one accomplishment deserves special mention: increased awareness of the importance of open space landscape preservation. A breakthrough was achieved with the establishment of a think team in 1990—composed of representatives of Israel's major nature and environmental bodies—to classify the country's entire open space landscape into characteristic landscape units according to criteria relating to the totality of their attributes and functions. This classification was accompanied by recommendations for appropriate levels and features for the protection/development of each landscape unit. The open landscape classification maps were integrated into the National Outline Scheme for Immigrant Absorption and will continue to be used in environmental lobbying and conservation campaigns.

Environmental Impact Statements (EIS)

One of the most important tools in the land-use planning process is the EIS. EISs have been used in Israel from the mid-1970s; regulations governing the requirements of EISs were promulgated under the Planning and Building Law in 1982.

The regulations specify four kinds of projects for which an EIS is mandatory: power stations, airports, ports and hazardous waste disposal sites. The regulations also urge the preparation of an EIS for landing strips, marinas, national water supply arteries, dams and reservoirs, wastewater treatment plants, quarries, waste disposal sites and industrial plants situated outside designated industrial zones—if the planning authority considers that significant environmental impacts may occur beyond the immediate vicinity of the project. In practice, regional planning authorities regard this recommendation as mandating an EIS, since all such projects have significant impact beyond the immediate vicinity.

In addition, any planning authority (national, district or local) may require an EIS on any plan expected to have environmental implications,

and every ministerial representative on the national or district planning level may require an EIS for any plan under discussion. Since the Ministry of the Environment is represented on the national and district planning authorities, it can exercise its right to require an EIS if the authorities themselves do not do so.

The regulations call for EISs to be prepared in accordance with guidelines, formally issued by the planning authority but prepared by the Ministry of the Environment. The ministry invests special efforts in the preparation of appropriate plan-specific guidelines to ensure that the EIS, when submitted, will be a useful tool to decision makers. Experience over the past few years shows that specifically-tailored guidelines produce useful EIS documents, which are not hampered by generalized, irrelevant data.

An EIS includes five sections as follows:

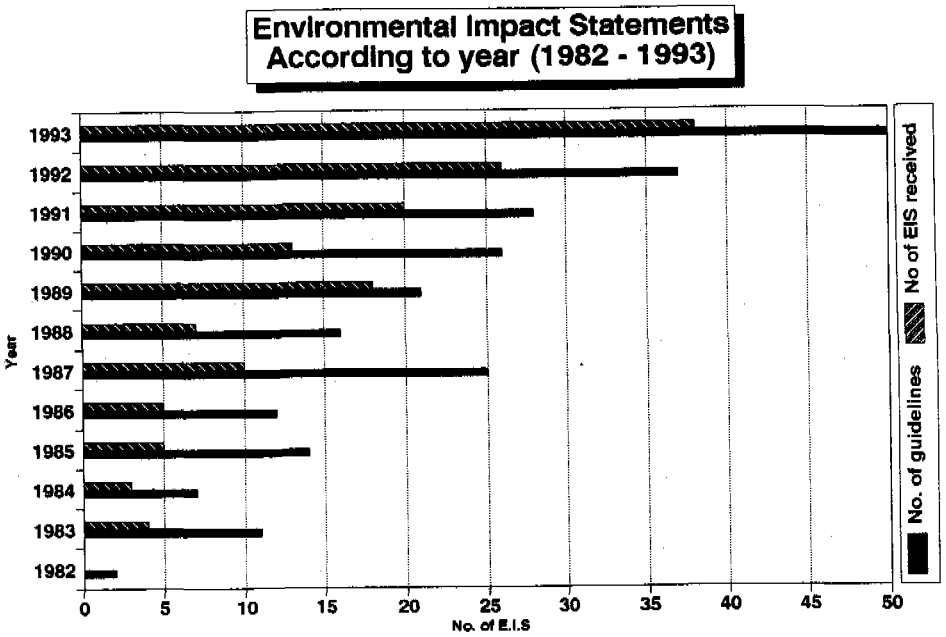
1. A description of the environment to which the plan relates, prior to the development activities.
2. Specification of the reasons for preference of the proposed site of the plan and its activities.
3. A description of the activities resulting from implementation of the proposed plan.
4. Specification and assessment of the projected environmental impact resulting from the implementation of the plan.
5. Presentation of EIS findings and proposed conditions to be included in the plan regulations.

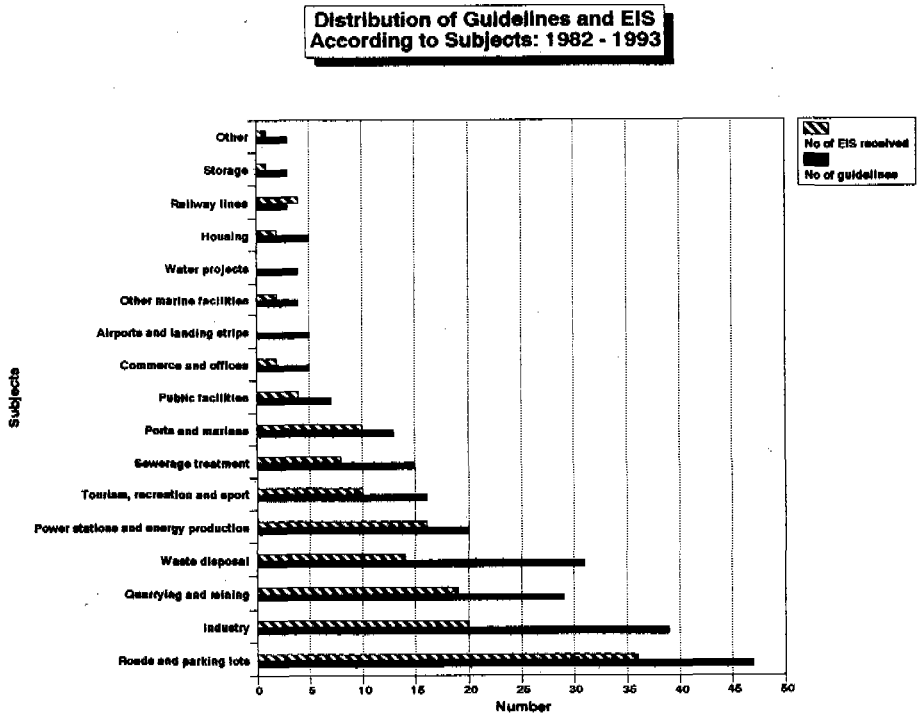
The developer is responsible for preparing the EIS in accordance with the guidelines prepared by the Ministry of the Environment. While the regulations do not specify how an EIS should be reviewed, the Ministry of the Environment has examined all EISs since 1987. Experts at the ministry evaluate each EIS and issue an opinion which includes a summary of the main findings of the EIS, the ministry's conclusions about the assessment, and a list of recommendations for the planning authority. In almost every case, the planning authority welcomes the professional advice it receives from the Ministry of the Environment and incorporates all of its recommendations in its decision concerning the plan.

Implementation of the EIS System

Over the years, there has been a constant rise in EISs required by planning agencies. From the time the system began operating until the end of 1993, 248 EISs had been commissioned: 47 for roads, parking centers and associated facilities; 31 for waste disposal sites or waste transfer stations; 39 for industries; 29 for quarries; 20 for power stations; 13 for ports or marinas; 15 for wastewater treatment; 16 for tourism, recreation and sport; and the remaining distributed among railway lines, water works,

residential and commercial projects, public institutions, airports and landing grounds, and marine facilities. About 70% of the EISs are prepared for public projects and infrastructure rather than privately-initiated development (Figures 13 and 14).





While EISs for major urban and interurban roads are not included in the statutory list, planning authorities nevertheless require the preparation of EISs for these projects. In fact, roads and associated facilities form the largest group of EISs required.

In 1993, the scope of activities within the system increased substantially (by about 50%) in comparison to previous years. In 1993 alone, 49 guidelines for EISs were prepared (as opposed to 37 in 1992 and 28 in 1991), and 38 EISs were received (as opposed to 26 in 1992 and 20 in 1990). The most dominant subjects for which EISs were required were: roads, industrial areas, quarrying, wastewater treatment, power stations and energy production.

Following are a few notable examples of the implementation of the EIS process in recent years:

- In planning for the central section of the Trans-Israel Highway, a two-stage EIS process was initiated for the first time in Israel: assessment of alternative alignments on the macro level in the first stage, and preparation of an EIS for the preferred alternative on a micro level at a later stage. This adheres to the growing awareness that the EIS should be introduced as early in the planning process as possible.
- In the case of industrial areas, the EIS reviews the suitability of the area for industrial development and places restrictions on the introduction of industrial plants. Since, at the time of preparation, it is not known which specific plants will be part of the industrial area, the EIS relates to infrastructure requirements such as sewage facilities.
- An EIS for a gas turbine complex in the Hagit area (south of Haifa) was presented in 1993. In this case, recommendations of the Ministry of the Environment on measures for minimizing adverse impacts were incorporated into the environmental regulations of the plan itself. Conditions and restrictions imposed on the Israel Electric Corporation related to the prevention of air and groundwater pollution.
- Submission of an EIS for an Alexander River National Park resulted in the introduction of various changes to the plan meant to reduce environmental nuisances (e.g. noise) and to promote the preservation of natural values such as sand dunes. These restrictions found expression in the restriction of commercial enterprises and parking areas.

Today, planning agencies view the EIS as a credible and reliable process that helps them analyze and resolve environmental conflicts. Developers tend to favor the process because it helps them present an environmentally-sound plan to a more environmentally-aware public, and the public uses it as a basic document upon which to base objections. Moreover, green organizations have begun using EIS requirements as a tool in their struggle against large-scale projects deemed to have major environmental repercussions. In the case of a now-defunct plan to build a Voice of America

(VOA) transmission station in the Aravah area, an appeal to the High Court of Justice led to a unanimous ruling which stated that no decision should be taken on the VOA complex before an EIS is completed in a comprehensive and professional manner. In a recent ruling on a petition by a non-governmental green organization to order the preparation of a comprehensive EIS for the entire Trans-Israel Highway, the High Court of Justice ordered the relevant authorities to explain why a complete EIS was not commissioned for the road.

In light of the growing use of EISs in Israel, the Ministry of the Environment compiled a list of Israeli consultants on EIS preparation. Over the last decade, the number of professional consultants on EISs has grown to about 200.

Future Directions in EIS Implementation

The EIS has proved to be a highly effective tool for a limited number of complex projects in which severe environmental impacts are anticipated and the plan is sufficiently detailed for the impacts to be identified and forecasted. The EIS is not an appropriate tool for checking multiple small plans whose cumulative environmental impact may be significant. For smaller-scale proposals, representatives of the Ministry of the Environment evaluate accumulated effects and make recommendations to the planning authorities; in most cases, their advice is accepted and incorporated into the planning decision.

In an effort to improve the EIS process, the Ministry of the Environment commissioned a review of EIS activities over the past decade. The review, recently completed, focuses on seven test cases, from initiation to implementation, as well as on the results of six workshops with the participation of professionals from various fields, including planners, environmentalists and lawyers.

Israel is currently considering widening its use of EISs to encompass additional areas, such as commercial centers, fuel and hazardous substances sites, and specific industries. Because EISs are prepared during the initial designation of sites for industrial purposes, they usually do not cover specific industries within such areas. While several local planning authorities do require non-statutory EISs when they suspect that an industrial proposal may adversely impact the environment, the failure of national regulations to require EISs for building permits for industrial plants should be remedied. In the meantime, environmental assessment of specific industries is carried out within the framework of the Licensing of Businesses Law, which allows for the incorporation of environmental conditions into business licenses.

Ways are also being sought to incorporate environmental assessments at an earlier stage in the planning process, before the plan is submitted for

approval. A recent development may provide the groundwork for such change in the future. An amendment to the Planning and Building Law (in force since April 1994) regulates, for the first time, consideration of the environmental nuisances which may arise from the paving of roads and railways and the construction of bridges, interchanges and tunnels—before granting of a permit. The law, enacted in order to accelerate the timetables for preparation and approval of road plans, obligates developers to submit road and other related plans to representatives of the Minister of the Environment in district commissions prior to submission of the plan for approval. The representative may then require preparation of an EIS which, along with the environmental opinion of the Ministry of the Environment, is then attached to the plan when it is submitted for approval to the district commission.

The model provided by the approval process for road plans may well serve as a model for the presentation of EISs at earlier stages of planning for other projects as well. Such a process requires active interaction with developers at the earliest stages of planning. Efforts are currently being focused on introducing environmental requirements, both in public and private projects, in the initial stages of planning. A notable example is the tourism sector where environmental consultants are included in the preparation of tourism development plans from the outset.

Geographical Information Systems

The development of Geographical Information Systems (GIS) in recent years has led to important breakthroughs in the organization and analysis of geographic data for environmental purposes. A GIS is a computer mapping database system which enables the user to present physical, statistical or thematic data (derived from maps, aerial or satellite photographs, field surveys and digital information) in their geographical context. Automated cartography is used in resource management to identify areas of environmental sensitivity and areas of conflict.

The Ministry of the Environment's Planning Division has been using the GIS as a planning tool since 1988. Despite budgetary limitations, the unit has developed a GIS which contains over 20 layers of information for the country, the average scale being 1:50,000 meters.

The first GIS project undertaken by the ministry was the Mediterranean coast database, which originally produced the maps included in the National Outline Scheme for the Mediterranean Coast. The coastal area is divided into 18 designated sections/maps, each of which includes the following layers of information: land-use features; areas including archeological, vegetation, and natural landscape sites; and communication lines (i.e. roads, railroads). The Mediterranean coast database is now being expanded to include information on monitoring sites and beach access.

The second database covers the entire country. It includes information, based on national outline schemes, on areas exposed to airport noise, quarries, roads, and solid waste sites as well as areas of aquifer sensitivity. This information was combined, analyzed and displayed in map form for use in the National Outline Scheme for Immigrant Absorption. Sites designated by the Israel Lands Authority for residential building and industrial development were checked with the database to identify areas where potential development may be subject to environmental degradation.

The third database deals with open spaces. It delineates national parks, nature reserves and landscape reserves which are included in national and regional masterplans; areas of special landscape value which were identified in a survey of open space landscapes; and areas proposed for afforestation in the afforestation masterplan. This database will provide a basis for open space policy and decision making.

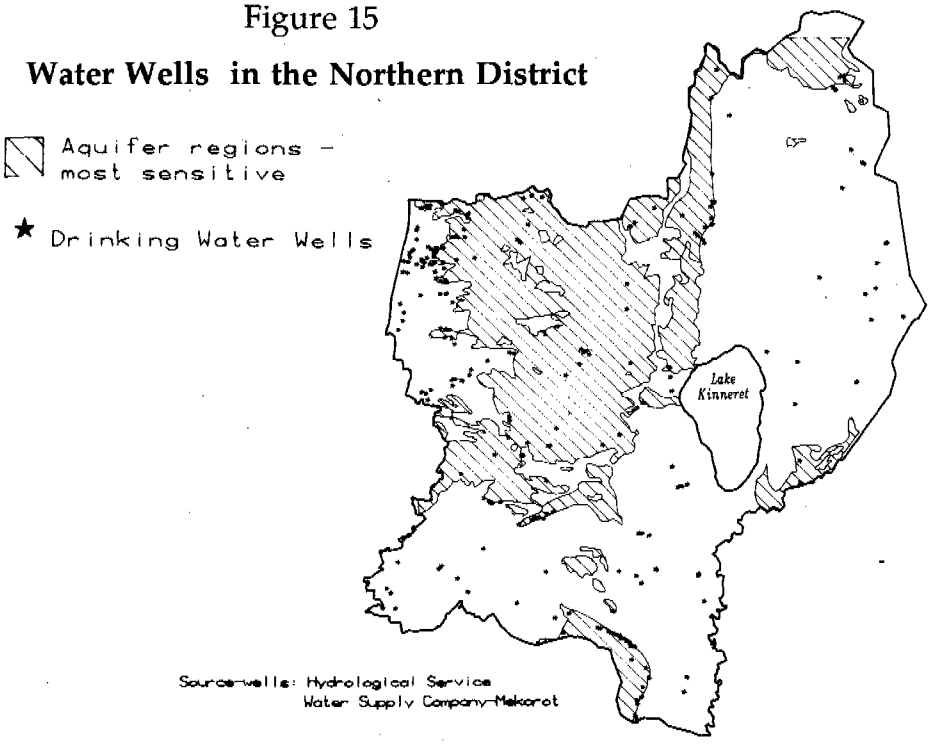
Using the information layers described above and additional data, several applications have been developed. One application was a pilot project to determine areas suitable for residential development. A ten-square kilometer area around the town of Karmiel was used as a pilot site. The project was based on a wide range of data including existing and proposed quarries, areas of slope greater than 30% on hard or soft limestone, road alignments with buffers, planted and natural forests, industrial areas, agricultural areas, sites of special interest with 50 meter buffers, wells with 100 or 500 meter buffers depending on rock type, nature reserves or national parks with 200 meter buffers and existing settlements and roads. This information was used with overlay to determine which sites were suitable for residential development based on select criteria. A map of sensitive areas was also developed.

In recent years, the GIS has been used extensively by many other divisions in the Ministry of the Environment including the divisions of solid waste, hazardous substances, marine and coastal environment, water quality and pest control.

- A database covering the entire area of country was developed for solid waste sites, including existing and planned landfills, illegal dumps, existing and planned transfer stations and recycling centers. The GIS was also used to assess the suitability, in terms of aquifer sensitivity, settlements and open space, of a major site slated to serve as a central landfill.
- Maps showing the accumulation of pollutants along the course of the Alexander and Na'aman Rivers were produced. In addition, a database of drinking water wells was developed with information compiled from the Hydrological Service and the National Water Authority. The location of wells was analyzed *vis à vis* aquifer-sensitive areas to create a map of wells with different buffer zones (Figure 15).

Figure 15

Water Wells in the Northern District



- Maps pinpointing the locations of microbial and heavy metal monitoring stations along the Mediterranean coast and displaying coastal land uses along the Mediterranean at a scale of 1:100,000 were produced. Land use types include swimming beaches and industrial, municipal and defense uses.
- A map of air pollution monitoring stations was prepared.
- A map and database showing major sites of hazardous substances in the country was developed.
- Maps analyzing the spatial distribution of the *Anopheles* mosquito and potential malaria sites throughout the country were produced.
- Maps of noise contours from civil and military airports were prepared.

Over the past year, cooperation has also developed with other government bodies using the GIS, for purposes of data exchange and joint projects. For example, a year-long project in the south Sharon region with the Hydrological Service should enhance cooperation between the two offices in such areas as data exchange, assessment of the environmental impacts of land uses and evaluation of water quality and water resources. Cooperative ties are also being developed with the GIS units of the Nature Reserves Authority, the Israel Lands Administration, the Jewish National Fund and the Society for the Protection of Nature in Israel. The GIS unit has contributed information and analysis to the planning team which

produced the masterplan on immigrant absorption and will be contributing information for the long-range masterplan for Israel (Israel 2020).

Finally, to determine the feasibility of using satellite imagery as a source of data for land use and environmental pollution, two remote sensing projects using image processing of satellite imagery have been contracted by the Ministry of the Environment. One project, in the Dan metropolitan area, was recently completed by a private company using Landsat TM satellite images to classify land use in the Greater Tel Aviv area, from Ashdod in the south to Herzliya in the north. Eight classifications of land uses were mapped: built areas, uncultivated areas, sand dunes, vegetation (3 types), water bodies and new construction. The project used images from two different years (1987 and 1993) to identify changes over time with regard to green areas, new neighborhoods, expansion of roads, infrastructure work, etc.

In a second project, the Geography Department of Bar Ilan University classified land uses in the Haifa-Carmel area using SPOT satellite images. The project used images from different seasons to classify agricultural, residential, industrial, quarrying, and other land use types. The main goal of the project is to develop methods of remote sensing for the purpose of mapping land uses in different conditions in Israel. The Carmel area was chosen as the area of research due to the variety of components it incorporates, and since it represents a wide range of coastal landscapes which are characteristic of large parts of the country.

While in the past major focus was placed on the use of air photography, today efforts are concentrated on satellite imagery over larger areas. While this method provides a lesser level of resolution, it provides essential digital information which can be utilized immediately.

The Legal Framework for Land-Use Planning

The Planning and Building Law of 1965 is a comprehensive statute with enabling regulations that monitors and regulates all building and land-use designation in Israel. The law vests development rights in the state; public or private landowners or developers cannot build without the state's permission. No construction and land-use activity can be initiated without a permit, and no permit can be issued unless it fully complies with the various statutorily-approved master and detailed plans applying to the specific area and project.

The law also serves as a foundation for environmental protection in Israel. It establishes a hierarchy of government planning bodies (on the national, regional and local levels) responsible for the planning of the environment and for all land use, both public and private. These planning authorities control development, taking into consideration all potential impacts, including environmental.

The Planning and Building Law provides for a public notification and participation process. The public is informed of schemes presented to the

regional and local planning authorities through public notices published in the legal gazette, in offices of the local authority and in daily newspapers. Public bodies or individuals are free to inspect such schemes and to file opposition during the deposition period of any given plan. The law also provides for an appeal process in case an objection is rejected.

Planning and Building Regulations (Environmental Impact Statements) were promulgated in 1982. Under these regulations, an EIS is defined as "a document reviewing the connection between a proposed plan and the environment in which it is to be implemented, including estimates of the expected or foreseen effects of the plan on this environment, and an itemized list of the measures needed to prevent detrimental effects." The regulations have been fully integrated into the planning system, ensuring that at all stages and at all levels of the planning process, major development plans (as defined in the regulations) undergo environmental assessment.

LEGISLATION AND ENFORCEMENT

Comprehensive environmental legislation is an integral part of any successful environmental management program. Israel's environmental legislation covers the entire range of environmental issues, uses all forms of legislative instruments—laws, regulations, administrative orders and by-laws—and is linked to a comprehensive international legislative system which includes numerous international conventions.

(A listing of international environmental conventions ratified by Israel is included in the appendix to this publication.)

Israel's environmental legislation is characterized by its diversity and scope. It includes laws dealing with specific environmental issues as well as laws of a more general nature which cover environmental matters. Specific legislation relates to air, water, marine and noise pollution as well as to solid waste, hazardous substances and nature protection. More general laws, such as the Planning and Building Law and the Licensing of Businesses Law, provide not only a framework but also an important legal basis for controlling the use of resources and promoting sustainable development. Regulations under the Planning and Building Law require the preparation and presentation of environmental impact statements, which form an integral part of the planning and building process. The Licensing of Businesses Law provides efficient tools for the supervision of industry by stipulating special conditions to business licenses. A special division within the Ministry of the Environment deals with about 4,500 requests for business licenses each year, of which some 25% require special conditions to prevent environmental degradation.

(A listing of environmental legislation in Israel is included in the appendix to this publication. Further details on the Planning and Building Law are provided in the chapter on Environmental Planning).

The Legal Powers of the Ministry of the Environment

The concentration of legal authority for environmental issues in the Ministry of the Environment has made a major contribution to the implementation of environmental policy in Israel. As a result, added emphasis has been placed on updating environmental standards, issuing administrative orders for the abatement of pollution and drafting new legislation. In fact, the past decade has seen a breakthrough in the enactment of environmental legislation, so that today Israeli law relates to nearly every aspect of the environment.

The Ministry of the Environment currently has full or partial authority for seventeen separate laws. All the laws provide for criminal sanctions which usually take the form of fines and, at times, terms of imprisonment as well. In addition, citizens have the right to initiate civil proceedings, with recourse to all civil remedies, including the payment of damages. Several of the laws integrate regulatory and fiscal means, and some include provisions for the appointment of special inspectors for purposes of enforcement. A brief description of the laws, in the chronological order of their enactment, follows:

1. **Public Health Ordinance, 1940**
   This law defines the powers of the Ministry of Health and the Ministry of the Environment to control public health and environmental nuisances of various kinds. The Ministry of the Environment is responsible for preventing malaria from mosquitoes and for eliminating nuisances from the confines of local authorities. Nuisances may include air pollution and odors emanating from dangerous dwellings or unsanitary conditions. A person who fails to remove the nuisance can be ordered to do so by the Minister of the Environment. The Minister of the Environment is empowered to undertake the necessary action in cases of failure to comply with nuisance removal orders.
   The law authorizes the Minister of Health to promulgate regulations setting standards and testing methods for drinking water quality. Violators of the law and of the orders issued under it are liable to criminal fines and six months' imprisonment.
2. **Water Law, 1959**
   This law establishes the framework for the control and protection of Israel's water sources. A 1971 amendment to the law introduced new water pollution prevention provisions; authority in this field has been transferred to the Ministry of the Environment. Other provisions of the Water Law are under the responsibility of the Minister of Agriculture and the Water Commissioner.
   To facilitate more effective enforcement, a 1991 amendment raised fine levels substantially, established personal liability, empowered courts to obligate polluters to pay for cleanup expenses or to undertake cleanups, and enabled citizens to initiate legal proceedings against offending authorities.
   In recent years, various regulations have been promulgated relating, *inter alia*, to pesticide discharge into water sources and use of cesspools and septic tanks.
3. **Abatement of Nuisances Law, 1961**
   This was the first legislative instrument in Israel for the control of air, odor and noise pollution. Under the terms of this law, it is illegal to cause "any considerable or unreasonable pollution by noise or in the air, including odors, from any source whatsoever, if it

disturbs or is likely to disturb a person in the vicinity or a passerby." The Minister of the Environment has the authority to promulgate regulations defining national ambient standards. Thus far, regulations have been issued to control air and noise pollution from stationary and mobile sources. Draft regulations setting emission standards for air pollutants have recently been completed.

The Minister of the Environment also has the power to address specific polluters with personal decrees instructing them on the adoption of measures for the prevention of pollution. These decrees have been instrumental in controlling industrial air pollution throughout the country.

4. **Local Authorities (Sewage) Law, 1962**
   The law prescribes the rights and duties of local authorities in matters concerned with the design, construction and maintenance of sewage systems. It requires local authorities to properly maintain sewage systems to the satisfaction of the Ministry of the Environment. New sewage systems must be approved by the district planning and building commissions and by health and environmental authorities.
5. **Streams and Springs Authorities Law, 1965**
   This law empowers the Minister of the Environment, after consultation with local authorities and the Ministers of the Interior and Agriculture, to establish an authority for a particular stream, spring or any other water source. Such authorities are empowered to undertake a variety of steps to protect the stream and its banks.
   The Yarkon River Authority was the first to be established under this law; its main purpose is to reclaim the river and to develop and manage a park to serve metropolitan Tel Aviv. In 1994, an additional river authority was established for the Kishon River in Haifa.
6. **Roads (Affixing of Signs) Law, 1966**
   This law forbids advertising along highways and interurban roads. The law, which is enforced by the inspection patrol of the Ministry of the Environment, has succeeded in keeping Israel's countryside free from the visual nuisance of commercial signs.
7. **Tel Aviv Power Plant Law, 1967**
   This law authorized the government to approve the plan to build a 450 MW power plant to the north of Tel Aviv (the Reading Power Plant), dispensing with the need for any license or approval under the Planning and Building Law. At the same time, it empowered the government to promulgate regulations on the use and operation of the power plant. The 1968 regulation to this law set up the framework for the first air quality monitoring network of Israel and for the alert system operated in the Tel Aviv area to determine and respond to dangerous air pollution levels resulting from the emissions of the power plant.

This law has recently been revoked, but will remain in effect for a transitional period of two years, at which time the Tel Aviv power station will be subject to the same laws that regulate all power plants in Israel.

8. **Licensing of Businesses Law, 1968**
The law empowers the Minister of the Interior, in consultation with the Minister of Health and the Minister of the Environment, to designate and define businesses requiring licenses in order to ensure: proper environmental conditions including appropriate sanitary conditions; the prevention of nuisances and compliance with the Planning and Building Law; the safety of those on or near the premises of a business; and the prevention of pollution of water resources by pesticides, fertilizers or medicaments. Licenses under this law are issued by the head of the local authority in whose jurisdiction the business is located. They are subject to prior approval by a person authorized by the Minister of the Environment, Health, Police or Agriculture, depending on the type of business. Special environmental provisions to be imposed within the framework of the license may include requirements for the preparation of preliminary surveys or for the establishment of infrastructures and treatment facilities for solid waste, sewage, recycling, hazardous substances and waste, as well as reporting, monitoring and control systems. In the case of air pollution nuisances, environmental limits are often based on emission standards.
In cases where a business requiring a license is also licensable under another law, the business license may be withheld until licensing under the other enactment is completed. For example, businesses handling hazardous substances are required to obtain poison permits (under the Hazardous Substances Law) before they are granted a business license.
Penalties for carrying on a business without a license and non-compliance with the regulations and conditions include fines or six months' imprisonment. The court may further order that the business be closed temporarily, by means of an administrative stop order.

9. **Prevention of Sea Pollution by Oil Ordinance (New Version), 1980**
This law forbids discharge of oil or oily substances into the territorial and inland waters from any shore nstallation or vessel, and makes any such act a criminal offense. The Minister of the Environment is empowered to appoint inspectors to discover or prevent violations. The law establishes maximal fines for oil spillage and liability for expenses of cleanup costs. Other salient features of the law and its regulations include an obligation to keep oil record books on vessels, measures to be taken in case of discharge of oil, and requirements for vessels to use port reception facilities for oily wastes.

Regulations promulgated within the framework of the ordinance establish a Marine Pollution Prevention Fund to generate income for preventing and combating marine and coastal pollution, cleanup operations and purchase of equipment. The major sources of the fund are fines collected from court convictions and fees levied on the owners or operators of vessels calling at Israeli ports and on shore facilities handling oil.

10. **Prevention of Sea Pollution (Dumping of Waste) Law, 1983**
This law prohibits the dumping of any waste from vessels and aircraft into the sea, except under permits which may be issued by an interministerial committee, headed by a representative of the Minister of the Environment. A court convicting an offender under this law may require, in addition to the fine levied, payment of cleanup expenses or of locating the waste dumped into the sea. The law provides for the appointment of inspectors to carry out inspections, investigations and searches to prevent or discover offenses.
Regulations under the law, drafted in accordance with the Dumping Protocol of the Barcelona Convention, include lists of substances which may or may not be dumped, and conditions for the issue of permits.
11. **Maintenance of Cleanliness Law, 1984**
This law forbids littering or the disposal of waste, building debris and vehicle scrap into the public domain. It also requires municipalities to establish special sites for the disposal of vehicle scrap and construction waste. It establishes a Cleanliness Fund to finance educational and enforcement programs and cleanup operations. The major sources of the fund are fees imposed on manufacturers and importers of disposable beverage containers and fines imposed on violators of the law.
An important and innovative enforcement feature of the law relates to the appointment of voluntary inspectors and cleanliness trustees, empowered by the Minister of the Environment to report on littering offenses. Enforcement efforts, by both police and volunteers, have increased littering complaints from hundreds to thousands each year.
12. **Prevention of Sea Pollution from Land-Based Sources Law, 1988**
This law forbids the discharge of any waste, including wastewater, into the sea in all cases where practical and economic alternatives for treatment or reuse exist on land, under the condition that such processes are less harmful from an environmental point of view. An interministerial permits committee, chaired by a representative of the Minister of the Environment, determines what may or may not be discharged into the sea and under what conditions. The conditions and criteria for the granting of permits and the types of waste which may not be discharged at sea were established in accordance with

the provisions of the Land-Based Protocol of the Barcelona Convention.

The law provides for the appointment of inspectors to carry out investigations and searches to prevent or discover offenses against this law.

13. **Abatement of Environmental Nuisances (Civil Action) Law, 1992**

This law enables private citizens to bring environmental law suits on behalf of themselves or non-profit organizations of which they are members, in cases of environmental pollution or nuisances. These may include air, marine and water pollution, solid waste, hazardous substances and radioactive pollution, and environmental nuisances which may threaten human health or cause major distress. Aggrieved citizens must give prior notice (60 days) of their intent to file a complaint to the Minister of the Environment and to the offender. If no action to eliminate the nuisance is taken during this period, the complaint may be filed. The law places three types of legal remedies at the disposal of the citizen: restraining orders, prevention of recurrence orders and corrective orders. In addition, the law allows, for the first time in Israel, the use of class actions in environmental law suits.

14. **National Parks, Nature Reserves, Memorial Sites and National Sites Law, 1992**

This law, first enacted in 1963 and revised in 1992, provides the legal structure for the protection of natural habitats, natural assets, wildlife, and sites of historic, architectural and national importance. Under the law, two authorities were created: the Nature Reserves Authority (NRA), responsible to the Ministries of Agriculture and the Environment and the National Parks Authority (NPA), responsible to the Ministry of the Environment.

A National Parks, Nature Reserves and National Sites Council, appointed by the Minister of the Environment, advises the relevant ministers on matters related to the implementation of the law.

15. **Hazardous Substances Law, 1993**

This law originates from the separation of existing authorities within the framework of the Pharmacists Ordinance. It authorizes the Minister of the Environment to license, regulate and supervise all aspects of the manufacture, use, handling, storage, marketing, import, export and transport of hazardous substances. Licenses are required for any premise selling hazardous materials, and permits are required by any business dealing in poisons. The Minister of the Environment may promulgate regulations on the classification of hazardous substances according to their use, degree of toxicity or risk. Regulations may also relate to the treatment, production, import, export, packaging, commerce, transfer, storage, maintenance and use of hazardous substances.

16. **Collection and Disposal of Waste for Recycling Law, 1993**
This law provides the principles and framework for recycling in Israel. It authorizes local authorities and obliges them, when so required by the Minister of the Environment, to allocate sites for recycling centers and to install recycling facilities and containers. Business or home owners within a municipality which operates recycling centers, must install and maintain recycling containers. Waste must be separated at source and discarded into specially-designated containers for the various components of waste. The Minister of the Environment is authorized to promulgate regulations on all matters relating to the implementation of the law.
17. **Animal Welfare Law, 1994**
This law prohibits cruelty to animals, either by man or by animal at the instigation of man, including the organization of animal fights. The Minister of Agriculture is responsible for the implementation of the law, but the Minister of the Environment is authorized to appoint animal welfare trustees empowered to present reports against offenders. Moreover, the law provides for the establishment of an animal welfare fund, within the framework of the Ministry of the Environment, to concentrate the financial means necessary for education, information, guidance and aid to animal welfare organizations. Funds will derive from budgetary allocations, contributions and fines imposed on offenders.

Implementation and Enforcement

Israel's environmental laws can ensure the population clean air, fresh water and a nuisance-free environment only if accompanied by effective enforcement. Therefore, enforcement of environmental legislation is a top priority issue in the Ministry of the Environment.

Since prevention is the ultimate goal of the ministry's environmental strategy, major emphasis has been placed on the enforcement of preventive measures within the laws under its jurisdiction. Administrative measures, both at the national and the local level, constitute one of the most important bases of prevention. At the national level, for example, the administrative system makes the granting of licenses and permits conditional on the fulfillment of specific stipulations aimed at preventing environmental damage. Such systems apply to planning and building, business licensing, marine pollution prevention, hazardous waste and resource management. At the local level, municipal administrative systems deal with business licensing, sewage and solid waste disposal.

While administrative enforcement provides an efficient method of preventive law enforcement, careful supervision is necessary to ensure strict compliance with legal stipulations. In general, the role of environmental

law enforcement is carried out by environmentalists trained and empowered as police officers, rather than by police officers equipped with technical and professional skills. Most supervisory bodies have the double role of supervising administrative measures as well as enforcing criminal provisions of environmental laws.

The bulk of inspection and investigation activity is undertaken by the Ministry of the Environment's environmental inspection patrol and by various inspection bodies empowered by the Ministry of the Environment to enforce legal and administrative measures. The inspection patrol fills the void in environmental law enforcement—focusing on neglected domains such as solid waste disposal sites, littering, hazardous waste disposal, cleanliness in gasoline stations and illegal sign-posting along interurban roads. In addition to the patrol, the ministry has established specialized supervision units in specific areas, such as the Marine and Coastal Inspection Unit and the Monitoring Unit for Poisonous Substances. Other bodies, such as the Nature Reserves Authority, the Drainage Authorities, the Jewish National Fund and other ministries, also carry out supervisory duties and aid in environmental enforcement acting as part of a so-called "Green Police." These bodies are staffed by professionals in their respective fields who are trained to perform inspection procedures and conduct investigations—and are legally authorized to carry out their tasks.

A unique innovation in the field of Israeli law enforcement is the recruitment of the general public as volunteer cleanliness trustees. These volunteers participate in enforcing the Maintenance of Cleanliness Law by filing complaints against offenders of the law. The complaints form the basis for a subsequent "finable offense" procedure (which provides for the payment of a fine in lieu of an appearance in court). To date, some 100,000 cleanliness trustees have been recruited from the general public; more than 10,000 tickets and court actions per year are initiated by their activities. Local authorities have their own supervisory infrastructure with thousands of inspectors who play an important role in the supervision of business licenses and in the enforcement of municipal legislation.

Environmental Litigation

If administrative and deterrent means of enforcement are insufficient, prosecution ensues. Most of the environmental cases are dealt with in the magistrates and local courts. Some cases, however, are deliberated upon at the district court level and others by the Supreme Court, sitting as a Court of Appeals or as the High Court of Justice.

Since the stigma of criminal proceedings is an effective punishment and deterrent, legal proceedings initiated by the Ministry of the Environment against a company or authority are generally accompanied by personal measures against a high-ranking official (mayor, manager or partner) having direct, or even indirect, institutional responsibility.

Israel's environmental litigation has been minimal for years. The Abatement of Nuisances (Civil Action) Law was passed in 1992 in order to ease the way for citizens to bring civil claims and secure injunctions against potential and actual polluters. While citizen complaints rarely result in legal action, environmental litigation has nevertheless increased in recent years as a result of greater public involvement in environmental issues. Several court cases have been initiated by the public (both by individuals and by non-governmental organizations such as the Society for the Protection of Nature and the Israel Union for Environmental Defense) and have contributed to the enforcement of environmental standards and improved environmental decision-making processes. In a few cases, the High Court of Justice has ruled in favor of petitions seeking redress against various authorities for inadequate administrative performance in environmental affairs. A prominent example was the petition to the High Court of Justice to prevent the construction of the Voice of America transmission station until the submission of a complete and comprehensive environmental impact statement. Additional successes include legal suits brought by the Ministry of the Environment and other organizations against mayors and municipalities charged with causing water pollution or operating landfills in an environmentally-unsound manner.

The public's role in pursuing court litigation remains the weakest link in the Israeli system of environmental enforcement. The goal today is to inform and educate the public concerning its right to a clean and healthy environment, and to provide it with the technical data and legal tools necessary to fight for that right.

ENVIRONMENTAL RESEARCH

The importance of sound environmental research is widely acknowledged. In Israel, environmental research is an imperative. If sustainable development is to be assured, methods must be developed to protect vital water sources, to safely recycle wastewater, to grow pesticide-free agricultural produce, to safely dispose of solid and hazardous waste, and to control air pollution in densely-populated areas. The main trend in Israel today is for government bodies to channel funds to non-governmental institutions, especially universities, for environmental research, and indeed, environmental research is highly developed in Israel's academic institutions.

National environmental research is coordinated by the Ministry of the Environment through the Office of the Chief Scientist. A program for the advancement of environmental research and surveys has been prepared to facilitate decision making and advance professional activities. In recent years, the chief scientist of the Ministry of the Environment has accorded high priority to surveys on water quality, improved sewage treatment methods, investigations of the hydrology of the Ramat Hovav hazardous substances site, rehabilitation efforts in the Carmel Park following a major forest fire in 1989, pretreatment of effluents from the Ramat Hovav industrial area, research on allergens, studies on effluent irrigation, and organization of steering committees on cleanup and rehabilitation requirements for the Kishon and Alexander rivers.

While hundreds of research proposals have been submitted to the ministry in recent years, budgetary constraints have severely restricted the number of projects able to receive ministry support. In 1993, 22 projects were approved in such areas as pest control, solid waste management, marine pollution prevention, environmental planning, agro-ecology, water quality, recycling and river rehabilitation.

Following are the research projects approved in 1993:

Solid waste treatment, disposal and recycling:

- A pioneer study on separation at source into wet and dry waste in the Kfar Sava-Ra'anana area, with the wet stream designated for compostation and the dry for classification and recycling.
- A research project on the agricultural use of compost at Kibbutz Nahal Oz in the south of Israel. The combination of loess soil, saline water and a good agricultural infrastructure in this Negev kibbutz should provide essential information on the possibilities of recycling about half of Israel's solid waste as compost for agricultural use.

- Analysis of alternative methods of municipal solid waste recycling; characterization and treatment of leachate from solid waste disposal sites and transfer stations; and recycling of plastic materials used for packaging (Technion).

Water quality:

- The effect of environmental conditions in Lake Kinneret on the survival of indicator bacteria for fecal coliforms (Yigal Allon Kinneret Limnological Laboratory and Tel Aviv University).
- Use of combined drainage and rain water for the irrigation of greenhouse crops (Agricultural Research Organization).
- Use of municipal sludge for improving productivity of desert soils (Ben-Gurion University).
- Constructed wetlands as a means of river rehabilitation: Evaluation of two types of constructed wetlands (subsurface flow and free water surface) for restoring the Alexander River and as a buffer system between the river and the wastewater treatment plant (Technion).
- Economic aspects of groundwater pollution. The aim of the research is to quantify in economic terms the scope of damage to Israel's subsurface water sources by pollution and to examine the relative efficacy of alternative policy tools in protecting groundwater quality, including economic disincentives such as pollution taxes and liability insurance (Haifa University).

Marine pollution:

- Characterization of pollutants in the coastal waters of Israel by spectrometric methods and remote sensing (Ben-Gurion University, Desert Research Institute).
- The use of seaweed and demersal fish to reduce waste products released from the commercial fish cage culture in the Gulf of Eilat. Efforts focus on the reduction of particulate organic and inorganic matter which settle on the seabed and on dissolved nutrients which are dispersed into the surrounding water column (Israel Oceanographic and Limnological Research, National Center for Mariculture).
- Feeding biology of the nomadic jellyfish and its contribution to the massive bloom of this macro-plankton in the eastern Mediterranean. A stinging jellyfish, identified as *Rhopilema nomadica*, has appeared in the coastal waters of the southeastern Mediterranean over the last eight years in large sizes and quantities, causing major disturbances to swimmers, fishermen and boats. Despite studies on the biology of this species, the question of how such a large bloom of jellyfish manages to find food in the ligotrophic waters of the eastern Mediterranean, an environment considered low in micro-plankton, has remained open. To answer the question, information on the diet and feeding behavior of this jellyfish is being obtained by various means. The results should clarify the food sources of the

nomadic jellyfish, and enhance understanding of how they survive in such massive blooms—essential information for solving the problem (University of Haifa, Center for Maritime Studies).

Environmental planning and noise abatement:

- The spatial pattern of environmental conflicts in the metropolitan development process and the resultant planning implications. The study, which focuses on the Tel Aviv metropolitan area, will suggest an approach for addressing such conflicts by identifying cases in which pollution sources should be relocated, and cases in which *in-situ* management solutions should be found (Department of Geography, Hebrew University of Jerusalem).
- Calibration of the traffic noise forecast model in order to check the applicability of the model to traffic noise conditions in Israel and to introduce correction factors (Tevet).
- Environmental changes in the Dan district—a study by remote sensing methods. The main objectives of the survey are to demonstrate the potential use of remote sensing images for the creation of an environmental digital database which can be used for change detection, monitoring and urban planning; and to create a comparative environmental database in the Dan region which will include: various land uses, "green lungs", distribution of thermal anomalies above industrial plants and open spaces, land-sea relationships, air and sea pollution, etc. (Kaplan Navot).

Pest control:

- Development of a method for hornet (*Vespa orientalis F.*) control with poison baits. This study aims at developing combinations of selective, environmentally-acceptable insecticides (such as micro-encapsulated formulations or insect growth regulators) and suitable baits for the control of hornets (Ben-Gurion University).
- The epidemiology of visceral leishmaniasis and the potential for human disease. Visceral leishmaniasis (Kala-azar) is endemic in the Galilee and several cases are reported each year. The study will help broaden knowledge concerning human exposure to the parasite, prevalence in reservoir hosts and identity of the sandfly vector in northern Israel (Carmel Medical Center, Haifa).

Coordination of Additional Funds

The chief scientist is also responsible for the coordination of a number of research funds set up to solve specific environmental problems. One such fund was set up in the wake of a government decision on air quality standards and the fuel economy. *Inter alia*, the government decision called for the establishment of an air quality research fund and for the creation of a judiciary committee to review proposals for practical research on the operation of intermittent control systems.

An annual $700,000 fund (financed temporarily by the Electric Corporation and the oil refineries) was set up and a number of research studies have been implemented, as follows:

- Alert system for sensitive air pollution periods: A system for short term forecast and alert for high pollution episodes in the Haifa area was developed at the Center for Advanced Solutions of IBM Science and Technology. The alert is based on the processing of data from monitoring stations collected by the system in real-time. Simulated tests on a historical database show that the system can significantly improve the reliability of the intermittent control system in Haifa.
- High-resolution coastal sea-breeze front structure in relation to air pollution: The project studied the structure and evolution of the sea breeze front penetration to the Ashdod-Ashkelon coastal plain. Better prediction of the time of the sea breeze front penetration to the coastal plain will be included in the intermittent control system in the area.
- Dispersion model for the Haifa Bay area: In order to study pollutant dispersion, a three-dimensional numerical air quality model was adopted. The model is based on integrating two existing submodels: a mesoscale submodel and a dispersion and transport submodel.
- Economic cost-benefit analyses of alternative policy scenarios for reducing air pollution levels in the Haifa Bay area: Studies carried out in recent years at the Natural Resources and Environmental Research Center of Haifa University have made it possible to carry out an economic analysis capable of indicating, with a satisfactory degree of accuracy, the desirable pollution reduction levels in the metropolitan Haifa region. The research will arrive at these levels under alternative assumptions and scenarios.
- Measurement of solar ultraviolet radiation levels (UV) in the coastal areas of Israel with special attention to the meteorological and environmental factors in the Tel Aviv area. UV radiation levels from the sun on a horizontal plane will be measured in this area on a continuous basis in order to set up a database on the biological effect of radiation. Data regarding air pollution indices and local meteorological conditions will be correlated with the measured data, in order to clarify the relationship between them.
- Analysis of conditions leading to high SO_2 concentrations in the Ashdod area: Monitoring results in Ashdod already reveal that high concentrations of SO_2, occurring during a few time periods, may be specifically defined by a small number of parameters. This database will be expanded in order to broaden analysis so that it will be possible to pinpoint the conditions leading to high concentrations.

In cooperation with the Ministry of Energy, the Israel Electric Corporation and the Coal Company, a joint administration for advancing

economic and environmental solutions to the growing quantities of coal ash has been established. The chief scientist of the Ministry of the Environment has prepared a document which should help solve the problem within a period of two to five years.

The ministry is cooperating with the Dead Sea Works Ltd. in a special fund targeted at examining the possibility of replacing sodium with potassium in an effort to reduce the salinity of the wastewater stream in Israel. It is well-recognized today that one of the major sources for the increase in Na (sodium) concentrations in sewage is the use of sodium salts (mainly NaCl) for water softening in various industries. Various research studies are being carried out on the reduction of soil sodicity hazards by replacing sodium with potassium in wastewater, on the potential changes in groundwater and soil composition as a result of replacement of salt by potassium, and on soil properties and crop yields in plots of land irrigated by potassium-enriched effluent.

Epidemiological Surveys

The Ministry of the Environment conducts epidemiological health surveys to check the impact of air pollution on the health of the population. Based on the results obtained from pulmonary function tests and health questionnaires, a trend of higher prevalence of most reported respiratory symptoms was found in populations, mostly schoolchildren, growing up in highly-polluted areas in comparison to children living in low-pollution areas. Following is a synopsis of the surveys undertaken thus far:

- Statistical analysis of a health monitoring project in the environs of the Hadera power plant which was carried out between 1980 and 1991. Analysis related to mortality and morbidity data and to follow-ups of patients with chronic respiratory diseases. (Financed by the Ministry of Health).
- Compilation of data on health monitoring in the environs of the Ashkelon power station, including mortality data, visits to health clinics and emergency rooms, and seasonal follow-up of children suffering from chronic respiratory disease. (Financed by the Ministry of Health).
- Compilation of data and statistical analysis of a comparative health survey carried out among children in the Yavne area (polluted area) and Nahal Soreq (low-pollution area) in 1992. The results were summarized and reported. (Financed by the Ashdod-Yavne Association of Towns for Environmental Quality).
- Completion of the collection of health data on adults living in a low pollution area for purposes of comparison with adults living in the Yavne area. (Financed by the Ashdod-Yavne Town Association for Environmental Quality).

- Analysis of health and environmental data collected among second to sixth graders (about 3,000 students) studying in Tel Aviv schools, situated in different areas in relation to sources and levels of air pollution. The survey will examine possible changes in the children's health *vis à vis* air quality levels in their area of residence and in relation to other environmental parameters. (Financed by the Tel Aviv municipality and the Israel Electric Corporation).
- Collection and classification of data (by age, sex, reason of arrival and place of residence) on visits to emergency rooms by children residing in the Tel Aviv metropolitan area. Air quality and meteorological data in different areas of the city are studied concurrently. (Financed by the municipality of Tel Aviv and the Israel Electric Corporation).
- Initiation of an epidemiological survey among schoolchildren in Beit Shemesh residing in areas exposed to different degrees of particulate pollution emitted from the Nesher cement plant. The epidemiological survey will be accompanied by environmental surveys. (Financed by the Ministry of the Environment and the Beit Shemesh municipality).
- Plans for epidemiological surveys around pollution sources in the Petah Tikvah and Bnei Brak industrial areas and in the environs of one of the oil-powered plants in Ashdod or Haifa. The aim of the surveys is to use health parameters as tools for the assessment of the economic cost of air pollution and the feasibility of installing pollution-prevention devices. (Financed by the Harrari Committee on Air Pollution).

Air Pollution Research

The Ministry of the Environment is also active in monitoring and studying air pollutants in various sensitive areas. Within this framework, the following studies have been conducted:

- Monitoring of asbestos fibers in the environs of the "Eitanit" plant in Nahariya (which produces asbestos cement), both within the city and in the quarry, and monitoring for the presence of asbestos fibers in educational institutions and plants.
- Monitoring of pollen counts in Ramat Gan, Jerusalem, Haifa and Beersheba, in cooperation with the Botany Laboratory of Tel Aviv University. A pollen monitoring center was set up by the Ministry of the Environment and Tel Aviv University in order to measure the pollen count in various parts of the country, at various times of the year; to correlate the data with allergy attacks and floral development; and to determine pollen concentrations in each area. Since the genetic potential for allergies exists in 30% of the

population, it is estimated that some 8%-15% of the population suffers from pollen-related allergies.

- Contribution of basalt and limestone quarries to environmental pollution and means of preventing dust emissions.
- Distribution and identification of coal dust in the air.
- Sulfate aerosols—characteristics, concentrations, formation in the atmosphere and paths of transport to Israel.
- The features of acid rain in the Carmel region, in cooperation with the Seagram Center for Soil and Water Research in the Hebrew University of Jerusalem. The study found acid rain to be more common than expected. Acidity of the wetfall appears to be imported from Central or Eastern Europe, via the Mediterranean Sea, as suggested by back-trajectories of 26 rain events.
- The contribution of sulfates and mineral desert particles to the acidity of clouds and rain in Israel, in cooperation with the Geophysics Department of Tel Aviv University.
- Determining the acidity and chemical composition of fog, haze and cloud droplets in Israel.
- The amount, nature and effect of the aerosol deposition on Lake Kinneret—a joint Germany-Israel research project with the Geological Survey and the Technion.
- The chemical, mineralogical and physical characteristics of both ambient aerosols and settling particles transported into Israel following dust storms originating in the desert regions. The results are used to calculate background values which can be used as a reference standard. This standard may then be used to assess the contribution of the desert aerosol to the environment as well as to identify pollution effects in both settling particles and the ambient aerosol.
- Methods of detecting individual particles emitted from vehicles, stacks, cement plants, etc.
- Extreme airborne asbestos concentrations in public buildings. The survey showed that very high exposure to airborne asbestos fibers can occur in public buildings. The concentrations were measured in the air of a communal dining room in which the damaged ceiling had a sprayed-on coating of insulation containing asbestos.

Environmental Research at Israel's Universities

In addition to the Ministry of the Environment, environmental research is carried out within the framework of a significant number of government and other organizations. However, the bulk of environmental research is undertaken by Israel's universities, listed here in alphabetical order.

Bar Ilan University

Research studies, largely concentrated in the *Department of Geography,* include: environmental quality in Jewish tradition; effects of fire on vegetation and soil nutrients of the Mediterranean forests and shrublands; spatial and temporal changes in the natural landscape; river and coastal monitoring; impact of Jerusalem's sewage on water quality in regional wells; soil-vegetation-erosion relations under diverse climatic conditions in arid and semi-arid regions; climatological studies; wind energy utilization; airborne and satellite-borne remote sensing of urban climate; analysis of building density and changes in land use in urban areas and their environs.

In the *Department of Life Sciences,* research focuses on a variety of subjects, including: the ecology and physiology of intertidal invertebrates, mainly their resistance to desiccation and high temperatures; symbiosis in corals; the roles of environmental conditions, genetic backgrounds of plants and genetics of pathogens in determining epidemic outbreaks and their severity; relationship of soil invertebrates and detrital food web structure to primary production in arid and semi-arid ecosystems; assessing the success of rehabilitation efforts on disturbed rangelands; reverse desertification processes and rehabilitation of coal strip mines; and the ecology of microflora and micromeso fauna (soil biota).

Ben-Gurion University of the Negev - Institute for Desert Research

While scientists at several faculties of Ben-Gurion University conduct environmental research (particularly in the *Department of Geography and Environmental Development),* the Sde Boker-based Institute for Desert Research serves as a national center for research on the desert. The Institute includes fourteen research units which concentrate on such subjects as desert meteorology, desert ecology, hydrology and water resources management; experimental run-off farms; remote sensing; energy and environmental physics; desert architecture; closed systems agriculture; applied microbiology; ecophysiology and introduction of desert plants; desert agrobiology; algal biotechnology; and aquaculture.

The Mitrani Center for Desert Ecology, one of the research units of the Institute for Desert Research, carries out research on the following:

Ecological responses to global climate change: This long-term research project aims at predicting responses of populations, communities and ecosystems to global climate change, to verify the predictions by developing a long-term ecological monitoring scheme, and to investigate means of utilizing biogenetic resources of climatic transition zones for ecosystem restoration and rehabilitation. Five long-term ecological research sites have been established covering the variation within an ecotone in rainfall (75, 100, 150 200 mm) and in habitat (loess plain, rock watershed, sand dune).

Management and monitoring for the promotion of biodiversity: Projects aimed at improving nature conservation and promoting ecosystem services include: evaluation of census data of endangered species and development of effective census methodologies; the effect of human visitation in protected areas on behavior and number of endangered species; identification of biological indicators for monitoring the effectivity of conservation and management measures in protected areas; quantitative methods for determining the geographical location of ecological transition between biotas; assessment of species richness and diversity of spiders in the Negev; and the effect of reintroduced species on the ecosystem of the Negev.

Biological control of agricultural pests: Projects deal with foraging behavior of nocturnal pests as affected by predation risk, and implications with respect to artificial illumination and the geometry of crop plots as measures of protection; foraging behavior of natural enemies of pests and implications for strategies and tactics of biological control.

Haifa University

Environmental research in Haifa University is distributed within the framework of several departments and faculties, as follows:

Center for Maritime Studies: Ecology of artificial reefs in the southeastern Mediterranean; feeding ecology and distribution of the nomadic jellyfish *Rhopilema nomadica* in the coastal waters of Israel; ecology and distribution of dangerous marine organisms along the coasts of Israel; and macrobenthic communities along the shallow Mediterranean continental shelf of northern Israel.

Institute of Evolution: Detection of marine pollution using genetic allozymic markers; restoration ecology and ecological management of the Hula wetlands; community ecology of temporary pools; biodiversity and conservation studies of Lower Nahal Oren ("Evolution Canyon"); environmental impacts of mole rats on the plant community; development of genetic resistance of crops to pollutants and pests; and pollination ecology.

The Resources and Environmental Research Center of Haifa University conducts a wide variety of research projects in the areas of air, water, energy, landscape and nature sites, recycling, and environmental planning and land-use. Select projects include: the assessment of the economic costs of changing ambient air pollution levels from industrial sources in the Haifa Bay region; the economic benefits of reducing air pollution induced morbidity damages; economic analysis and damage assessment of groundwater pollution from industrial spills; an economic perspective on sharing scarce fresh water resources in the Mediterranean basin: developing a methodology for evaluating the options for clean energy production in Israel; glass bottle recycling; environmental and economic analyses of various physical masterplan scenarios for the Haifa Bay area.

Hebrew University of Jerusalem

For decades, the Hebrew University has promoted ongoing research projects in vital areas such as air quality control, water pollution management and environmental health. Today, as a result of increasing pressures on the environment, both worldwide and in Israel, research efforts have mounted. Environmental research at the Hebrew University of Jerusalem is carried out within the framework of a large number of departments in all faculties, most prominent of which are: the Environmental Sciences Division of the School of Applied Science and Technology, the Center for the Study and Management of the Environment and the Department of Ecology, Systematics and Evolution at the Faculty of Science, the Department of Geography at the Faculty of Social Sciences, the Faculty of Agriculture, the Institute for Marine Biological Research in Eilat and the Department of Medical Ecology at the Hebrew University-Hadassah School of Public Health and Community Medicine.

Following is a short summary of the interdepartmental research on the environment which is conducted in the university:

Water quality research: Development of technologies to examine water particles and to characterize organic and inorganic materials found in water and wastewater; development of new technologies for the filtration of drinking water and the treatment of sewage; study of the biology and ecology of wastewater stabilization ponds and storage reservoirs; investigation of the ecology of the Gulf of Eilat; investigation of the coastal aquifer.

Air pollution and atmospheric research: Development of sophisticated technologies for measuring extremely small concentrations of compounds in the atmosphere; atmospheric transport and pollution processes; effect of air pollution on plants and stone structures; air pollution and rising ozone concentrations in Jerusalem.

Environmental health research: Disease incidence of populations exposed to pathogens from wastewater irrigation sprinklers; microbiologic and health aspects of the use of treated wastewater effluent in aquaculture; health effects of exposure to asbestos and to electromagnetic fields.

Soil contamination research: Study of the behavior of contaminants in desert settings (especially with regard to the siting of the Ramat Hovav hazardous waste site); hazards and advantages of subsurface injection of hazardous waste.

Ecological, geological and botanical research: Coexistence of plants in desert and Mediterranean ecosystems; desert adaptations and interaction of abiotic and biotic factors in desert ecosystems; evolution of ecological systems in the Middle East; physical anthropology; and environmental physiology.

Other areas of study include research into desert ecosystems (within the framework of the Arid Ecosystems Research Center); work on alternative

energy sources, especially solar energy; and study of the legal and economic aspects of environmental problems including transportation policy and industrial development.

The Rehovot-based *Faculty of Agriculture of the Hebrew University of Jerusalem* is recognized as a world leader in agricultural science. Environmental research in various departments focuses on the reduction of soil erosion, better use of water resources, reduction of fertilizer use, recycling of agricultural waste and development of a variety of methods for biological pest control. Most of the environmental research is carried out in the Department of Soil and Water Sciences, the Department of Plant Pathology and Microbiology, the Department of Field and Vegetable Crops, the Department of Agricultural Botany and the Department of Animal Sciences.

A representative sampling of research studies on agriculture and the environment includes: utilization of coal ash in greenhouse agriculture; purification of water using organo-clays; development of a method for removal and photochemical destruction of organic pollutants from water; risk assessment for soil pollution by heavy metals in forested and agricultural lands in Israel; recycling of municipal and agricultural solid waste and its utilization in agriculture; use of organo-clays in slow-release formulations of herbicides; biological control of weeds by pathogens and optimization of chemical control of plant diseases; changes in Israeli flora following continuous herbicide application; environmental fate of herbicides in soil and water; reduced application of pesticides via breeding for multiple pest resistance in plants; removal of heavy metals from industrial effluents by plant biofilter and development of novel biofiltration technology; and control of rodents by biological means.

Technion - Israel Institute of Technology

Several departments of the Technion are active in environmental research. A representative sampling of research studies undertaken in the various faculties includes:

Department of Civil Engineering: Most environmental research is carried out through the Center of Research in Environmental and Water Resources Engineering and the Water Research Institute. Research facilities include laboratories for all aspects of water quality and treatment, wastewater treatment and reuse, atmospheric pollution, environmental chemistry and microbiology, and solid waste treatment.

Faculty of Agricultural Engineering: Water quality management in the Lake Kinneret watershed; regional water and drainage management in the Jezreel Valley; operational, economic, and mechanical aspects of municipal solid waste recycling; reuse of compost in agriculture; development of clean energy sources; and minimization of pollution by fertilizers.

Department of Chemical Engineering: Dynamics of the catalytic

converter; sulfur removal from combustion gases; adsorption models for soil contaminants; synthesis of ceramic aerogel and xerogels for catalytic combustion with reduced NO_x emission; capillary absorption of liquid spills; emulsion liquid membranes for metal ions purifications; and development of zero-discharge evaporation equipment.

Department of Chemistry: Modeling of atmospheric processes; atmospheric sampling by supersonic molecular beams; and several aspects of environmental analytical chemistry. Special attention is accorded to *in situ* environmental analysis and water treatment.

Faculty of Mechanical Engineering: New methods for gas cleaning and filtration; development of self-cleaning filtration systems based on porous ceramics; development of a new method for pesticide dispersion by ground spraying to reduce toxic residues; improvement of air quality by reducing the asphaltene content in fuel oils; and study of the biological effects of exposure to aldehydes and PAH emitted from diesel engines using low methanol concentration fuel.

Tel Aviv University

Tel Aviv University, the largest of Israel's higher education institutions, has recently intensified research in several pertinent areas including cloud and rain physics and chemistry, climate modeling, radiative transfer and remote sensing, atmospheric chemistry, plant and animal ecology and biology, ecophysiology, biomonitoring and reduction of environmental pollutants, biotechnology of recycling industrial waste, pest control and soil sciences. Over 100 faculty members deal with research in the various environmental fields.

Recognition of the complex and multidisciplinary nature of environmental and ecological studies has led Tel Aviv University to establish the Porter Super-Center for Environmental and Ecological Studies which will allow for basic and applied research projects on logistical and time scales transcending single scientists and departments. The Super-Center will be affiliated to the Faculties of Life Sciences, Exact Sciences, Social Sciences, Engineering, Humanities and the Medical School—in each of which unique facilities and programs related to the environment already exist. The Super-Center will further expand and coordinate current research efforts within these departments.

Other institutes and facilities that will form part of the Super-Center include: the Museum of Natural History, the Zoological Gardens, the Botanical Gardens, the Institute for Nature Conservation Research and the new Institute for Biotechnology. The Environmental Research Institute at the Sackler Faculty of Medicine, the Gordon Center for Energy Studies (Engineering and Exact Sciences) and the new Minerva Center for Dead Sea Research will also be affiliated with the center.

Following is an outline of current research efforts in the various faculties:

Faculty of Life Sciences: Basic research on flora and fauna in various parts of the country; conservation of endangered species of flora and fauna; reactions of ecological systems (forest, desert, sea, rivers) to man-made pollution. Applied research on the detection and monitoring of environmental pollutants; development of biomonitors; development of molecular technologies for pollutant neutralization; production of food sources through genetic improvement of grains; biotechnological development through genetic engineering of biologically active products.

Faculty of Engineering: Treatment of water reservoirs; pollutant dispersion in the atmosphere; prevention and treatment of pollutants in groundwater and aquifers; pollutant impact and particulate distribution; remote sensing as a means of detecting and studying marine pollution.

Faculty of the Humanities: The relationship between man and the environment and the ways in which socio-spatial processes (urbanization, population growth, immigration, climate change, cognitive-spatial perception, environmental planning) are related to the creation of environmental problems and means of solution.

Faculty of Exact Sciences: Changes in global climate; study of atmospheric-ecological interactions; operation of a radar station for cloud research and rain; quantitative models for forecasting atmospheric-climatological phenomena; use of remote sensing for studying climate change; study of natural materials with biological activity.

The Environmental Research Institute of the Medical School of the University (part of the Ministry of the Environment) deals with the detection and monitoring of environmental pollutants; treatment of hazardous waste; technologies for reducing pollutants from industrial plants and power plants; and radiation monitoring.

Faculty of Law: Environmental legislation and enforcement measures.

The Super-Center for Environmental and Ecological Studies, inaugurated in May 1994, will further expand and coordinate these research efforts while developing new ones.

The Weizmann Institute of Science

The Weizmann Institute's research in the environmental sciences is spearheaded by the *Department of Environmental Sciences and Energy Research.* Research projects concentrate on water (extending from rainwater and surface waters to the unsaturated zone and deep aquifers), atmospheric pollution and climate change, and energy research, especially solar energy.

Areas of water research include: Isotope hydrology to trace the source and pathways of natural recharge; the geochemistry of Lake Kinneret and the Dead Sea; groundwater hydrology including macroscale studies of contamination trends in regional aquifers both in the saturated and

unsaturated zones; development of methods for the removal of toxic metals from polluted waters; monitoring and forecasting of water and soil pollution; and developing nonpolluting approaches to agriculture.

Areas of atmospheric pollution study include: The effect of ozone depletion on plant life; effect of effluent irrigation and deforestation on climate change; effect of oceans on global climate; and paleoceanography and paleoclimatology studies.

Energy research focuses on developing nonpolluting energy options, especially solar energy.

Work performed in the *Department of Plant Genetics* relates to environmental damage to photosynthesis, effects of stress on plants, breeding of high-protein wheat and development of novel herbicides.

ENVIRONMENTAL LABORATORY

Most government ministries have research institutes and laboratories to serve their specific needs. The Ministry of the Environment operates one of Israel's major laboratories for pollutant monitoring. The laboratory is furnished with specific equipment for the measurement of pollutant concentrations in various environments. The laboratory aids the district offices of the Ministry of the Environment and local environmental units in identifying, both qualitatively and quantitatively, pollutants in the environs of industrial areas and other sources of pollution. The major aim of the laboratory is to respond to ministry needs in various subjects, most notably air quality.

Laboratory Services

One of the major functions of the laboratory is to serve as a national reference laboratory for quality assurance and control. It supervises environmental tests undertaken in public, private and industrial laboratories so as to ensure that tests are conducted in accordance with standardized methods and that the results obtained are valid. The laboratory also provides essential calibration services to the Ministry of the Environment in the realms of air quality and hazardous substances. It carries out quality assurance of air monitoring equipment operated by town associations for environmental quality and by the Israel Electric Corporation, as well as calibrating equipment for the detection, identification and measurement of hazardous substances during accidents.

The laboratory collects field samples for laboratory analysis in order to determine pollutant levels in residential and industrial areas; to monitor pollutant emissions from industrial plants, power plants and other sources; to determine levels of pollution in surface water, groundwater, soil, marine water, sewage, sludge and toxic waste; and to assess pollution damage to vegetation.

Analytical tests are undertaken for the following:

- Airborne dust including settling dust, suspended dust, soiling index and smoke emissions from vehicles;
- Components of combustion gases including those formed by photochemical processes;
- Emissions from industrial plants and emissions released during hazardous materials incidents, including solvents and organic and inorganic compounds;

- Pesticides, toxic metals, carcinogens as well as algae and oil spills at sea.

With the recent introduction of eco-labeling in Israel, the laboratory will work along with the Israel Standards Institute in establishing standards for the "green label." The label is granted following an overall evaluation of the product's environmental quality, as compared to other products in the same category.

Finally, the laboratory organizes environmental courses and provides environmental training to Israelis and new immigrants alike, and offers consultancy services on environmental problems to the general public.

Surveys and Research

The laboratory conducts surveys and practical research on subjects which are of special importance to the ministry. Research fields include the development of new analytical methods; development of equipment for the prevention of pollution by particulates, toxic metals, micro-organisms and other pollutants; development of meteorological models to determine the contribution of pollution sources to different regions; and vehicular and industrial pollution surveys in the metropolitan areas of Tel Aviv, Haifa and Jerusalem.

Chemical Tests and Equipment

The laboratory performs its chemical tests in accordance with standard methods, or according to recommendations of the U.S Environmental Protection Agency as published in the Federal Register and ASTM (American Society for Testing and Materials), or as per NIOSH (National Institute for Occupational Safety and Health) methods for workplaces.

Tests currently conducted by the laboratory include:

- Laboratory tests of inorganic compounds include sampling and analysis of different materials in air, water, sewage, sludge, soil and plants. Analysis of metals is carried out by an atomic absorption spectrometer which includes a graphite furnace; analysis of anions by means of an ion chromatograph; chemical tests using wet processes such as spectrophotometry; direct field monitoring of gases emitted by various sources in the environs of residential areas and in industry using a mobile air monitoring station.
- Tests of organic materials using a gas chromatograph (GC) and high pressure liquid chromatography (HPLC); sampling and analysis of organic solvents and other hazardous organic materials and pesticide residues in the air; analysis of organic solvents in sewage using the EPA Purge and Trap method.

ENVIRONMENTAL ECONOMICS

The economic approach to environmental policy seeks to internalize environmental costs and considerations into corporate decisions. Traditionally, environmental policy has been implemented principally through government regulation: the polluter either complies with the regulation or faces administrative or legal penalties. The theory underlying the economic approach is that polluters should be liable for all expenditure involved in safeguarding the environment against the damage they cause. Recently the concept has been broadened to include prevention of damage at source. The emphasis has shifted from the "polluter pays" principle to the "potential polluter pays for pollution prevention" principle.

According to the economic approach, environmental problems will be alleviated when individuals and companies will bear the real and full price of using environmental commodities and natural resources. This price will include all possible adverse effects on human life, quality of life, habitats and species.

Taxes, Subsidies and Incentives

The mechanisms used to put economic principles into effect fall into two general categories: revenue collecting devices, which provide funds for environmental purposes, and incentives for companies to reduce the level of pollution they emit into the environment. Until recently, economic mechanisms in Israel, as in the rest of the world, fell almost exclusively into the first category—increasing revenues.

Economic tools such as fines, fees, taxes and subsidies are designed to punish organizations which misuse or pollute natural resources, to impose the costs of use on the user (i.e. tipping fees in landfills) and to serve as incentives for the adoption of environmentally-friendly activity.

In Israel, the use of economic mechanisms to implement environmental policy is still in its infancy. Levies (paid by polluters for the use of environmental resources) are most commonly imposed—but are often too low to provide an incentive for changing environmental behavior. Levies in Israel include user fees, product taxes, administrative levies and differential taxes.

User fees cover sewage and garbage collection. Municipalities collect two types of sewage fees: a one-time fee, paid by new home owners, is used in the construction of sewers and sewage treatment plants, and an additional fee, based on the amount of water used by each consumer and included in the

water bill, is used for maintaining sewage systems. By law, the fees should be set at a level appropriate for running the sewage system as a closed system; in practice, however, funds collected for sewage are often used to finance other municipal activities.

Home owners and industrial consumers also pay a garbage collection fee, usually incorporated into the annual municipal tax assessment, to the local authority. However, since the consumer cannot attach a specific value to the service, there is no incentive for reducing waste volume or separating its contents; only a separate fee reflecting the true cost of disposal would provide the consumer with such an incentive.

Product taxes imposed in Israel apply to quarry restoration, marine pollution prevention and disposable beverage containers. Quarry operators pay a fee calculated according to the type and quantity of material quarried and sold. The income from the levy accrues in the Quarry Restoration Fund administered by the Ministry of Industry and Commerce. This is a dedicated fund from which money is set aside in order to finance the restoration of disused quarries.

All ships calling at Israeli ports and all oil unloading platforms operating in Israel pay a Marine Environment Protection Fee, which is fixed according to the size of the ship and the amount of oil. The fee, as well as fines paid by violators of marine pollution prevention laws, is collected in a Marine Pollution Prevention Fund. Funds are used to finance the Marine and Coastal Environment Division of the Ministry of the Environment. The fund has played a major role in substantially reducing oil pollution on Mediterranean and Gulf of Eilat beaches.

A fee on disposable beverage containers is imposed within the framework of the Maintenance of Cleanliness Law. It constitutes 0.25% of disposable beverage sales. Fees and fines paid into the Cleanliness Fund are used to finance cleanup campaigns, educational programs, and the entire enforcement infrastructure for the Maintenance of Cleanliness Law.

At present, one kind of administrative levy is imposed in Israel for environmental purposes—a monitoring fee. This fee is imposed on industrial facilities which emit pollutants into the air. The fee is collected for a specific purpose: to carry out monitoring in the vicinity of these facilities. Monitoring activities are budgeted as a closed budget. The fee charged to every polluter is based upon the relative share of pollution emitted, calculated according to the quantity of fuel used in the facility.

To switch from regular to lead-free gasoline, the price on lead-free gas was reduced, making it less expensive to the consumer than regular gas—thus providing an incentive for increasing its use. Statistics reveal that consumption of lead-free gas increased by a factor of twelve in 1992 as opposed to the previous year and by a factor of 3.5 in 1993 in comparison to the previous year.

The use of subsidies to promote environmental goals is less well established in Israel than levies. Subsidies are usually used to provide

incentives for the development of "clean" technology, or in cases where the polluter will not survive financially if he complies with environmental regulations. In certain cases, import duties are waived on equipment for monitoring and controlling pollution and for reducing waste. The possibility of granting financial aid to companies for the purchase of green technologies and for the establishment of eco-auditing in small and medium-sized companies is currently being considered. An interdisciplinary committee, chaired by the director general of the Ministry of the Environment, has been appointed to prepare criteria for financial support to industrial plants wishing to invest in environmental technology. In 1993, the Ministry of the Environment granted such support to three industrial plants which have invested in effluent recycling and treatment technologies.

Financial enforcement incentives make compliance with the law an economically-viable option: non-compliance results in punishment, either by advance payment or fine. Fines on activities which pollute the environment are included within the framework of environmental legislation. Several of the laws also require the polluter to pay for removal of the nuisance, for cleaning up the damaged area, and for repairing the damage. Generally, though, green fines are too low to provide effective incentives to reduce pollution levels. Moreover, enforcement is costly, as it involves continual monitoring of industrial activity.

Other economic mechanisms in use today include deposit-return and market creation. Deposit-return of glass bottles was successfully used in Israel for years before the advent of plastic, non-returnable bottles. Today, the system is still used with returnable beer bottles—with a 90% return rate. The feasibility of expanding the system to other beverage containers and to pesticide packaging is currently being examined. Israel is also reviewing possibilities for the creation of new markets for green products, especially for products assembled from recycled materials. Current efforts focus on the promotion of government purchase programs for recycled paper.

Green Accounting

Today the use or misuse of air, land and water takes little if any consideration of the true economic/social cost of such use. If it were possible to measure the social or regional cost of using a natural resource and to obligate users to pay this cost, market forces would bring about a substantial reduction in pollution. Yet, it is difficult to measure all the impacts of a specific activity on land, air and water in the present and in the future—and more difficult still to translate these impacts into monetary terms.

National green accounting—the use of advanced accounting tools to quantify and measure such resources as clean air, forests and streams—is only now beginning in Israel. A notable example is a research project undertaken by the Natural Resources and Environmental Research Center at

Haifa University which, during the course of a three-year survey, assessed the economic costs of air pollution in the highly-industrialized city of Haifa. The project focused on the economic valuation of reductions in air pollution-induced morbidity. It concluded that large investments in pollution-prevention equipment are economically as well as environmentally justifiable. The development of national green accounting can serve an important role in the struggle to preserve open spaces and nature reserves and in the assessment of large-scale infrastructure and development plans, such as the paving of new highways *vis à vis* the development of mass transportation systems such as railroad or subways.

Life-cycle cost analysis quantifies in monetary terms the "cradle-to-grave" cycle of a product in terms of raw materials, emissions, waste, energy, and other environmental impacts. Israel's new program of environmental labeling represents an important step in this direction.

At the initiative of the Ministry of the Environment, the Israel Standards Institute has published a standard for ecological labeling, dubbed the "green label." The label represents an holistic judgement, giving overall assessment of a product's environmental quality relative to other products in its category. A product will be granted the eco-label when it meets certain environmental criteria in such realms as waste, soil pollution, water pollution, air pollution, noise, energy consumption, natural resource consumption and other factors (e.g. health, damage to flora or fauna, or degradation of landscapes).

One of the stated purposes of the "green label" is to direct manufacturers to review and account for the environmental impact of their products at each stage of the product's life, from preproduction to disposal. The aim of life-cycle analysis is to help ensure that consideration of environmental effects throughout product life will constitute an integral part of the production process, as do the quality and safety of the product itself.

Environmental Management Systems

Increasing concern about environmental protection has led organizations worldwide to undertake environmental audits in order to assess their environmental performance. On their own, however, audits cannot provide an organization with the assurance that its performance not only meets, but will continue to meet, legislative and policy requirements. To be effective, they need to be integrated into the overall management system and policy of the company.

In Israel, an interdisciplinary technical committee on environmental management systems has reviewed the subject and helped prepare an Israeli standard, published by the Standards Institute of Israel in February 1994. The new standard for environmental management systems (IS 1550) is based on the British Standard for Environmental Management Systems (BS

7750). It requires organizations to formulate policies and objectives taking into account information about significant environmental impacts. It is applicable to any organization which wishes to assure itself of compliance with a stated environmental policy and to demonstrate such compliance to others.

Environmental management audits and environmental management reviews are inherent, but separate, parts of the system. Audits assess the effectiveness of the system and the achievement of the environmental objectives; reviews check the continuing relevance of the environmental policy, update the evaluation of environmental effects and check the efficacy of audits and follow-ups.

Elements incorporated into environmental management systems relate to the establishment and implementation of the system and the definition and documentation of environmental policy. In addition, the standard relates to such issues as organization and personnel, environmental effects, environmental objectives and targets, environmental management manuals and documentation, operational control, environmental management records, environmental management audits and environmental management reviews.

Since risk and damage potential from environmental disasters is most significant in dollar terms, companies will have an incentive to adopt eco-auditing and environmental statements. The incorporation of high premiums on new environmental insurance policies will further encourage companies to deal with risk management and eco-auditing as will new banking policies which seek to incorporate environmental considerations into business and funding decisions.

Israel and the World Community

On the positive side, environmental protection is labor-intensive; economic growth, employment and environmental sustainability are interrelated. Israel, within the context of regional and bilateral agreements, is currently investing efforts in identifying potential environmental professions in Israel which would be advantageous both to environmental protection and to the national economy.

In Israel, where environmental fine levels are relatively low and legal actions are few, industry will have to be convinced that expenditure on prevention is lower than expenditure on the repair of damages. Moreover, pollution control and waste reduction can actually strengthen economic competitiveness through more efficient use of raw materials and through the development of a green image, an effective marketing tool in an increasingly environmentally-conscious world. Since nearly a third of Israel's export is directed toward Europe, Israel will have to accommodate itself to stringent international environmental requirements. As a signatory to the General Agreement on Tariffs and Trade (GATT), Israel will work

along with the other parties to the agreement to promote environmental protection standards, within the framework of the World Trade Organization (WTO). Business practices will have to comply with national and international environmental regulations. Sound environmental practices, including risk assessment and environmental management, will have to be integrated into corporate management.

ENVIRONMENTAL EDUCATION

Environmental education and information are essential components in environmental programs. Their major objectives are to increase the environmental awareness of both the general public and decision makers, to educate them toward responsibility and concern for the environment, and to arouse their willingness and ability to contribute to environmental enhancement. It is widely recognized today that environmental awareness and understanding are prerequisites for environmental improvement. Environmental education is all the more crucial in light of today's complex global problems, whether ozone depletion or climate change. To ensure wise environmental management on the local, regional and global levels, awareness must be increased and behavior changed.

The foremost example in Israel of a successful environmental re-education effort is the protection of wildflowers campaign, launched in the mid-1960s, soon after the enactment of the National Parks and Nature Reserves Law. The campaign was so successful that the law has rarely been invoked. Picking wildflowers is now taboo among young and old alike.

In recent years, heightened concern about environmental issues has resulted in increased activism among the populace. New non-governmental environmental organizations are being created on the national level, while grass-roots groups are organizing in many areas to pressure authorities to seek solutions to environmental problems at the local level (see chapter on Non-Governmental Organizations).

General Principles of Environmental Education

Environmental education strives to integrate cognitive goals—acquiring multidisciplinary knowledge, and socio-behavioral goals—increased consciousness, responsibility and involvement. It constitutes a unique educational experience whereby the student is given the opportunity to develop independent thought and study while undertaking concrete steps to improve his environment.

The philosophy of environmental education seeks to integrate three approaches—scientific, socio-political and educational. Its basic tenets are:

- The environment must be perceived in a holistic manner, as an integrated and interdependent system;
- The teaching of environmental education must be interdisciplinary and multidisciplinary, integrating natural sciences, social sciences

and the humanities, and emphasizing the interrelationships between them;

- The learning process must expose the student to the environment and help develop problem-solving skills to enable the student to observe, identify, evaluate, research and take a part in informed decision making;
- The student's sense of responsibility for the environment must be cultivated through community involvement and public participation.

While all too frequently public involvement and participation in environmental issues arise as a result of disasters and crises, environmental education seeks to achieve involvement by means of a process whereby the realization of one goal leads to the next. Environmental education leads the student through the following stages: attainment of information, fostering of understanding, development of awareness, changes in attitude and participation and involvement in environmental activities. Under the motto, "Think Globally, Act Locally," each individual is encouraged to act, on a personal level, for the improvement of the environment on the community, regional and global levels.

To foster the student's interest and involvement and to promote the development of new patterns of behavior, environmental education strategy is based on three elements: study *in* the environment, *on* the environment, *for* the environment.

Study *in* the environment stimulates the student to experience the problem directly within his immediate environment. Direct exposure leads to questioning and inductive reasoning and helps develop such skills as observation, questioning, spatial understanding and research. It helps create an emotional bond between the student and the environment, leading to responsibility and involvement.

Study *on* the environment fosters the development of environmental systems thinking and analysis. It incorporates historical aspects, current events and decision making which impacts both present and future events. The student acquires investigative, analytical skills and systems thinking.

Study *for* the environment spurs the student toward direct action and involvement. Learning through action obliges the student to deal with specific problems, to develop a system of values and sound judgement based on priorities, responsible decision making and implementation. The student develops such essential skills as team work, pluralistic and democratic thinking and accountability. The holistic environmental approach emphasizes combined cognitive and affective learning which places value considerations side by side with scientific considerations in the decision-making process.

The Role of the Ministry of the Environment

One of the Ministry of the Environment's major aims is to educate a new generation which is concerned and knowledgeable about environmental issues. To implement this policy, the Education and Information Division of the ministry has produced environmental curricula, information booklets, films and slides, and has organized environmental projects, cleanup campaigns and environmental events in conjunction with other organizations. The ministry operates an information center for teachers, students and the general public and provides booklets and teaching aids on environmental subjects.

In 1982, in line with the Ministry of the Environment's policy of broad dissemination of information, environmental education centers were established throughout Israel, within the framework of environmental units in municipalities. The major impetus for this move was the difficulty in introducing environmental education as a multidisciplinary subject into the traditional formal education system. Today, 27 local environmental education and information centers operate throughout the country, in the Jewish and Arab sectors, serving as focal points for community environmental activities. They assist the formal education system in the planning and preparation of environmental curricula (in conjunction with local teachers), conduct in-service teacher training programs, and support the introduction of innovative educational approaches into the learning process.

The centers provide educational material for both teachers and interested citizens, including audio-visual materials, simulation games, literature, slides, films, cassettes, posters, demonstration models and exhibits for study by students at all levels. They promote informal environmental education by stimulating public involvement; they initiate and coordinate lectures, seminars, environmental tours and training courses; and they promote events such as Israel Environment Week, Nature Protection Week, and recycling and cleanup campaigns. In addition, environmental education centers publish information notices on environmental matters in local newspapers, serve as centers for public complaints on environmental problems and, in general, guide and support local environmental efforts.

The Formal Education System

Formal environmental education is the responsibility of several divisions within the Ministry of Education. Over the years, the Education and Information Division of the Ministry of the Environment, the staff of the environmental centers, and teachers throughout Israel have worked with the Ministry of Education to develop formal environmental education curricula which encompass the principles of environmental education.

Environmental topics have been integrated into primary, secondary and higher education programs. While environmental studies are frequently integrated into such traditional subjects as nature studies, agriculture, chemistry, history, geography and biology, more and more schools have begun preparing programs for teaching environmental studies as a multidisciplinary subject. For example, the subject of acid rain, taught in the intermediate grades, is integrated into the following subjects: geography (climatology—air pollution and rain, hydrology—water cycle and water pollution), chemistry (acidity—water, flora and fauna), botany (forests and vegetation), technology (industry and air pollution), agriculture (fertilizers and biological and chemical control) and mathematics (graphic presentation of data). Environmental subjects can also be taught from various points of view: legal, aesthetic, historic and universal, to name but a few. The choices are unlimited.

The focus of nearly all study and activity, especially in the lower grades, is on subjects and sites which are close to the student: the school, the neighborhood, nearby industrial areas, gardens and parks. Educators believe that environmental involvement can be developed in stages: beginning with responsibility for the immediate environment and concluding with responsibility for the larger environment—community, city, country and world. Textbooks and workbooks adhere to the principles of environmental education and include background material, concrete tasks for performance in the field, research, and conclusions. The modular structure of most study programs provides the teacher with maximum flexibility in choosing subjects and adapting them to the time frame provided and the level of the students.

Unique high schools specializing in environmental studies have also emerged in recent years. The first, established in 1976 in Sde Boker, and affiliated with the Institute for Environmental Education of the Ben-Gurion University of the Negev, uses the desert environment as a model for natural and human ecological systems. The Institute developed learning units, called eco-shops, for use in the high school. The method is based on integrative, interdisciplinary study whereby students leave the school to undertake field studies within the environment itself. Based to a large extent on the Sde Boker model, several specialized schools have been inaugurated in recent years offering three to six-year programs in environmental studies.

In 1984, the Ministry of Education approved a special environmental studies program for high school matriculation examinations, at two levels of study. The basic program provides an understanding of the concepts and foundations of environmental study and focuses, in more depth, on an individual environmental subject related to a specific location in the vicinity of the school. The more intensive program includes all these elements with the addition of a special project, entitled "ecotope"—an independent project undertaken by the student which involves fieldwork,

observation, surveys and the presentation of a paper. In all cases, study of such issues as water scarcity, urban problems or air pollution is accompanied by community work, cultivation of environmental values, use of modern technology and methodology, development of independent study, and nurturing of such values as responsibility and respect for humankind and the natural environment. Over 20 high schools currently offer the matriculation program on the environment; their numbers are increasing each year.

In addition to the matriculation program on the environment, high-school biology students are required to work on a "biotope" project—an ecological study analyzing the interrelationships of organisms in a given ecosystem. Students are encouraged to do independent work, but ecology experts, notably field instructors of the Society for the Protection of Nature in Israel, frequently guide them in the selection of the organisms for study and in the research and observations.

Formal education is augmented by informal education programs which play a crucial role in fostering environmental awareness among the general public. Special events, lectures, field trips, seminars, periodicals, posters and films have served the purposes of both governmental and non-governmental organizations in alerting the public to the need for environmental action. The Society for the Protection of Nature in particular, with its extensive network of field study centers and guided outings, has achieved success in instilling a conservation ethic in the population.

The Year of the Environment

One of the central goals of the Year of the Environment in Israel was to increase public awareness of the environment and to involve the public in environmental activities. While environmental curricula have been developed for every level of schooling, from kindergarten to university, environmental studies have remained elective, part of a non-compulsory enrichment program. This year's decision to place environmental studies at the center of the educational curriculum has changed this. While maximum freedom is given to each school to adapt the wide range of available environmental material to its own requirements, the subject can no longer be ignored.

The Year of the Environment was officially launched in the formal education system in December 1993. To mark the occasion, an environmental education fair, organized by the Pedagogical Service of the Ministry of Education, was held in Jerusalem. The fair, in which some 90 bodies participated, displayed the entire gamut of educational material now available on the environment—textbooks, workbooks, computer programs, audio-visual material, films, study kits and games. Workshops were held to demonstrate teaching methods in the classroom, and some 20 schools

presented their experience in environmental education. Most importantly, thousands of visitors, among them hundreds of teachers and educators, became acquainted with available materials and returned to the classroom equipped not only with innovative ideas but with tools and materials with which to implement them.

Within the framework of the Year of the Environment, the Ministry of the Environment prepared a special study kit for all schools in Israel including material on recycling, solar energy, environmental activities for youth, air pollution and general environmental information in Hebrew and in Arabic. The Ministry of Education, on its part, distributed special circulars on environmental education principles and environmental curricula and model programs—as well as a 550-page catalogue of environmental materials, including 400 entries. Entries are subdivided into four categories: subject matter, age and target audience (e.g. kindergarten to 12th grade, teachers, professionals, Hebrew, Arabic, English and French speakers), type of teaching aid (e.g. workbooks, teacher guidebooks, periodical articles, cassettes, videos, slides, computer games, exhibitions, posters) and type of activity (guided tours, shows and plays, workshops, simulation games, scientific experiments, lectures, discussion groups).

Special Events to Promote Environmental Education

Special events are an important part of any publicity effort directed at the general public. Environmental events serve to acquaint the public with environmental issues and provide information. Thus, Israel Environment Week is celebrated every June in conjunction with World Environment Day. Government officials, heads of local authorities, and representatives of environmental organizations and industries participate in a special ceremony to mark the occasion. The presentation of environmental awards to individuals, local authorities and industries excelling in environmental protection constitutes the highpoint of the annual celebration. In addition, a wide range of events, including school competitions, youth marches, photography and art contests, cleanup campaigns, workshops and environmental exhibitions are organized to acquaint Israelis from all walks of life with environmental issues.

Every spring, Nature Protection Week is held to encourage Israelis to become familiar with the natural environment. Each year a different ecological issue is selected as the central theme: the rehabilitation of fire-damaged forests, coastal protection, desert nature reserves, rehabilitation of streams and rivers, wildflower protection, protection of open spaces, etc. The Nature Reserves Authority, the Society for the Protection of Nature in Israel, the National Parks Authority, the Jewish National Fund, the Education Ministry and the Ministry of the Environment—all take part in the events, which include workshops and seminars.

Institutes of Higher Learning

Courses and programs on environmental subjects are offered at each of Israel's universities thus assuring a pool of professionals and researchers capable of environmental problem-solving and able to influence policy and decision making at all levels. Today, universities in Israel offer a variety of options for environmentally-related bachelors', masters' and doctoral degrees.

Special efforts are currently being invested in helping retrain new immigrants, most from the former Soviet Union, for environmental careers. The Ministry of the Environment, in cooperation with the Ministry of Energy and Infrastructure, has organized a retraining course for dozens of immigrant professionals. Over a third have already been absorbed into the work force in the realms of environment, geology and geophysics. These and other retraining programs, along with the academic education provided at each of Israel's universities, help meet the need for training scientists, engineers, planners, and other environmentalists.

Following is a brief description of the environmental programs currently being offered in Israel's principal institutes of higher learning. Research activities undertaken by these universities are surveyed in the Environmental Research chapter of this publication.

The Technion - Israel Institute of Technology (established in 1924 in Haifa) offers environmental studies within the framework of several faculties, including:

- *The Department of Civil Engineering, Environmental and Water Resources Engineering Division,* offers two required undergraduate courses in environmental engineering. Elective courses deal with various aspects of environmental protection including water, wastewater, air pollution and solid waste management. On the graduate level, two graduate programs are offered: environmental engineering and environmental quality sciences.
- *The Faculty of Agricultural Engineering,* which deals with the management of open systems, fields and watersheds, incorporates environmental planning into the curriculum. The faculty offers an introductory course on environmental management as well as more advanced courses on soil and water pollution, wastewater reuse, salinity, aquatic systems, etc.
- *The Department of Chemical Engineering* offers both undergraduate and graduate courses on environmental problems in chemical engineering, environmental hazards and safety in chemical industries, and catalytic and bio-catalytic processes of pollutant purification. During the upcoming academic year (1994/5), a graduate course will be offered on environmental impact analysis (e.g. pollutant sources, waste minimization, fate of chemical pollutants dispersed in the environment, exposure and risk assessments, risk reduction strategies).

- *The Department of Chemistry* currently offers an undergraduate and a graduate course on environmental chemistry and is planning an additional course for next year.
- *The Faculty of Architecture and Town Planning* integrates environmental issues in each of its degree programs in architecture, landscape architecture and urban and regional planning. The faculty offers over 20 courses dealing with the environment, from the micro spaces within built-up structures to macro land-use management on the national level.

The Hebrew University of Jerusalem (established in 1925) offers a wide variety of environmental studies within the framework of most departments. The university grants degrees in environmental studies in the following faculties:

- *The Division of Environmental Sciences in the School of Applied Science* is a graduate program founded in 1972. It includes five major areas of teaching and research: water pollution control and treatment technology, air resources quality management, industrial hygiene, environmental health and environmental chemistry. Over 30 diverse courses are included in the curriculum for an M.Sc. in Environmental Sciences, covering every aspect of environmental protection from environmental toxicology to industrial waste treatment, from environmental acoustics and noise control to environmental administration and urban and regional planning.
- *The Department of Geography in the Faculty of the Humanities* offers a masters' program in environmental management, planning and policy.
- *The Life Sciences Institute in the Faculty of Life Sciences* offers a masters' program in environmental biology with courses ranging from microbial ecology to ecological genetics to ecosystem and landscape ecology.
- *The Unit for Agriculture and the Environment in the Faculty of Agriculture* offers a program in agriculture and the environment.
- Environmental courses are also offered in the Department of Medical Ecology of the Hebrew University-Hadassah School of Public Health and Community Medicine, in the Institute for Marine Biological Research in Eilat, in the Center for the Study and Management of Environment at the Faculty of Sciences, in the Law Department and in the Institute for Earth and Atmospheric Sciences.
- A new bachelors' program in environmental studies will be inaugurated next year (1994/5).

The Weizmann Institute of Science (established in 1934 in Rehovot) is a recognized post-graduate center for research in the sciences. It offers the following graduate courses in environmental sciences: probabilistic methods for fractured and heterogeneous rock groundwater hydrology; atmospheric chemistry; and geochronology with radioactive isotopes.

Bar Ilan University (established in 1955 in Ramat Gan) offers a number of environmental courses, most within the context of the *Department of Geography*. Courses include: Jewish approaches to spatial organization as manifested, *inter alia*, in Jewish sources; introduction to ecology; climatology of air and environmental pollution; environment and development; site preservation and internal tourism; and an environmental seminar on select environmental issues including lectures and research projects on water pollution, solid waste and recycling, pest control, sewage, nature protection, environmental communication, etc.

Tel Aviv University (established in 1956) is Israel's largest university. Environmental courses are offered in the following faculties:

- *The Faculty of Life Sciences* offers environmental studies in the departments of zoology, botany, biochemistry and molecular microbiology and biotechnology with 50 courses ranging in subject from environmental bioindicators to the ecology of water pollution, from use of bacteria to treat environmental pollution to the ecophysiology of plants.
  A new M.Sc. program in Ecology and Environmental Quality is now being offered (from 1994) within the framework of the Faculty of Life Sciences. Required courses will fall into four categories: ecological systems and energy flow, microbial ecology, biometry and environmental protection.
- *The Faculty of Engineering* offers courses in the technology of environmental quality.
- *The Humanities Faculty* offers environmental studies within the framework of the Geography Department. Courses focus on the relationship of socio-spatial processes to environmental problems.
- *The Faculty of Exact Sciences* offers environmental studies in the Department of Geophysics and Planetary Sciences and in the School of Chemistry. Subjects relate to global climate and atmospheric-ecological interactions.
- Additional environmental courses are offered in the *Faculty of Social Sciences* and in the *Faculty of Law*.
- *The Super-Center for Environmental and Ecological Studies*, inaugurated in May 1994, is affiliated with numerous faculties and institutes within the university.

The University of Haifa (established in 1963) offers environmental studies in several faculties:

- *The Center for Maritime Studies*, within the framework of the Graduate Department of Maritime Civilizations, offers undergraduate and graduate courses on the environmental aspects of general oceanography, marine fauna and flora in the Mediterranean and marine biogeography. On the graduate level, courses on the marine ecology of the Gulf of Eilat are offered as well as a graduate seminar in oceanography and marine resources and an interdisciplinary graduate seminar.

- *The Institute of Evolution* offers undergraduate courses on ecology and society, flora in Israel, research problems in evolutionary biology and experimental ecology of temporary pools. A Ph.D. program in evolutionary biology and ecology has been proposed.
- *The Department of Economics* offers undergraduate and graduate courses in environmental economics, natural resource economics, cost-benefit analysis and applied welfare economics.
- *The Department of General Studies* offers an undergraduate study unit in environmental studies as well as a wide variety of courses spanning the following: introduction to ecology, environmental law, economic aspects of environmental problems, environmental planning, and environmental health.

Ben-Gurion University of the Negev (established in 1967 in Beersheba) offers environmental studies in four academic departments:

- *The Department of Chemical Engineering* has proposed a bachelors' program specializing in environmental engineering and is currently preparing a masters' program in environmental studies.
- *The Department of Geography* offers a B.A. program specializing in environmental studies.
- *The Department of Geology* offers a B.A. program specializing in environmental geology.
- *The Department of Life Sciences* offers an M.A. program in ecology.

Students in all the above departments may attend a university seminar on environmental issues with topics ranging from the greenhouse effect to groundwater and air pollution. An interdepartmental teaching committee on environmental studies is being formed to assist in the planning of interdisciplinary syllabi for masters' degrees. A bachelors' degree program on the environment will be considered at a later date.

An integral part of the university is the *Institute for Desert Research* (Sde Boker campus) which serves as a national center for research on the desert. Within the framework of the Jacob Blaustein Graduate Program for Desert Studies, the *Mitrani Center for Desert Ecology* conducts a series of graduate courses on theoretical and experimental aspects of desert ecology for Israeli and foreign graduate students. The program includes topics in physiological ecology, behavioral ecology, population and community ecology, habitat selection and its implications for community ecology, and ecosystem and landscape ecology.

The Israel Institute for Biological Research, by special arrangement with Israel's academic institutions, accepts graduate students for M.Sc. and Ph.D. degrees. The Institute is oriented toward research, development and production in the fields of biology, chemistry, ecology and public health.

Regional colleges, situated mainly in non-urban areas, offer academic courses under the auspices of one of the universities. Several of these colleges and seminaries offer environmental studies. A notable example is the **Tel Hai Rodman Regional College**, founded in 1957 in the Upper

Galilee. In 1993, the college inaugurated its School of Sciences and Technology which includes three departments: biotechnology, electronics and environmental sciences. The environmental program focuses on natural, life and earth sciences in the first two years and on environmental management, prevention and treatment of environmental nuisances, and agriculture and biotechnology in the third year.

ENVIRONMENTAL AWARENESS

The 22 years that have elapsed since the momentous Stockholm Conference on the Human Environment were characterized by a dramatic increase in environmental awareness worldwide. Today, environmental protection is recognized both as a prerequisite to sustainable development and as its end result. The international environmental awakening has and will continue to have an impact on Israel. From nearly zero awareness of environmental issues in Israel's early years, public awareness and understanding have dramatically increased. But if Israel's environmental movement is to succeed, much more needs to be done. Therefore, major efforts are now being invested in further increasing environmental awareness and instilling an environmental code of ethic in every man, woman and child in Israel.

The Year of the Environment

Recognition of the central role that public awareness holds in the formation of national priorities and the formulation of environmental policy has not eluded Israel's decision makers. This recognition was embodied in the resolution to declare the Jewish year 5754 (September 1993 to August 1994) as the Year of the Environment in Israel.

The government decision, taken on September 1, 1992, called upon the Ministry of the Environment, in cooperation with the Information Center and other government ministries, to prepare a program marking the Year of the Environment in Israel. Since the subject is interdisciplinary and affects most government offices, nearly all ministries took an active part in this year's program of environmental events and activities.

The goals of the year, as formulated in the resolution, were:

- To increase public awareness of the environment, primarily among youth, and to involve the wider public in environmental activities;
- To focus the efforts of the various government ministries on the subject and to promote environmental awareness among all sectors of the community;
- To strengthen Israel's national information campaign abroad;
- To promote specific environmental issues, such as: cleanliness in public places, green consumerism, eco-labeling, recycling, improved appearance of municipalities, and much more.

Environment Year Activities

Environment Year was officially launched on September 6th, 1993 with two ceremonies: the first, at the top of the Hiriya garbage dump in the Tel Aviv metropolitan area, and the second, at the President's Residence in Jerusalem. The official inauguration of the year at the President's Residence was attended by such dignitaries as President Weizman, Prime Minister Rabin and Minister of the Environment Sarid as well as a wide array of government and public representatives. Together they signed an environmental covenant outlining Israel's commitment to environmental protection (see below).

Over the past year, some 650 activities took place, their impact exceeding initial expectations. No day went by without media coverage of environmental issues, without environmental lectures, audio-visual presentations, events, exhibitions or cleanups. Every means was utilized to increase public consciousness: televised public service announcements, television programs, radio shows, audio-visual presentations, jingles, media coverage, posters, stickers, information campaigns, publications—and a "green diary," on recycled paper, to remind the public, on a day-by-day basis of environmental issues. Requests for environmental information poured into the Ministry of the Environment in the thousands. Specially-prepared pamphlets, car stickers, posters, rulers, bookmarks and garbage bags for vehicles were distributed to the general public—some printed in English and Arabic as well as in Hebrew and all stamped with the year's motto: "To the Environment with Love."

While the Ministry of the Environment stood at the forefront of activities, the interdisciplinary nature of the subject encompassed nearly all government ministries in projects and undertakings targeted at attaining two central aims: bringing about concrete improvements in environmental quality in Israel and dramatically increasing environmental education, awareness and public involvement. Worthy of special note is the Ministry of Education which adopted the subject as the central theme of the formal education system this year. In addition to publishing new study programs and educational materials, the Ministry of Education sponsored a unique educational fair in December 1993, displaying a wealth of pedagogical materials on the environment, and distributed a special publication, providing a comprehensive listing of all available environmental education material—from textbooks to games to computer programs.

Throughout the country, local authorities, environmental organizations, citizen groups, schools and youth movements brought the environmental issue to the fore through the organization of competitions, games, exhibitions, quizzes, cleanups, marches, tours and study days. Various sectors of the population were introduced to the subject by means of environmental awareness weeks. These were launched by the Arab educational sector, by universities, volunteer organizations, local

authorities and the Histadrut Labor Federation as well as by numerous government ministries. In June of 1994, the Ministry of the Environment sponsored Environment Week in Israel, to synchronize with the celebration of Environment Day around the world. Celebrations included an official ceremony in the Knesset in which awards were granted to industries, local authorities and cleanliness trustees who have excelled in their environmental activities, and two cleanup campaigns: one along the Mediterranean shoreline, the other, with the cooperation of local diving clubs, underwater in the Gulf of Eilat.

During the course of the entire year, the general media played an important role in placing environmental concerns at the forefront of national concern. Special environmental supplements were included in the country's major newspapers, and several new periodicals on environmental and nature protection were published by Israel's green organizations. Environmental film marathons, both local and international, were held at cinematheques throughout the country; public service announcements on cleanliness, battery collection, eco-labeling and recycling were aired on radio and television; and dozens of new television programs on the environment were produced by both the general and educational television networks.

Nearly every holiday was dedicated to the theme of the environment. As part of a special campaign, organized by the Ministry of the Environment in cooperation with local environmental units, dozens of environmental information stations were opened in strategic locations throughout the country during the three major holidays of Succot, Passover and Shavuot. Tens of thousands of vacationers and hikers stopped at the stations, picking up environmental material, posing environmental questions and signing on as cleanliness trustees. A special musical performance, entitled "Life to the Rivers," replete with singers and artists, marches and hikes, drew thousands to the Galilee area during the Succot holiday. Independence Day celebrations were also dedicated to the environment. Special events included the traditional lighting of twelve torches by environmentalists during the central ceremony, free environmental tours, and a spotlight on the environment within the framework of the annual International Bible Quiz held in Jerusalem.

During their free time, Israelis viewed innovative environmental exhibitions displayed in museums throughout Israel. The Youth Wing of the Israel Museum in Jerusalem, for example, featured a long-running exhibition entitled "Landscapes." The presentation focused on the encounter between man and the landscape around him and featured visual displays alongside active participation by the public using computers and audio-visual equipment. Another popular exhibition, entitled "From Material to Material," has been making the rounds of all of Israel's major museums, featuring unique displays using recycled materials.

The Israel Government Coins and Medals Corporation produced an official mint set featuring a twelve-sided bronze coin with the words "For a

Better Environment" and the Philatelic Service came out with a set of three stamps on the environment featuring the symbols of air, water and earth.

Businesspeople were given the chance to review environmental opportunities within the framework of international commercial exhibitions on quality of life, ecology, recycling, and environmental and landscape protection, sponsored by the Ministry of the Environment in Tel Aviv's exhibition grounds.

The conclusion of the Year of the Environment is being marked by additional projects including: a special supplement distributed to local newspapers as well as to all high school students in the country; a river cleanup campaign with the participation of some 5,000 youngsters on summer programs to Israel from abroad; an environmental march, organized by the Ministry of the Environment in conjunction with youth movements, green organizations and the general public; a new exhibition on the environment; and a grand finale featuring youth bands in a musical program of environmental songs and an audio-visual presentation. All these activities will reinforce the fact that environmental awareness is a continuous process, which should not fade away with the conclusion of the year.

All told, some 160 bodies took part in the year's events, including the Society for the Protection of Nature in Israel, the Council for a Beautiful Israel, the National Parks Authority, the Histadrut Consumer and Environmental Protection Authority, the Jewish National Fund, the Museum Forum, women's organizations (Na'amat, WIZO), B'nai B'rith, Rotary International, the Manufacturers' Association and many many more. Environmental associations, public bodies, governmental organizations—each has vowed to do its part to improve the environment in Israel. From organizing cleanup campaigns to joining Israel's corps of cleanliness trustees, each group has played an important role in fostering environmental awareness and commitment.

Special Projects

In order to bring about concrete improvements in the quality of the environment in Israel, several areas have been targeted for priority action. Throughout the Year of the Environment, renewed efforts were placed on the enforcement of environmental laws and regulations, in cooperation with the police, the inspection patrol (the Ministry of the Environment's environmental inspection and enforcement unit) and local authorities. Special attention was focused on the restoration of the country's polluted rivers, with first priority to the Yarkon, Kishon, Alexander, and Lachish Rivers. Local environmental units and town associations for environmental quality—currently serving over 80% of Israel's population—promoted environmental projects in their own localities. The number of these units,

which are under the administrative jurisdiction of their respective municipalities, but under the professional aegis of the Ministry of the Environment, has increased from 22 to 27. The new units were set up in the Arab sector.

Wherever possible, activities focused on a number of key projects, in which the general public could take an active part—and make a difference. The most prominent of these included promotion of cleanliness and recycling, battery collection and green consumerism.

Towards Improved Cleanliness

Throughout the year, cleanup campaigns, with the participation of thousands of volunteers, were launched in municipal areas, along the coasts, on the roadsides—and even underwater in the Gulf of Eilat. Special efforts were invested in increasing Israel's legion of volunteer anti-litter trustees, a unique Israeli innovation whereby cleanliness inspectors and trustees are appointed by the Minister of the Environment to help enforce the Maintenance of Cleanliness Law. Since the beginning of the Year of the Environment, the number of cleanliness trustees has doubled to 100,000. The target by the end of 1995—250,000 volunteers.

On a national level, special efforts were concentrated on closing down or rehabilitating illegal dump sites, and new undertakings focused on recycling and reuse. Experimental recycling projects were initiated in 30 local authorities, separation at source of paper in all government offices began, and the purchase of recycled products in government and educational institutions was encouraged. Beginning with the September 1994 school year, all notebooks used in first to fourth grades will be made from recycled paper.

Battery Collection

It is estimated that some 50 million used batteries find their way to garbage dumps each year. Efforts are currently being invested in separating batteries from household refuse, preventing their disposal in municipal landfills and promoting their disposal at the national hazardous waste site at Ramat Hovav. To promote the project, a nationwide battery-collection campaign, accompanied by a massive public information campaign, was launched. By means of special service announcements in the media along with posters, publications and stickers, the public was encouraged to discard used batteries in about 43,000 specially-designed containers which were dispersed in strategic locations throughout the country. Local authorities are responsible for the transport of the batteries for disposal at the national hazardous waste site, instead of haphazardly dumping them at landfills and other sites.

Eco-Labeling

With the advent of eco-labeling in Israel, individuals will have the chance to opt for a cleaner and safer environment through the purchase of environmentally-friendly products. In 1993, criteria for eco-labeling were defined and a symbol designed, setting the way for manufacturers and importers to apply to the joint committee of the Ministry of the Environment and the Israel Standards Institute for permission to append the eco-label to their product.

Israel's "green label," designed as a white tree with three heart-shaped leaves on a green background, will be awarded on a "cradle to grave" basis, taking into consideration the product's environmental impact at each stage of its life cycle (pre-production, production, packaging and distribution, use and disposal).

Criteria for the evaluation of a product's impact on the environment relate to the product's impact on waste, soil pollution, water pollution, air pollution, noise, energy consumption, natural resources, and other factors.

The new standard will provide uniform, recognized criteria for environmental labeling which will replace the multitude of environmental claims currently being made by manufacturers regarding their products. The provision of accurate and reliable information on the environmental effects of certain products will increase consumer awareness, change consumer behavior, lead manufacturers to develop environmentally-friendly products, and improve the environment. The environmental label is conceived as a market-oriented instrument of environmental policy which will provide a competitive edge to environmentally-friendly products relative to other products in the same category.

The first three standards for environmentally-friendly products were published by the Israel Standards Institute in March 1994. They include: general guidelines for the assessment of products with reduced environmental impact ("green" products), sanitary paper (e.g. toilet paper, paper napkins and towels, tissues, etc.) and writing and printing paper (notebooks, printing paper, envelopes, computer paper, etc.). Other

standards, in advanced stages of preparation, include: cardboard and other paper products, water-based paints and batteries.

A public information campaign will help persuade manufacturers and importers to work toward environmentally-friendly products and will encourage the general public to purchase products which have been accorded the "green label".

Environmental Databases

Both environmental awareness and environmental improvement depend on the availability of up-to-date information concerning the environment. The Ministry of the Environment currently operates an information center on hazardous substances, which supplies data on a 24-hour-a-day basis, both to the multitude of bodies now dealing with hazardous substances and to the general public. Plans are underway to expand its operations to other areas in the future.

The Ministry of the Environment serves as the focal point for INFOTERRA, the United Nations Environment Programme's information exchange and referral service. The INFOTERRA system is comprised of a network of over 150 participating nations which serve as access points for public queries regarding environmental issues. National focal points draw on the resources of network partners in order to respond to environmental questions. The Ministry of the Environment is currently investing major efforts in updating and increasing its reference sources in Israel for the benefit of other national focal points. Simultaneously, it is working to inform government, academic and other environmental institutions about the availability of the system.

Another recent breakthrough is the development of a computerized database on the environment by the Hebrew University of Jerusalem. The environmental information system, entitled Holit, was established in 1993. It is available to students, researchers, public institutions and the general public—in fact to anyone with access to a personal computer. All users can obtain online access to local and international environmental information bases, can address questions to environmental bodies in Israel and can publish announcements on environmental problems, important events, lectures and conferences, nature observations, etc. The goal of the system is to foster environmental awareness and activity by enabling more people to obtain up-to-date and easily accessible information on the environment.

Towards Increased Awareness

The emergence of environmental databases, the initiation of environmental campaigns, the implementation of environmental projects—

all have contributed to growing environmental awareness in Israel. While the multitude of initiatives currently being launched are too many to list here, suffice it to say that they have made a major impact.

Since the declaration of the Year of the Environment in September 1993, the number of citizens who have turned to the Ministry of the Environment for help in solving environmental problems has skyrocketed. Citizens, students and educators have bombarded both the district and national levels of the ministry with dozens of requests, suggestions and complaints on a daily basis. While citizens appear to be concerned with nearly every aspect of the environment, the majority of the queries relate to recycling, noise, cleanliness and air pollution.

Indubitably, Israel's efforts to increase public environmental awareness have made a difference. The Ministry of the Environment intends to continue its efforts, helping to ensure that the environmental covenant signed at the beginning of the Year of the Environment will be implemented for many years to come.

The Environmental Covenant

We hereby attest that we have convened in Beit Hanassi [the President's Residence] in Jerusalem on Monday, the 20th day in the month of Elul 5753, September 6th 1993, to implement the government decision declaring the Jewish year, 5754, the Year of the Environment.

We, the citizens of Israel—Jews, Arabs and Druse—representatives of the cabinet and the Knesset, the Chief Rabbinate, local authorities, the Histadrut Federation of Labor, the Manufacturers' Association, farmers, industrialists and friends of the environment undertake, within the framework of this covenant, to heed the environmental commandments:

Namely:

Our world is one and our country is one and irreplaceable. They are entrusted to us to bequeath to future generations as they were bestowed upon us and improved by our own contribution, as the Creator commanded Adam: "See My works, how beautiful and perfect they are, and all I created—I created for you. Beware lest you spoil and destroy My world, for if you will spoil it, there is no one to repair it after you" (*Ecclesiastes Rabba, 7:28*).

It is incumbent upon us to nurture and respect our plot of land— with its unique landscape, climate and diversity of flora and fauna of which it is written, "the good and ample land which Thou wast pleased to give as a heritage to our fathers and to us, to eat of its fruits and to be satisfied with its goodness"; a land in which the past touches the future and commands it: remember and observe; a land in which landscape and spirit, culture and

creativity, tradition and renewal are inextricably intertwined and become one.

Our universe and the natural resources which embellish it are our source of life—bestowing water and nourishment, medicine and building resources to sustain humankind and the living world which surrounds us. Their goodness must be derived in prudence and wisdom so as neither to deplete nor destroy them, so as not to disrupt the precious and wondrous balance of nature—lest we destroy from our midst flora, fauna, and landscape resources.

The goal of scientific development and technological progress, which have skyrocketed in the 20th century, is the advancement of quality of life upon this earth. Yet, all too frequently, in the blaze of development set off by the human-dominated machine, the blessing of progress is transformed into the curse of decline, bringing about irreparable disruption and ruin—by our very hands.

Therefore, We Hereby Declare:

We have hereby entered into a covenant with all human beings, wherever they may be, to stand united to close the breach, to stop the mindless destruction and extinction which threaten our planet. Environmental degradation knows no boundaries, no nationalities, no states. Now is the time to heed the message of the Rio Earth Summit, the message of international and regional cooperation and national responsibility—our only guarantees of success.

The commandment of environmental protection is in our hands—and in our hearts—to fulfill. We must ensure that whatever is undertaken for the benefit of the individual and the collective takes account of the environment and its resources, taking care not to destroy, damage or mar our planet's natural beauty. We must preserve the image of the land and the rich heritage which is embedded in its landscapes, for we are the image of our native landscape.

At the forefront of our concern are the limited natural resources which were handed to us—water, soil and air; we shall preserve them from all harm to prevent their depletion and deterioration—through wise use and sustainable development. We will use these resources without abusing them, without disturbing the sensitive balance between human welfare and environmental wholeness. We will endeavor to rehabilitate natural resources heedlessly damaged, environmental treasures recklessly destroyed.

We shall base our activity on the sound foundation of legislation, both international conventions and national legislation, placing environmental welfare high on the priority list of decision makers and planners. We shall develop innovative technologies which will benefit the environment, and we shall foster study and research to promote wise development.

Quality of the environment is synonymous with quality of life, for "the beauty of a place reflects on its inhabitants" *(Sotah 47)*. It is written in the Talmudic literature that a pleasant home and pleasant furnishings enlarge one's contentment, and the same is said with regard to trees and flowers and above all—the cleanliness of premises, markets and courtyards. It is incumbent upon us to inculcate an environmental ethic and code of conduct in the individual and in humankind, for only thus will we achieve the full measure of our humanity.

We hereby sign this covenant with the faith and conviction that our concern for the environment will be a challenge calling out to every individual, organization and group. May we have the chance to fulfill, in theory and in practice, the special slogan of this year: "***To the Environment with Love.***"

INTERNATIONAL COOPERATION

Cooperation with international organizations and states is an important component of the Ministry of the Environment's agenda. Since the Stockholm Conference on the Human Environment in 1972, Israel's contribution to international environmental protection efforts has spanned many areas, including: environmental management and impact assessment, marine and coastal management, water conservation, wastewater treatment and reuse, solar energy, nature protection, combating desertification, and environmental education and awareness.

International activities have significantly increased in the wake of the United Nations Conference on Environment and Development (the Earth Summit), which took place in Rio de Janeiro in June 1992. This largest-ever meeting of world leaders, bringing together senior representatives of 179 governments, proved a landmark in the environmental movement worldwide. It produced two international agreements (Climate Change and Biological Diversity), two statements of principle (the Rio Declaration on Environment and Development and principles on the conservation and sustainable development of forests) and a major action plan on worldwide sustainable development, Agenda 21. The principal effect of the Earth Summit, however, was to raise public consciousness of the necessity to reconcile the legitimate needs of environment and development. It has prompted both states and international organizations to adopt rational strategies for sustainable development.

United Nations Environment Programme

Israel's international activities are carried out within the framework of various international organizations, foremost among which is the United Nations Environment Programme (UNEP). Others include the affiliated United Nations organizations and independent international organizations.

UNEP, with its headquarters in Nairobi, was established in 1972 "to serve as a focal point for environmental action and coordination within the U.N. system." The Ministry of the Environment, as the focal point of UNEP activities in Israel, has been an active participant in UNEP-sponsored conferences—sending delegates, preparing national reports and contributing of its expertise. The Ministry of the Environment also serves as the focal point for INFOTERRA, UNEP's environmental information and referral network, now comprising over 150 participating countries.

Following are some highlights of Israel's recent activities within the framework of UNEP:

Combating Desertification: It is estimated that one-quarter of the world's land is already affected by degradation; an additional six million hectares are transformed into desert every year. The gravity of the problem has prompted participants of the Earth Summit to give the subject high priority and to call for the preparation of an international convention on the subject. In the wake of this recommendation, an intergovernmental preparatory committee, including an Israeli expert, was established. Based on its success in rolling back the desert and developing innovative programs of water harvesting in arid areas, Israel has expressed its readiness to share its wide experience with other countries. It has also proposed that an international center for combating desertification be established within the framework of Ben-Gurion University's Desert Research Institute in Sde Boker. (For further details, see chapter on Nature and Desertification.)

Ozone Protection: Israel ratified the Vienna Convention for the Protection of the Ozone Layer, the Montreal Protocol on Substances that Deplete the Ozone Layer and the London Amendment in June 1992. Ministry of the Environment representatives have subsequently participated in meetings of the contracting parties to the convention and the protocol. Israel, a major supplier of methyl bromide, is currently investing major efforts in addressing the problem of this soil fumigant which has been targeted as a potential ozone-depleting substance. Concern over the risks associated with continued methyl bromide use has led Israel's Minister of the Environment to appoint a task force to survey methyl bromide use in Israel and worldwide and to present and implement recommendations on the reduction of emissions and introduction of substitutes. (For further details, see chapters on Agro-Ecology and Air.)

Transport of Hazardous Wastes: Growing concern over the adverse impacts of the export and import of hazardous substances on the environment has prompted Israel to accelerate the ratification procedure for the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. Israel expects to ratify the convention in 1994.

Climate Change: Israel has signed, but has not yet ratified, the Climate Change Convention. Israeli scientists are taking an active part in research efforts on the possible impacts of climate change in general, and within the Mediterranean region, in particular. In 1991, Israel hosted an international workshop on climate change. (For further details, see chapter on Air.)

Endangered Species: The Nature Reserves Authority (NRA) is responsible for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in Israel. Enforcement of the CITES provisions is highly efficient in Israel, due to its comprehensive nature protection legislation and efficient monitoring

system. For this reason, Israel was chosen to host the Asian regional meeting of CITES, held in Jerusalem in March 1994.

Israel has ratified a long list of international environmental conventions. A full list of these conventions appears in the appendix to this publication.

Mediterranean Action Plan

Israel's contribution to the protection of the Mediterranean Sea environment has been carried out within the framework of the Mediterranean Action Plan (MAP). Today the organization has 19 members, including all Mediterranean states and the European Union. Israel is an active member of the organization and is well-respected for its contribution to all components of the action plan: legal, socio-economic and scientific.

In the legislative realm, Israel has signed and ratified the Convention for the Protection of the Mediterranean Sea Against Pollution (the Barcelona Convention) and its four protocols. As an active participant in the Blue Plan (part of the socio-economic component), Israel published a national environmental scenario, analyzing current trends and predicting environmental conditions for the years 2000 and 2025. Within the context of the Priority Actions Programme (PAP), which focuses on concrete development projects, Israel continues to contribute of its expertise and experience to nearly all priority areas (from integrated planning of coastal zones to environmental impact assessment). Monitoring and research are conducted through the assessment component of the plan, known as MEDPOL, in which Israel takes an active part. (Israel's research and monitoring activities are described in further detail in the Marine Water and Coasts chapter.)

In recent years, MAP has approved two significant projects which promise to be of special significance to Israel's environmental protection efforts: a Coastal Areas Management Program (CAMP) for Israel and a subregional agreement between Egypt, Cyprus and Israel on preparedness and cooperation in response to medium and large-scale oil spills.

In October 1991, in a landmark decision, Israel was unanimously elected, along with Egypt, Tunisia and Monaco, to serve on the MAP Bureau, the steering committee of the entire plan. The breakthrough can be attributed to several factors, foremost among which is the growing regional appreciation of the important contribution made by Israel to MAP since its creation.

MAP is widely acclaimed as a model of regional cooperation. It constitutes a forum which has enabled direct contact and professional cooperation between Israel and its Arab neighbors for nearly two decades. MAP was the first large-scale project to demonstrate that the decisions taken at the Stockholm Conference could be transformed into meaningful action.

Today, in the wake of the Earth Summit, the MAP Bureau has approved a proposal to prepare an "Agenda 21" for the Mediterranean Sea area. In order to refocus MAP's activities on the management of coastal regions, the marine environment and marine biological resources, in accordance with the recommendations of Agenda 21, an expert meeting was convened in May 1994 in Tunisia. This represented the first time that Israel was invited, in an official capacity, to participate in a MAP conference taking place in an Arab country which does not have diplomatic relations with Israel. The Tunisian invitation gave expression to the new atmosphere created in the Middle East as a result of the peace process. It is anticipated that the spirit of environmental cooperation which has characterized MAP in previous years will continue to stand at the core of MAP activities in the future.

Bilateral Cooperation

Israel's increased involvement in environmental protection has led to several bilateral agreements for environmental cooperation, including:

Israel-U.S.A: In February 1991, a Memorandum of Understanding was signed between the Ministry of the Environment and the U.S. Environmental Protection Agency. The memorandum establishes a framework for scientific and technical cooperation between the two organizations in the field of environmental protection, including exchanges of scientific and technical information, exchange visits of scientific personnel, joint scientific symposiums and workshops, and cooperative research on problems of common interest.

In the wake of the agreement, several professional workshops have already been held in Israel and in the U.S.A. on subjects such as wastewater treatment, sludge treatment, and reuse of effluents in agriculture.

In recent months, Israel has expressed its willingness to join Vice President Al Gore's initiative—the Global Learning and Observations to Benefit the Environment (GLOBE) program. The program will link school children and their teachers worldwide in data gathering and scientific experiments designed to monitor the global environment.

Israel-Germany: A cooperative agreement, similar in content to the Israel-USEPA memorandum, was signed between the Ministries of the Environment in Israel and Germany in March 1993. Germany, a world leader in the protection of the environment, has developed some of the most advanced environmental standards worldwide in such areas as air pollution, solid waste and eco-labeling. Israel hopes to learn from Germany's experience while contributing of its own expertise in such realms as water conservation and effluent reuse, nature conservation, combating desertification and solar energy utilization.

Within the framework of the accord, an agreement was reached on the implementation of an Israeli-Egyptian-German trilateral project on the reduction of pesticides in agriculture. In addition, a seminar on air quality standards with the participation of Israeli and German experts was convened in Israel in March 1994.

Israel-Egypt: In April 1993, two environmental agreements were signed between Israeli and Egyptian institutions. The Israel Ministry of the Environment and the Egyptian Ministry of Agriculture and Land Reclamation signed an agreement on cooperation, information exchange and joint projects on reduced environmental impact from agriculture. The Israel Ministry of the Environment and the Egyptian Environmental Affairs Agency signed a Memorandum of Understanding on cooperation on mutual environmental problems, including planning and management of coastal resources along the Mediterranean Sea and Gulf of Aqaba, establishment of marine pollution response centers in case of oil spills, environmental education and information, and creation of a regional center for combating desertification.

As part of the agreement, several joint workshops and seminars were envisioned. A five-member expert team from Egypt has already visited Israel for a study tour on wastewater treatment in small communities, and an environmental education seminar was recently held with the participation of Israeli and Egyptian non-governmental organizations.

Israel-Austria: Increased cooperation on environmental issues is also on the agenda between Israel and Austria, in the wake of a visit of the Austrian Minister of the Environment to Israel in October 1993. A seminar on the treatment of hazardous materials, with the participation of Austrian and Israeli experts, will be held in Austria at the end of 1994.

Israel-Sweden: A clause on cooperation in environmental fields was incorporated into a cooperation agreement between Israel and Sweden. Within this framework, a seminar on solid waste treatment has already been held in Israel with the participation of Swedish experts.

Israel-Spain: An agreement on cooperation in the field of desertification was signed between Israel and Spain in November 1993. Cooperation between the two states will be promoted in the areas of applied research, joint projects, vocational training and data exchange.

Israel-Turkey: An agreement on cooperation in environmental matters and nature conservation was signed between Israel and Turkey in April 1994. The agreement targets a number of fields which are of particular interest to both parties, including pollution control, environmental awareness, environmental impact assessment, environmental monitoring, environmentally-sound technologies, and diversity of species.

Israel-European Union: The European Union (EU) is actively pursuing the implementation of an environmental section included in the agreement of cooperation between the State of Israel and the EU. The European Investment Bank, on its part, has accelerated its investment plan for environmental protection projects in the Mediterranean Sea basin. Within this framework, it is allocating resources for the improvement of environmental infrastructures in Mediterranean states which are not members of the Union, including Israel.

Peace and the Environment

The expansion of the peace process is expected to bring about sweeping changes in the ability of Middle Eastern countries to address environmental issues. The Middle East constitutes a single environmental system which is particularly vulnerable to transboundary pollution. The countries in the region share similar environmental problems; regional cooperation is crucial to promote sustainable development and prevent the spread of pollution.

Future environmental cooperation between Israel and its Arab neighbors will be based on two critical elements: the creation of coordination mechanisms between the countries to deal with the question of shared natural resources, and the development of joint projects designed to solve common environmental problems.

The Ministry of the Environment actively participates in the peace process through two tracks: multilateral and bilateral.

The Multilateral Track

Within the framework of the multilateral peace talks for regional cooperation in the Middle East, the Working Group on the Environment, headed by the director general of the Ministry of the Environment, has played a key role in setting forth proposals for future cooperation on environmental issues. Since the process was initiated in Moscow in January 1992, five meetings have been held, and subjects for regional cooperation have been identified. These include: emergency preparedness and prevention of marine pollution, especially in the Gulf of Aqaba, development of sewage and solid waste infrastructures, combating desertification, environmental management and impact assessment, and public education.

A significant breakthrough was made in 1993 when the parties agreed to cooperate in combating marine pollution and oil spills in the Gulf of Aqaba. The operative significance of the agreement lies in the readiness of Jordan, Israel and Egypt to place pollution control equipment at each other's disposal in case of an oil spill. The regional plan for cooperation on

maritime pollution and emergency response in the Gulf of Aqaba is based on three centers of operation: Jordanian (Aqaba), Israeli (Eilat) and Egyptian (Nueiba), which will work in coordination and with mutual aid in case of emergency.

The Gulf of Aqaba, which is bordered by Israel, Egypt, Jordan and Saudi Arabia, poses a particularly urgent challenge. The natural resources and the climate of the Gulf of Aqaba make the area very attractive to scientists, sport divers and tourists from all over the world. On the other hand, Eilat and Aqaba are principal ports, with major oil terminals and chemical export facilities which, along with the recreational facilities in the region, place major stress on the delicate ecosystem and threaten to damage it irreparably. The decision on emergency response, preceded by factfinding missions and workshops in Japan and the U.S.A., proved that only through full and open coordination can environmental problems be effectively addressed.

An Israeli proposal for a regional project on desertification has been significantly advanced in 1994. Today, the struggle against the encroaching desert is more pressing than ever. With a view to counteracting this trend, the World Bank has spearheaded an initiative for the establishment of regional centers on the study and prevention of desertification, with the participation of Israel, Egypt, Jordan, Tunisia and the Palestinians. The multi-million dollar project, to be financed by donating states and led by Japan and the World Bank, will serve as a model of peaceful and productive international cooperation, offering knowledge and expertise to improve the lives of people not only in the Middle East but in arid areas all around the world.

A World Bank delegation is currently preparing an inventory of regional institutes and experts on desertification, and an expert meeting will be organized to discuss means of advancing the subject. Several educational and research institutions in Israel have already expressed their readiness to take part in the project.

Still another major initiative focuses on the environmental future of the Mediterranean Sea region which constitutes an essential resource for millions of people. Members of the Working Group on the Environment have welcomed the European Union initiative on integrative management of the eastern Mediterranean coast which is designed to develop channels of cooperation for the environmentally-sound development of the resources of this sensitive area. In the wake of the findings of a study mission to the area, the European Union has consolidated an action plan on integrated planning, manpower training, seminars and investments, which should go a long way toward paving the road toward integrated and comprehensive management of the eastern Mediterranean coast.

Another project which has been accorded high priority within the context of the multilateral peace talks is environmental education. No environmental management program can be effective without the support of

the people—and education is the best tool available for nurturing support for environmental projects. Moreover, education can play a crucial role in building bridges of understanding among the people in this region. Israel has therefore welcomed the Jordanian proposal for establishing a regional education and information center and the Jordanian endorsement of the Israeli suggestion to declare a "Year of the Environment in the Middle East." Israel's experience during the course of the Year of the Environment, launched in Israel in September 1993, may prove a model for similar consciousness-raising campaigns in the entire region.

Similarly, Israel has welcomed the Japanese initiative for a long-range endeavor on the preparation of a regional environmental code of conduct. The switch from a state of war and belligerence to a state of peace and cooperation requires, more than ever, the delineation of a new code of conduct which will govern the relations between the countries. The code of conduct should determine basic common attitudes towards the environment and should define values which are shared by all the people in the region concerning the protection of nature and the environment.

Other subjects on the environmental agenda for peace include: sewage treatment in small local authorities, solid waste treatment, industrial waste treatment, coastal planning, monitoring, and environmental impact assessment.

Over the past two years, the multilateral talks have progressed from the identification of shared problems to the formulation of concrete solutions and joint projects. The continuation of the talks is expected to help forge new paths toward cooperation and collaboration on the sensitive environmental issues facing the Middle East.

The Bilateral Track

Alongside its participation in the multilateral peace talks, the Ministry of the Environment is a full partner in the government effort to develop peaceful relations with individual neighboring Arab states. Several environmental components were incorporated within the framework of the Declaration of Principles on Interim Self-Government Arrangements between the Government of Israel and the Palestinians (signed in September 1993). These include the establishment of an Environmental Authority by the elected Palestinian Interim Council and the creation of a joint Israeli-Palestinian committee on economic cooperation. Under the protocol for cooperation on economic and development plans, the two sides have agreed to establish a continuous committee for economic cooperation, which would concentrate, *inter alia*, on "an environmental protection plan providing for joint and/or coordinating measures in this sphere." Pursuant to this agreement, an interministerial directors general committee was established, with the full participation of the Environment Ministry.

The director general of the Ministry of the Environment heads the interministerial subcommittee on the environment. The environmental subcommittee has already prepared a position paper on the required coordination between Palestinians and Israelis on pollution prevention and environmental promotion and has defined fields for future cooperation. The document underlines the importance of management and sustainable development of land, water, air, marine and coastal resources.

Representatives of the Ministry of the Environment serve as members of professional committees on environmental issues which have been established by Israel and Jordan. They take an active part in the Washington peace talks and have worked with their Jordanian colleagues on finding common solutions to the fly problem plaguing the Dead Sea region and in promoting environmentally-sound tourism in this area.

It is envisioned that peace will bring an unprecedented era of economic development to the Middle East. Means must be found to ensure that accelerated development does not lead to environmental deterioration, but rather to sustainable development for all countries in the area. Israel will be pleased to make the environmental expertise at its disposal available to its neighboring Arab states and to learn from the experience of its neighbors. The free exchange of experience and ideas by all parties is certain to have a positive impact on the future face of the Middle East.

Non - Governmental Organizations

NON-GOVERNMENTAL ORGANIZATIONS

In contrast to the relatively high priority accorded to nature protection in Israel's national consciousness, public awareness of environmental issues has lagged far behind most Western countries. While grassroots environmental groups organized throughout the Western world in the 1970s, the general public in Israel only awakened to the need for environmental protection in the 1980s and 1990s. Yet, despite a slow start, recent years have witnessed a dramatic increase in environmental awareness and activism. To a large extent, the growth of environmental consciousness in Israel is reflected in the increased numbers of non-governmental organizations which have taken root and sprouted in recent years.

The Society for the Protection of Nature

Perhaps more than any other organization, the Society for the Protection of Nature in Israel (SPNI) has been instrumental in raising public consciousness of nature and environmental protection in Israel. The SPNI began with the organization of a small group of teachers, kibbutzniks and natural scientists in 1953 around a specific issue: the draining of Lake Hula and the surrounding swamps. As a result of their efforts, a few hundred hectares of untouched swampland were preserved as a protected refuge for the flora and fauna of the Hula Valley. The campaign, however, succeeded in a much larger sense as well: it put environmental awareness on Israel's national agenda.

The SPNI's first campaign on behalf of nature conservation was a prelude to countless other achievements during its forty year history—the most successful of which was the 1960s campaign against the picking of wildflowers. Over the years, the SPNI has continued to spearhead dozens of campaigns against the destruction of unique, ecological systems and scenic landscapes as a result of unwise development.

In order to introduce as many people as possible to an awareness of nature and to foster sensitivity to conservation problems, the SPNI, in its early years, organized guided tours into little-known wild areas and to scenic spots. A fine educational network was soon built with 26 field study centers, 33 branches and community centers, hundreds of youth clubs and comprehensive teacher training programs.

The response of the public to the SPNI's outreach program has been enthusiastic. Today, the Society is Israel's largest environmental non-governmental organization, boasting a membership list of over 25,000

families, representing about 100,000 individuals from every stratum of Israeli society. Through a broad-based program of education, conservation, research and public action, the SPNI involves over a million people annually (about 20% of Israel's population) in its myriad activities–walking tours, roving camps, lectures and seminars.

Recognizing that information is crucial to environmental protection, the SPNI places major emphasis upon the scientific investigation of Israel's landscape and wildlife. Together with Israel's leading universities and the Ministry of Science, it operates 13 Information, Research and Development Centers—focusing on mammals, raptors, birds, insects, reptiles, caves, amphibians and plants. The centers provide essential data for developing conservation strategies through a variety of surveys and field research programs.

In recent years, the SPNI has broadened its orientation to include environmental activism. As a public representative on the National Planning and Building Board, the SPNI has been a strong advocate of environmental interests. Its activities have been backed up by public protest and legal action, including petitions to the High Court of Justice. Recent campaigns have included a struggle to preserve a unique sand dune near the city of Ashdod from destruction due to a proposed housing project, a petition to the High Court of Justice to delay construction of a Voice of America transmission station in the Aravah until completion of all environmental impact statements (the project has since been canceled) and, at present, a campaign against hasty approval of the proposed Trans-Israel Highway.

SPNI-Related Organizations

Increased environmental awareness has led the SPNI to further broaden its orientation to the education of the industrial community toward sustainable development. One notable achievement was the formation of the Industrial Association for Environmental Quality (ALVA) in 1990. Founded by the SPNI, Ormat Turbines, Ltd. and the Manufacturers' Association of Israel, the organization is committed to instilling an environmental approach into all branches of industry. Its major objectives include promoting energy and resource conservation and use of environmentally-friendly products; disseminating environmental information to the industrial community; encouraging waste reduction, reuse, recycling and proper disposal; and promoting environmental careers.

The SPNI's wide experience in promoting environmental education and action has drawn newly-emerging environmental groups into its organizational framework. Thus, when the Education and Culture Committee of the Knesset recommended the establishment of a Public Council for the Preservation of Monuments and Sites in 1984, it appealed to the SPNI to place the council under its aegis and to cooperate in its

activities. With the aid of the SPNI, some 35 public, vocational and academic bodies agreed to join forces to increase public awareness and foster public activity aimed at influencing decision makers to preserve the unique heritage of the past few centuries.

Still another SPNI-led initiative is the recently-established Israel Forum for Recycling. The forum was established in 1993 as a lobby group dedicated to increasing awareness of recycling, with the cooperation of the public, government, local authorities and the industrial sector. The objectives of the forum are waste reduction, reuse and recycling.

The Council for a Beautiful Israel

Established in 1968, the Council for a Beautiful Israel (CBI) is active in promoting environmental education and awareness; protecting the natural beauty of Israel and preserving its historical sites; promoting the rehabilitation of run-down urban areas; and developing public gardens and parks, sport fields and recreation and leisure sites.

Working in cooperation with government and public bodies, CBI's thousands of volunteers have spearheaded projects and activities designed to implement the organization's goals. Among the CBI's best-known activities are competitions and awards granted to industrial plants, army bases, schools, police stations and gas stations for cleanliness, greenery and environmental enhancement. The competitions, accompanied by educational programs, have helped promote aesthetic values in the home, the workplace, the school, and even the military.

An important milestone in the growing environmental commitment of the CBI was the inauguration, in May 1992, of the CBI Center for Environmental Studies in Tel Aviv. The unique structure consists of five pavilions, two terraces and two courtyards, surrounded by wide expanses of demonstration gardens. It houses a comprehensive library, classrooms, meeting rooms and an auditorium—as well as an exhibition pavilion for local and international displays. The center's educational program, concentrating on hands-on education, focuses on the built environment; ecology, conservation and recycling; gardening and landscaping; design and aesthetics; basic architecture; preservation; and community beautification.

Life and Environment

Established in 1975, Life and Environment serves as an umbrella organization to coordinate environmental activities among Israel's non-governmental organizations and to avoid duplication of efforts. At the time of its establishment, Life and Environment included ten national bodies; today this number has more than doubled. Representatives of the various groups meet regularly to exchange information on specific environmental

activities, plan campaigns, and select priority areas for action, but each organization is free to promote environmental action according to its particular interests and priorities.

Life and Environment's major goals include: representation of Israel's environmental bodies, as a strong united lobby group, at the level of the Knesset, government ministries and local authorities; formulation of comprehensive solutions to environmental problems, on the national and local levels; publication and dissemination of environmental information in order to arouse citizen action and involvement; and representation of Israel's environmental NGOs on the international front.

Israel Economic Forum on the Environment

The establishment of the Israel Economic Forum on the Environment in 1991 represented an important breakthrough in the greening of industry in Israel. The aim of the forum is to increase environmental awareness within the business community, to deepen industry's involvement in the advancement of environmental quality and to adopt the "pollution prevention pays" principle (instead of the "polluter pays" principle). The forum encourages industry, agriculture, transport and other economic sectors to incorporate environmental concerns into their socio-economic development planning, alongside economic and operational concerns, in line with its motto "development with forethought."

At the time of its establishment, the forum included 30 businesspeople, representing Israel's major industrial, commercial and economic organizations and industries. Today, its numbers have risen to 120 businesses and organizations. The forum is currently planning a number of new initiatives: publication of a Hebrew bi-monthly, in cooperation with the Jewish National Fund; operation of mobile environmental workshops, utilizing four buses equipped with environmental material; and establishment of a new environmental center in Givatayim.

The Jewish National Fund

As the executive arm of the Zionist movement, the Jewish National Fund (JNF) has been instrumental in reclaiming, developing and afforesting the land of Israel since its establishment in 1901. In a world threatened by encroaching deserts, shrinking forests and the dangers of the greenhouse effect, JNF's afforestation efforts are a unique phenomenon. By 1994, the JNF had planted 200 million trees, creating 280 forests over an area spanning 80,000 hectares—in addition to caring for 40,000 additional hectares of natural woodlands.

Greening strategies implemented by the JNF since 1948 have succeeded in pushing the edge of the desert southward, actually reversing the process of

desertification. The JNF has developed innovative methods of harvesting scarce natural precipitation, and has initiated large-scale water conservation projects to cope with the water scarcity problem in Israel. It is building reservoirs and dams to capture floodwater for irrigation, halt soil erosion and replenish underground aquifers. It is clearing clogged river beds and reinforcing river banks to rejuvenate waterways. It is undertaking extensive drainage work in the Jezreel Valley to lower the saline water table and restore agricultural productivity. It is introducing special plantings and earthworks to anchor drifting sands and reduce dust in the western Negev and elsewhere in the country.

EcoNet Israel

EcoNet Israel, established in 1990, is an environmental research, information and advocacy organization established by members of the public seeking solutions to environmental problems. The organization began as a handful of concerned citizens who joined forces in the wake of the 1986 nuclear accident at Chernobyl to disseminate information on nuclear energy via a bi-monthly newsletter. As the newsletter became more established, the organization, originally named the Israel Agency for Nuclear Information, broadened its frame of reference and changed its name to EcoNet, the Ecological Network.

The organization seeks to inform Israelis about key environmental issues (e.g. nuclear energy, pesticides, electromagnetic radiation), to promote enlightened policy making, to broaden citizen participation in environmental matters, and to protect Israel's environment. EcoNet's involvement has taken several forms, from direct action and lobbying, through cooperation with other volunteer organizations and government bodies, to providing seed funding for projects and research.

EcoNet has been instrumental in helping to establish a number of environmental NGOs in Israel as well as setting up an environmental library, and a phone and fax hotline which directs inquiries to the correct source of help.

The Israel Union for Environmental Defense

Indubitably, the establishment of the Israel Union for Environmental Defense (UED) in the summer of 1990 marked a milestone in the coming of age of Israel's environmental organizations, in general, and in the use of legal means to tackle environmental problems, in particular. The UED is a public interest law group which provides free legal advice and representation to individuals and grassroots organizations. It also acts as a "watchdog" over government ministries to ensure that responsible environmental policies are developed and implemented, addresses local

pollution problems through citizen suits and nuisance actions, and serves as a national resource center for Israeli environmental law and environmental attorneys. Through a combination of lobbying, press releases and legal proceedings, the UED has often been successful in bringing about more rigorous enforcement policies by government agencies. Where need be, it has turned to the courts, including the High Court of Justice, on such issues as air pollution, sewage treatment and more recently, the proposed construction of the Trans-Israel Highway.

The organization has also established Israel's only Citizens' Laboratory, providing low cost analysis of key environmental parameters in drinking water, air and soil samples. The laboratory, which was officially dedicated in 1993, is meant to improve public access to reliable information on environmental quality.

The many projects implemented by the UED in recent years have made a significant mark on Israel's burgeoning environmental consciousness, impressing upon citizens nationwide that involvement and activism can yield positive results in the battle for environmental quality.

Grassroots Organizations

In recent years, spurred by growing environmental awareness in Israel and by the success of environmental activism abroad, concerned citizens have begun organizing to improve the quality of their environment. While most grassroots groups have organized around local environmental problems, several organizations have widened their horizons to deal with nationwide issues as well.

One of the first models for grassroots organization in Israel was a group of citizens which banded together in 1985 to fight air pollution in Haifa, under the name ENZA (Hebrew acronym for Citizens Against Air Pollution). ENZA's efforts were augmented by the Environmental Action Committee of the Association of Americans and Canadians in Israel (AACI). Armed with a background in civil rights activism and administrative and marketing skills, this Anglo-Saxon group of activists collaborated with ENZA and with several other sympathetic public groups in Haifa to bring about environmental changes. Together, they conducted a high-profile campaign, utilizing petitions and publications, demonstrations and lobbying, to raise awareness and to pressure both polluters and politicians to stem the tide of pollution plaguing the city.

As a result, Haifa's grassroots organizations achieved not only visibility, but much more. They succeeded in helping reverse a proposal to build a second power plant in Haifa, in electing an environmental candidate to the Haifa City Council, and in convincing both the Israel Electric Corporation and the oil refineries to burn low-sulfur fuel.

Within a few years, several organizations followed in ENZA's

footsteps. A group of concerned citizens in the Galilee organized in order to protect the Galilee's water, air and environment. The group, Citizens for the Environment, uses volunteers for its information drives, lobbying, law suits and cleanup campaigns. Similar groups have sprouted throughout the country, in Petah Tikvah, Hadera, Bnei Brak, Tel Aviv, Modi'in, Eilat, Karmiel, Kfar Sava, the Jezreel Valley—to name some prominent examples.

Other grassroots organizations have broadened their activities to include nationwide interests. In Herzliya and its environs, ALMA (the Hebrew acronym for Association for Environmental Quality) was established in May 1991. Like other grassroots organizations, it grew from a handful of concerned citizens to hundreds of members. At present the association is involved in promoting the use of environmentally-friendly products and organically-grown produce, in encouraging industry to reduce the waste it produces, in forming an environmental youth movement and in advancing the recycling of plastic, paper and glass.

Another group, based in Rehovot, has expanded from birdwatching to environment-watching. The group formed a non-profit organization, Guardians of the Environment, in 1990, and seeks to award the label "Green Star of David—Guardians of the Environment" to companies, factories, organizations and individuals whom it considers deserving of the award.

In the Arab sector, the Galilee Society is making new inroads into environmental activism. The Society, founded in 1982 to work on health-related issues in the Arab sector, has expanded its activities to environmental hygiene, including sewage disposal, clean drinking water, reduction of industrial emissions and environmentally-safe waste disposal and recycling. Its environmental work concentrates on advocacy, research and education, and it serves as the Ministry of the Environment's focal point for environmental education and for the recruitment of cleanliness trustees in the Arab sector.

Several new grassroots organizations were established in 1994. One of the most innovative is GreenAction, established in January 1994, as a grassroots organization seeking to raise environmental consciousness through non-violent civil disobedience. This young and dynamic direct action group, modeled on Greenpeace, aims to link committed individuals and groups across the country who are prepared to act together on environmental issues. GreenAction operates out of its head office in Tel Aviv, but is currently setting up new chapters in Jerusalem and in Haifa.

Another environmental NGO, set up in the spring of 1994, is working on the integration of Jewish and environmental values in education. The Abraham Joshua Heschel Center for Nature Studies seeks to develop short- and long-term curricula and educational programs utilizing a values-oriented approach to environmental studies, both in the formal and informal educational frameworks. Utilizing Jewish sources, it seeks to understand the interrelationship between natural landscapes and cultural

perspectives, to bring environmental issues to bear on Jewish education while bringing a Jewish perspective to nature studies.

Public Organizations and the Environment

A major indicator of the dramatic increase in environmental awareness in Israel has been the gradual incorporation of environmental issues into the agenda of Israel's veteran public service organizations. The Histadrut Federation of Labor in Israel, the country's largest trade union and volunteer organization, is now promoting environmental protection through its Consumer and Environmental Protection Authority and through its women's organization, Na'amat. The Authority has been active in the organization of Earth Day celebrations in Israel, in sponsoring environmental seminars and workshops for hundreds of its volunteers, in implementing environmental surveys, and in publishing information sheets on the environment. Na'amat, the working and volunteer women's movement of the Histadrut, has initiated its own environmental consciousness-raising campaign with the aid of its extensive network of volunteers, associated with 100 branches throughout the country.

The successful experience of the Histadrut in working with thousands of volunteers led to the establishment of a new volunteer body on the environment in 1989: the Forum of Organizations on Quality of Life and the Environment, within the framework of the Israel Volunteer Center. The forum, including more than 50 organizations, meets regularly to coordinate activities and priorities, but enables its individual members to deal with projects which are of special interest to them through their environmental protection committees.

Women's organizations have long stood at the vanguard of environmental activism in Israel, both individually and collectively. The Council of Women's Organizations in Israel has recently set up its own environmental committee, composed of WIZO, Na'amat, Emunah, Hadassah, Academic Women and B'nai B'rith Women. Each of these organizations will continue to play its own part in environmental improvement, but collectively the organizations hope to multiply their efficacy in instilling a new environmental ethic in Israeli citizens everywhere. The environmental committee has already prepared, and is currently implementing, an action plan including seminars and workshops to raise environmental consciousness and involvement.

These and other public organizations intend to turn their volunteers into Israel's environmental torchbearers, leading the way to a better quality of life and the environment for each and every Israeli.

Appendices

APPENDIX I

ENVIRONMENTAL LEGISLATION IN ISRAEL

General Provisions

★ Public Health Ordinance, 1940
Municipal Corporations Ordinance (New Version)
Local Councils Ordinance (New Version)
Civil Wrongs Ordinance (New Version)
Civil Wrongs (Liability of the State) Law, 1952
Association of Municipalities Law, 1955
Planning and Building Law, 1965
★ Licensing of Businesses Law, 1968
Land Law, 1969
Road Transport Ordinance (New Version), 1971
Penal Law, 1977
★ Abatement of Environmental Nuisances (Civil Action) Law, 1992

Air and Noise Pollution

★ Abatement of Nuisances Law, 1961
Operation of Vehicles (Engine and Fuel) Law, 1961
★ Tel Aviv Power Station Law, 1967
Restriction of Smoking in Public Places Law, 1984

Water Quality

Fisheries Ordinance, 1937
Water Drilling Control Law, 1955
Drainage and Flood Control Law, 1957
★ Water Law, 1959
★ Local Authorities (Sewerage) Law, 1962

★ Legislation for which the Ministry of the Environment is wholly or partly responsible.

Marine Pollution

Petroleum Law, 1952
Ports and Trains Authority Law, 1961
Ports Ordinance (New Version), 1971
★ Prevention of Sea-Water Pollution by Oil Ordinance (New Version), 1980
★ Prevention of Sea Pollution (Dumping of Waste) Law, 1983
★ Prevention of Sea Pollution from Land-Based Sources Law, 1988

Solid and Hazardous Waste

Public Health (Food) Ordinance, 1935
Radioactive Minerals Ordinance, 1947
Civil Defense Law, 1951
Plant Protection Law, 1956
Safety of Workers Law, 1970
★ Maintenance of Cleanliness Law, 1984
Animal Diseases Ordinance, 1985
★ Collection and Disposal of Waste for Recycling Law, 1993
★ Hazardous Substances Law, 1993

Protection of Flora, Fauna and the Natural Environment

Mining Ordinance, 1925
Forests Ordinance, 1926
Prevention of Field Fires Law, 1949
Plant Protection (Damage by Goats) Law, 1950
Protection of Wild Animals Law, 1955
Bathing Places Law, 1964
★ Streams and Springs Authorities Law, 1965
★ Roads (Affixing of Signs) Law, 1966
Antiquities Law, 1978
Building Refurbishment and Maintenance Law, 1981
★ National Parks, Nature Reserves, National Sites and Memorial Sites Law, 1992
★ Animal Welfare Law, 1994

★ Legislation for which the Ministry of the Environment is wholly or partly responsible.

APPENDIX II

INTERNATIONAL ENVIRONMENTAL CONVENTIONS AND AGREEMENTS RATIFIED BY ISRAEL

Agreement for the Establishment of a General Fisheries Council for the Mediterranean (as amended), Rome, 1949

Convention for the Establishment of the European and Mediterranean Plant Protection Organization (as amended), Paris, 1951

International Plant Protection Convention, Rome, 1951

International Convention for the Prevention of Pollution of the Sea by Oil, London, 1954

Convention on the Continental Shelf, Geneva, 1958

Convention on the High Seas, Geneva, 1958

International Convention for the Protection of New Varieties of Plants (as amended), 1961

Treaty Banning Nuclear Weapons Tests in the Atmosphere, in Outer Space and Under Water, Moscow, 1963

Treaty on Principles Governing Activities of States in the Exploration and Use of Outer Space including the Moon and other Celestial Bodies, 1967

Convention on the Conservation of the Living Resources of the Southeast Atlantic, Rome, 1969

Convention concerning Protection against Hazards of Poisoning Arising from Benzene, 1971

Convention on International Trade in Endangered Species of Wild Fauna and Flora, Washington, 1973

International Convention for the Prevention of Pollution from Ships, 1973/ 1978 and Protocol

Convention for the Protection of the Mediterranean Sea against Pollution, Barcelona, 1976

Protocol for the Prevention of Pollution of the Mediterranean Sea by Dumping from Ships and Aircraft, Barcelona, 1976

Protocol concerning Cooperation in Combatting Pollution of the Mediterranean Sea by Oil and other Harmful Substances in Cases of Emergency, Barcelona, 1976

Convention on the Conservation of Migratory Species of Wild Animals, Bonn, 1979

Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources, 1980

Protocol concerning Mediterranean Specially Protected Areas, Geneva, 1982

Vienna Convention for the Protection of the Ozone Layer, 1985

Montreal Protocol on Substances that Deplete the Ozone Layer, 1987

Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (London Amendment), 1990

Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal, Basel, 1989 (in the process of ratification)

APPENDIX III

ENVIRONMENTAL NGOs IN ISRAEL

Action Committee for the Prevention of Air Pollution
P.O.B. 6535, Haifa 31060

Association of Americans and Canadians in Israel
11 Pinsker Street, Jerusalem 92278

Alva - Industrial Association for Environmental Quality
Ormat Turbines Ltd.
P.O.B. 68, Yavne 70650

Alma - Association for Environmental Quality
70 Kaplan Street, Herzliya

B'nai B'rith
10 Kaplan Street, Tel Aviv 64734

Council for a Beautiful Israel
76-78 Bograshov Street, Tel Aviv 63429

EcoNet Israel
P.O.B. 581, Karkur 37105

Emunah - National Religious Women's Organization
166 Ibn Gvirol Street, Tel Aviv

Forum of Organizations on Quality of Life and the Environment
Israel Volunteer Center
P.O.B. 7341, Tel Aviv

Galilee Society for Health Research and Services
P.O.B. 330, Shefar'am 20200

GreenAction
Haim Levanon 88, Ramat Aviv, Tel Aviv

Guardians of the Environment
P.O.B. 1488, Rehovot 76110

Hadassah Israel
24 Strauss Street, Jerusalem

Heschel Center for Nature Studies
Bar Giora 9/6, Tel Aviv 64336

Histadrut Consumer and Environmental Protection Authority
93 Arlozoroff Street, Tel Aviv 62098

Israel Chapter of the International Council on Monuments and Sites (ICOMOS)
Bezalel Academy of Arts and Design
P.O.B. 24046, Jerusalem 91240

Israel Society for Ecology and Environmental Quality Sciences
Department of Life Sciences
Tel Aviv University, Ramat Aviv 69978

Israel Economic Forum on the Environment
P.O.B. 33036, Tel Aviv 61330

Israel Recycling Forum
Society for the Protection of Nature in Israel
4 Hashfela Street, Tel Aviv 66183

Israel Landscape Gardeners Association
1 Maklef Street, Hakirya, Tel Aviv

Israel Union for Environmental Defense
317 Hayarkon Street, Tel Aviv 63504

Jewish National Fund (JNF)
P.O.B. 283, Jerusalem 91002

Life and Environment
P.O.B. 20040, Tel Aviv 61200

Na'amat
Histadrut Working Committee
93 Arlosoroff Street, Tel Aviv 62098

Organization for Better Housing
3 Lincoln Street, Tel Aviv

Public Council for the Prevention of Noise and Pollution in Israel (MALRAZ)
Tchernichowsky 30, Tel Aviv 61230

Public Council for the Preservation of Monuments and Buildings
Mikve Israel 58910

Rotary International
P.O.B. 2742, Holon 58127

Society for the Protection of Nature in Israel
4 Hashfela Street, Tel Aviv 66183

WIZO
38 David Hamelech Street, Tel Aviv 64237