



Desk Study
on the
Environment
in the
Occupied Palestinian
Territories

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Foreword

The Seventh Special Session of the Governing Council/Global Ministerial Environment Forum in Cartagena, Colombia, 13-15 February 2002 adopted unanimously a decision concerning the environmental situation in the Occupied Palestinian Territories (GCSS.VII/7).

The Governing Council requested the United Nations Environment Programme (UNEP) to carry out a desk study as a first step in the implementation of this decision outlining the state of the environment in the Occupied Palestinian Territories and to identify major areas of environmental damage requiring urgent attention.

Over 120 countries and 90 ministers participated in this important Governing Council, including observers from the Palestinian Authority and the Government of Israel. The unanimous decision of the Council was motivated by the alarming reports related to the pollution of water, dumping of wastes, loss of natural vegetation and pollution of coastal waters in the region.

I gave the implementation of this decision high priority, and one month later, during the preparatory ministerial segment of the Arab League's 14th session at the summit level in Beirut in March, 2002, I presented the decision in my address to the ministers of finance and economy, and invited all the member states of the Arab League to cooperate with UNEP in working towards achieving a scientifically solid desk study with a forward-looking approach.

In July, I undertook an official visit to the region, hosted by Dr. Yousef Abu Safieh, Minister of the Palestinian Higher Agency for the Environment, and Mr. Tzachi Hanegbi, Minister of Environment of the State of Israel. I also had the honour of meeting with His Excellency Yasser Arafat, President of the Palestinian Authority and Chairman of the Executive Committee of the Palestinian Liberation Organization, and His Excellency Ariel Sharon, Prime Minister of the Government of Israel, both of whom gave their backing to this important endeavour.

During my visit, I agreed with both Israel and the Palestinian Authority on the framework for the desk study. Both sides indicated their willingness to cooperate with UNEP, and underscored that urgent attention and action were required to address environmental needs in the region.

Following my visit I invited Mr. Pekka Haavisto, former Finnish Minister of Environment and Development Cooperation, to act as Chairman of the Desk Study team that was to carry out this assessment. The Post-Conflict Assessment Unit in the Division of Environmental Policy Implementation was the unit within UNEP in charge of this assignment.

The Desk Study team comprising of eight highly qualified and impartial environmental experts was formed during the early autumn and it visited the region between 1 and 11 October. The experts covered the following areas identified as the most vital for the environment in the region: water quality and quantity; solid waste; waste water; hazardous waste; biodiversity; land use and land use change; and environmental administration.

Despite the fact that the mandate for the Desk Study is the Occupied Palestinian Territories, as defined by the United Nations, UNEP has emphasized that the study should have a positive environmental outcome for the whole region. We have therefore sought to make clear recommendations on how to improve the environment in such a fashion that it will be beneficial not only to the Occupied Palestinian Territories, but to the region as a whole.

Following my visit to the Occupied Palestinian Territories and Israel in July 2002, I left with a feeling of compassion and deep sympathy for the plight and suffering of the Palestinians and the sense of insecurity felt by the Israelis. This report must be viewed in the context of the current very grave situation in the whole region. The deepening crisis and the human suffering in the region cannot be neglected and the international community should do its utmost to assist those who are affected. The peaceful end of the occupation and cessation of all violence must be the ultimate objective. Environmental cooperation can be a tool in the peace process.

Environmental degradation will slowly but surely worsen the conditions and threaten the future of people who are already daily experiencing extremely difficult circumstances. This desk study not only presents scientific findings, but also gives clear recommendations on how problems can be addressed.

In other conflict-related situations, UNEP has, at the request of those concerned, undertaken environmental assessments that have paved the way for remedial action. In addition, UNEP seeks to keep environmental priorities on the agenda throughout a reconstruction phase, to support longer-term sustainable goals for managing natural resources and to address environmental management practices. I believe that the expertise gained by UNEP in other conflict-stricken parts of the world could also help in the Middle East.

Furthermore, I express my gratitude to all my UN colleagues – including those at UNSCO, UNRWA, UNDP, OCHA and ESCWA – for their assistance and advice during this challenging task. I would also like to thank the governments and institutions, whose generous financial contribution has enabled us to prepare this report at fairly short notice. My thanks go to the Desk Study team that visited the region, who met more than 120 experts during their visit, and contributed to this report. Last but not least, I express my gratitude to Pekka Haavisto, the Chairman of the Desk Study, for his outstanding contribution to this report.

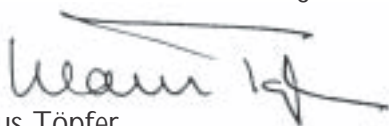
This report identifies critical environmental issues that, despite the current political difficulties, should be addressed urgently in order to preserve natural resources and establish a safe environment for future generations.

I am fully aware that this Desk Study, with its conclusions and recommendations, is published at a time when intensive political discussion is underway to resolve the very challenging problems in the region. It is my sincere hope that this report could contribute to the peace talks, and that cooperation on environment could serve as a confidence-building tool between the parties.

The Desk Study has been carried out in close cooperation with the parties involved, and has focussed on scientific and technical issues. I therefore present this document to the 22nd Governing Council of UNEP as requested by the Governing Council/Global Ministerial Environment Forum in Cartagena.

I sincerely hope that this document can facilitate future negotiations and action related to environmental protection, and thus the full implementation of the Cartagena Governing Council decision

It is evident that UNEP is ready to take further steps to assist the parties in their efforts to improve the environmental situation in the Occupied Palestinian Territories. UNEP stands ready to also act as an impartial moderator, if requested by both parties, to assist in solving urgent environmental concerns where there is a clear incentive for both sides to work together to achieve common goals and to facilitate future cooperation.



Klaus Töpfer
United Nations Under-Secretary General
Executive Director of the United Nations Environment Programme

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Introduction

The Middle East is a meeting point of many escalating environmental threats. This is particularly the case in the Occupied Palestinian Territories. Long-term environmental degradation has occurred over the decades spanning several conflicts. In an already densely populated area, there are additional problems of scarcity of water resources and land, rapid population growth, long-lasting refugee situation, climate change, desertification and land degradation.

The years of conflict have presented huge challenges to the Palestinians efforts to manage in a sound manner the environment and natural resources. To obtain a comprehensive picture of the alarming environmental situation in the Occupied Palestinian Territories, long-term environmental challenges were addressed in this Desk Study, in parallel with the additional environmental risks and damage created by the on-going conflict.

The aim of this desk study was to outline the state of the environment and identify major areas of environmental damage requiring urgent attention. It was based on a review of available, relevant studies and interviews with officials and experts. It lists priorities and proposes recommendations to solve environmental problems. The Desk Study addresses environmental issues identified as the most vital for the environment in the region

The geographical scope of the Occupied Palestinian Territories is addressed in several resolutions of the United Nations General Assembly and the Security Council. The main emphasis of this UNEP Desk Study has been on the areas where there are acute environmental problems.

Following the visit of the Executive Director, Dr. Klaus Töpfer, to the region in July 2002, a preparatory UNEP expert mission to Occupied Palestinian Territories and Israel took place from 15-22 August 2002. Immediately after the mission, on 23 August 2002, UNEP convened a one-day advisory meeting on the desk study in Geneva, to exchange information and collect views on the topic.

The Desk Study team visited the Occupied Palestinian Territories and Israel between 1 and 11 October 2002. Meetings took place with officials from the Palestinian Authority, including His Excellency Yasser Arafat, President of the Palestinian Authority, and from the Government of Israel, as well as with representatives from United Nations organizations, NGOs, municipalities and academic institutions. The mission aimed at obtaining additional relevant studies, and undertaking technical discussions and interviews with officials and experts. In addition, site visits relevant to the Desk Study were organized.

The eight-member Desk Study team included in-house experts, as well as experts contracted from UNEP's collaborating centres and other international environmental institutes. The experts covered the following topics: water quantity, water/soil quality; wastewater; solid waste, hazardous waste; environmental administration; land use and biodiversity. In addition, other UNEP specialists contributed to the analysis of satellite images and cartography work in the report. Important background information has been included in the Annexes, which are an integral part of the report.

By sometimes splitting up into five different groups, the team was able to visit many sites, ranging from solid waste dumps and wastewater treatment plants, to rangeland rehabilitation projects and sites where there has damage to environmental infrastructure caused by the conflict. The team stayed in Jerusalem (Al Quds) and in Gaza, and was also able to visit

► West Bank and Gaza



Bethlehem, the Emek Hefer area, Halhoul, Hebron (Al Khalil) and surroundings, Jenin, Ramallah, and Tel Aviv.

Several challenges were encountered in preparing this Desk Study. Firstly, the time factor. Due to the deteriorating situation in the region during the spring of year 2002, work could only begin in earnest 5 months ago. Secondly, the quantity and quality of the printed material and studies made available for this Desk Study. Even if over 500 printed documents were reviewed, the Desk Study team learned that in some cases precise environmental data is still lacking or was not available for UNEP. Therefore where relevant information was not available or if the information received from the two parties was contradictory, with the objective of proposing remedial measures to improve the environmental situation, the desk study recommends that field studies be conducted, as referred to in the Governing Council decision.

Thirdly, the very tense atmosphere prevailing in the region had repercussions on all activities in society. In the region, there are political and other sensitivities associated with certain topics and language. Even in the context of a scientific environmental report, some expressions are interpreted in a political rather than in a technical way.

Important political issues are still pending the outcome of the permanent status negotiations. The Oslo I Accord, or the Declaration of Principles on Interim Self-Government Arrangements, dated 13 September 1993, states in Article V.3. "It is understood that these negotiations shall cover remaining issues, including: Jerusalem, refugees, settlements, security arrangements, borders, relations and cooperation with other neighbours, and other issues of common interest." No statement in this report should be construed as a position by UNEP on, or prejudicing, any issue that is subject to these permanent status negotiations.

There are already some examples of bilateral and regional cooperation in which Israel is involved. The Desk Study found that broadening and strengthening this type of cooperation could help to protect the environment.

It goes without saying that UNEP recommends intensified participation of the Palestinian Authority not only in all regional environmental cooperation, but also in all relevant Multi-national Environmental Agreements (MEAs). The international community should do its utmost to give the Palestinian Authority full access to these processes. A first step would be to remove all administrative obstacles, thus ensuring the successful participation of Palestinians in these meetings.

This Desk Study raises serious concerns on both the degradation of water quality in many areas, as well as the issue of unsustainable over-pumping of water from aquifers. In environmental terms, there are many inter-linkages between water quality and water quantity. According to the Oslo II Accord, issues related to water rights will be negotiated in the permanent status negotiations. Any statements on the water issues in this Desk Study should not be seen as taking any position on these permanent status negotiations.

On the one hand, there are problems directly linked to the conflict, and on the other hand, there is environmental deterioration that has occurred over the longer-term. The conflict-related issues include land clearing, obstacles such as curfews and closures to the transport of waste, difficulties in obtaining spare parts for environmental facilities and collateral damage to environmental infrastructure caused by military action. The longer-term environmental degradation is evident in the pollution of groundwater resources, the lack of proper waste management, shortcomings in environmental administration and legislation. These two types of environmental degradation were found in all previous post-conflict environmental assessments carried out by UNEP.

► Cities and areas visited by UNEP



Shortly after the outbreak of the second intifada in September 2000, a joint declaration was issued by the Palestinian and Israeli authorities for keeping the water infrastructure out of the cycle of violence. This Desk Study has found cause for alarm in relation to the quality of the drinking water and quantity extracted, as well as the contamination of the aquifers from wastewater, landfills and hazardous waste. On the basis of this, the study fully supports the efforts to keep water and environmental issues out of the conflict, and to preserve these resources for present and future generations.

To do so, increased level of co-operation between the parties is needed. The model of the Israeli-Palestinian Joint Water Committee (JWC), which continued to meet throughout the conflict, should be extended to other joint environmental bodies.

Nevertheless, many long-term environmental solutions cannot become reality without a peace process for the region. In that process the environment could be seen as a bridge-

building element, building the confidence between the two parties seeking a new ground for cooperation. This study points out many reasons why the environment should be among the first issues to be dealt with by the conflicting parties.

This Desk Study could not have been prepared without the full cooperation and support both from the Palestinian Authority and the Government of Israel, who have shared their information and provided their comments to the first draft of the study. However, all the conclusions and recommendations are made by UNEP, based on the work of the UNEP Desk Study team. The study was prepared in response to the request by the Governing Council to the Executive Director in Cartagena to prepare a desk study outlining the state of environment in the Occupied Palestinian Territories and to identify major areas of environmental damage requiring urgent attention.

All UN organizations in the region, including United Nations Development Programme (UNDP), United Nations Relief and Work Agency (UNRWA), the Office of the United Nations Special Coordinator for the Middle East Peace Process (UNSCO), the Office for Coordination of Humanitarian Assistance (OCHA), the Economic and Social Commission for Western Asia (ESCWA) and the Office of the High Commissioner for Human Rights (OHCHR) have been fully supportive during this study. Embassies and government offices from several countries have been sharing with UNEP their project documents and experiences from the region. Non-governmental organizations, Palestinian, Israeli and international alike, have also shared their materials and recommendations. Representatives of municipalities and academic institutions provided very useful inputs.

The spirit and the enthusiasm among all experts, scientists and environmental activists of the region towards our work and environmental challenges in general, lead me to believe that environmental cooperation could play a key role in the process towards a lasting peace.



Pekka Haavisto
Chairman
UNEP Desk Study on the Environment in the Occupied Palestinian Territories

Geneva, 20 January 2003



STUART CHAPE

View of countryside outside Hebron

3

Background

3.1 Geography

The Occupied Palestinian Territories are made up of two geographical regions, Gaza and the West Bank, which are separated by the State of Israel. Neighbouring countries include Jordan and Egypt.

The West Bank has a varied topography consisting of central highlands, where most of the population lives, and semi-arid rocky slopes, an arid rift valley and rich plains in the north and west.



SUSAN BRANNON

Roadside scene in Hebron

The West Bank is mostly composed of limestone hills that are between 700 to 900 metres high. The lowest point of the area is the Dead Sea at 410 metres below sea level, and the highest the Tall Asur at 1,022 metres above sea level. Brown lithosols and loessial arid brown soils cover the eastern slopes and grassland, with pockets of cultivation spreading over the steep slopes. Fertile soils are found in the plains. Soil cover is generally thin and rainfall is erratic. In all, about 12 percent of the land is desert, eroded or saline.



STUART CHAPE

Mediterranean geographic zone

► West Bank and Gaza



Gaza is a narrow, low-lying stretch of sand dunes along the eastern Mediterranean Sea. It forms a foreshore plain that slopes gently up to an elevation of 90 metres. The sea is warm and saline and is affected by water outflow from the Nile River.

3.2 Vegetation

The Occupied Palestinian Territories can be divided into five main ecological sub-regions: the Mediterranean shoreline coastal plain, the upper coastal plain, the central highlands, the semi-arid eastern slope steppes and the arid semi-tropical Jordan valley

The dry southern West Bank, eastern slopes and central Jordan valley are composed of Mediterranean savanna grading into land dominated by steppe brush and spiny dwarf shrubs. The southern Jordan valley around Jericho and the Dead Sea is also influenced via the Wadi Araba by Sudanian vegetation.

On the Gaza coastal plain the original Saharo-Sindian flora has been almost completely replaced by farmland and buildings. Gaza includes six main vegetation zones: the coastal littoral zone, the stabilized dunes and blown-out dune valleys, the Kurkar, alluvial and grumosolic soils in the northern part, the loessial plains in the eastern part, and three wadi (river) areas.

3.3 Climate

The climate in the Mediterranean region has four months of hot dry summer and a short winter with rain from November to March.

The climate in the West Bank can be characterized as hot and dry during the summer and cool and wet in winter. The central highlands have occasional frost, snow and hail. The Jordan valley is warm and very dry in the south, while the climate in Gaza, by the sea, is more temperate even though it borders the desert. The mean summer temperatures range from 30°C at Jericho through 25°C at Gaza to 22°C at Hebron which is 850 metres above sea level, the mean ranges in winter from 13°C at Jericho and Gaza to 7°C at Hebron. The average annual precipitation is 450 - 500 mm, decreasing from north to south and from high to low altitude. Rain tends to fall in intense storms. The northern Gaza Strip receives 400 mm, the south 200 mm per year, and the Dead Sea less than 100 mm. The annual average relative humidity is about 72 percent at Gaza and 52 percent at Jericho. Evaporation is high in summer when there is always a water deficit. Winds prevail from the northwest but come from the southwest in winter. Land and sea breezes occur, and in late spring the hot dry *khamsin* blows from the desert in the south.

3.4 Water resources

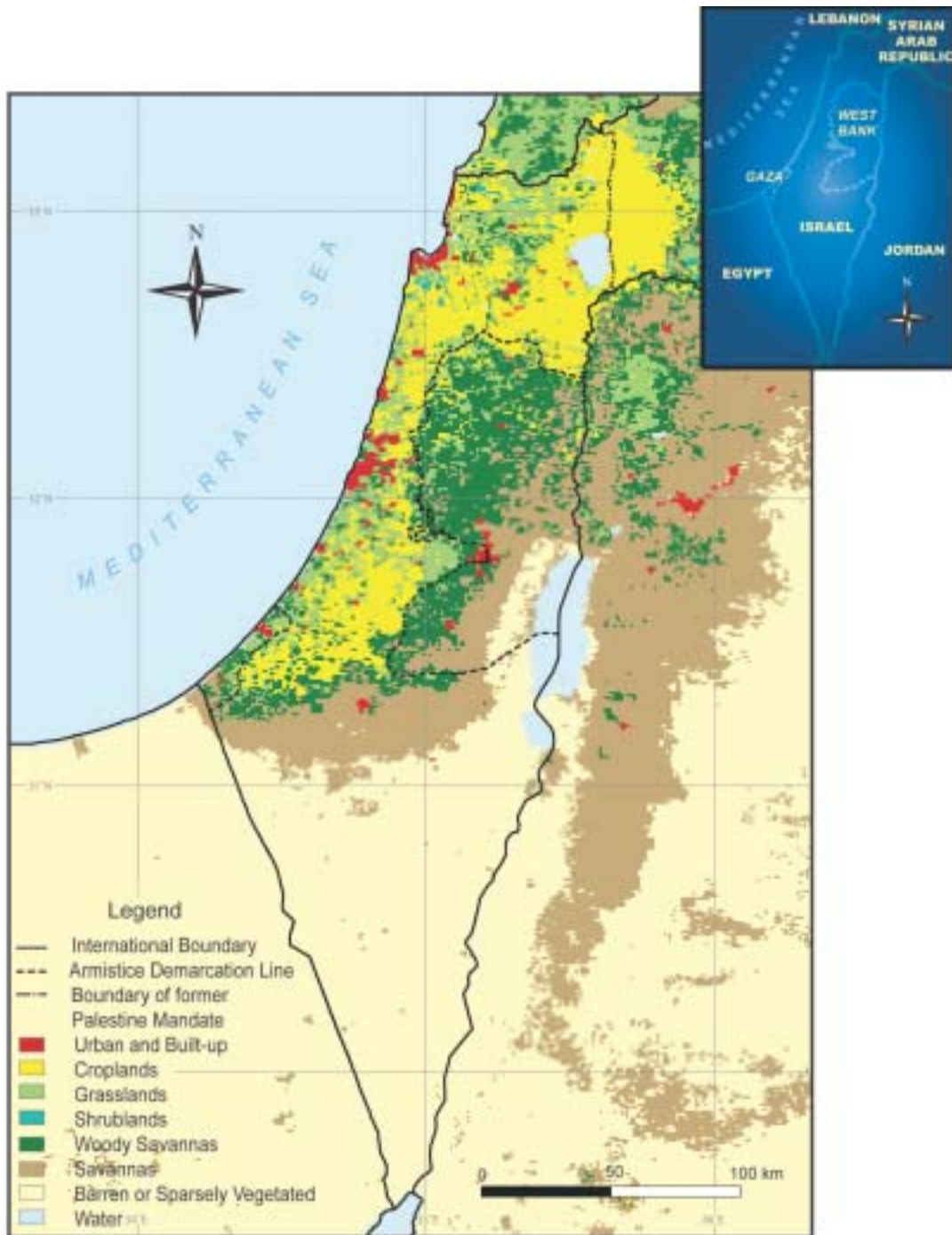
The principal water resources available to Palestinians include groundwater, springs and harvested rainwater. The River Jordan, which is used by Jordanians and Israelis, is not a water resource for the Palestinians in the West Bank. According to the Israeli-Palestinian Interim Agreement on the West Bank and the Gaza Strip, Appendix 1, Article 40, Principle 1, "Israel recognizes the Palestinian water rights in the West Bank. These will be negotiated in the permanent status negotiations and settled in the Permanent Status Agreement relating to the various water sources."



Oak (*Quercus* sp.) is a dominant species in the Mediterranean plant region

STUART CHAPE

► Land cover





SUSAN BRANNON

The Wadi Gaza

The Occupied Palestinian Territories lie over two main aquifers, the Mountain Aquifer and the Coastal Aquifer, which are shared with Israel. The Mountain Aquifer is divided into the Western Aquifer, the Northern Aquifer, and the Eastern Aquifer. The Eastern Aquifer and part of the Northern Aquifer flow east towards the Jordan River. The Western Aquifer, part of the Northern Aquifer and the Coastal Aquifer all flow westerly towards the Mediterranean Sea.

In a regional context, the Jordan River is about 260 km long and drains a total area of 18,300 km². The river's largest tributaries in the north are the Dan (rising in Israel with an annual average flow of about 260 million m³ per year), the Hasbani (rising in Lebanon with a discharge of about 160 million m³ per year), and the Baniyas (rising in the Syrian Arab Republic, with discharge of about 160 million m³ per year). These rivers, which are fed by steady spring discharges, provide the main inflows to Lake Tiberias (Kinneret).

The river system that composes the Jordan River basin is composed of four tributaries: the Baniyas, the Hasbani, the Dan and the Yarmouk. The Baniyas, Hasbani and Dan meet in the northern Israel to form the Upper Jordan River that flows into Lake Tiberias (Kinneret) and the Yarmouk River flows in a southwesterly direction into the Lower Jordan forming the border between Jordan and Syria, the Jordan and Israel (see Lowi, M. R.). The Yarmouk River has a higher flow during the winter periods which is used to dilute the increasing salinity of the river Jordan (Lonergan, S., and D.B. Brooks, 1994)

Although the combined water outflow from the Yarmouk River, Lake Tiberias (Kinneret) and other rivers previously added up to a total of 1.25 billion m³ (500 million m³ each from the Yarmouk River and the Lake Tiberias (Kinneret), and 250 million m³ from smaller rivers), today the outflow is greatly reduced due to impoundment from these major sources. It has been reported that in the future flow reduction could reach 200 million m³. (State of Israel, 1992)

Water allocation from the Jordan River has been the subject of lengthy negotiations over the course of decades. Israel takes about 500 million m³ per year from Lake Tiberias (Kinneret) into its National Water Carrier, while Israel, Jordan and the Syrian Arab Republic between them take almost the entire flow of the Yarmouk. This leaves only about 250 million m³ per year to flow to the Dead Sea. The water level of the Dead Sea has been dropping dramatically since 1970, at a rate of 80 cm to 1 m per year, attributed to upstream water diversion and the mineral extraction industry on its shores (IMoE, 2002e).

The salinity of this water is high, due to the presence of saline springs and to returns of irrigation water.

3.5 Governorates

The Occupied Palestinian Territories are divided into sixteen Governorates. Eleven of these are located in the West Bank, and five are located in Gaza. The Governorates are sub-divided into 105 municipalities of which 89 are in the West Bank and 16 in Gaza. In addition, local councils have been formed to manage all infrastructure and basic services.

The Oslo Accords divide the West Bank and Gaza into three types of areas, A, B and C. Areas A are under Palestinian control, areas B are under joint Palestinian and Israeli control, and areas C are under Israeli control.

3.6 Population

Approximately 3 million Palestinians live in the Occupied Palestinian Territories, of whom over 1 million are in Gaza (PCBS, 1997). Forty percent of Palestinians living in the Occupied Palestinian Territories are refugees from 1948, and 4 million Palestinians are refugees in the neighbouring Arab countries. Approximately 65 % of the population live in urban areas (UNFPA, 2001). Annual population growth in the Occupied Palestinian Territories is estimated at 4.8% (UNDP, 2002).

In 1970, the Israeli settler population living in the West Bank and Gaza was 1,514. It rose to 12,424 in 1980, and ten years later it was 76,000. It nearly doubled over the next five years to reach 146,207 people, and in 2000 it was 203, 067 (Jewish Virtual Library, 2002).

3.7 Economic situation

The outbreak of the second intifada in September 2000 and the subsequent worsening of the crisis has had devastating effects on the economy in the Occupied Palestinian Territories. After several years of relative economic prosperity, real GDP growth in the West Bank and Gaza dropped from plus 6% per annum in 1999, to a 6.5% shrinkage in 2000 and a 12.5% shrinkage in 2001. Unemployment reached over 40% in early 2002.

There are a variety of causes for this. The slowdown of the Israel economy has had a direct impact on Palestinian economic indicators, owing to very close inter-linkages. Substantial numbers of Palestinians were employed in Israeli industry, service and agriculture, but whose employment was terminated as the crisis deepened. The withdrawal of Palestinian workers from Israel has negatively impacted both sides. Tourism revenues have also plummeted on both sides.

The main cause of economic decline in the Occupied Palestinian Territories has, however, been the policy of curfews and closure instituted by Israel in the face of the deteriorating situation. There have been varying degrees of closure in different Palestinian areas at different times. Closures limit the movement of people and vehicles, as well as any goods and

services requiring movement. Closures are implemented through checkpoints and roadblocks and can vary from a total restriction on all movement to a limited use of only secondary and tertiary roads. Curfews mean that people must remain inside their houses at all times.

Direct impacts from these restrictions include a decline in income for workers unable to go to their workplaces, the restricted access to markets for businesses and producers, and the rising cost of imports. This decline has recently brought all economic activities to a near standstill (ILO, 2002).

3.8 Environment in the peace process

■ Oslo Accords I (1993) and II (1995)

The Oslo I Accord, formally entitled 'Declaration of Principles on Interim Self-Government Arrangement of 1993 between Israelis and Palestinians', includes annexes that outline cooperation in economic and development programmes (Annex III) and regional development programmes (Annex IV). These contain provisions that are of relevance to the environment. In Annex III, the parties agree to establish an Israel-Palestinian Committee on Economic Cooperation focusing, among other matters, on environmental issues such as water, energy and industry. The parties also agreed to develop an environmental protection plan, providing for joint and/or coordinated measures.

The Oslo II Accord, formally entitled 'Interim Agreement on the West Bank and the Gaza Strip of 1995', created three territorial zones in The West Bank: area A where the Palestinian Authority has responsibility for public order and internal security; area B where the Palestinian Authority assumes responsibility for public order for Palestinians, while Israel controls internal security; and area C, where Israel maintains exclusive control. In addition, Israel also maintains exclusive control over borders, external security, Jerusalem and settlements. Under Article 12 of Annex I to the Accord, which deals specifically with environmental protection, the Israelis transferred powers and responsibilities to the Palestinian side to undertake limited environmental management activities in the West Bank and Gaza Strip. Furthermore, Israelis and Palestinians agreed to cooperate, on the basis of mutual understanding and shared responsibility, in virtually all areas of environmental protection. For example, the parties agreed, pursuant to their environmental and developmental policies, to:

- prevent damage to the environment and take measures to ensure that activities in areas controlled or managed by one party do not cause environmental damage to areas controlled or managed by the other party;
- adopt, apply and comply with internationally recognized environmental standards concerning emissions and effluents;
- prevent uncontrolled discharge of wastewater and effluents to water bodies and promote proper treatment of wastewater, solid and hazardous wastes;
- ensure that a comprehensive environmental impact assessment (EIA) is conducted for all major development programmes specified in the Accord;
- take precautions to prevent water and soil pollution as well as other environmental safety hazards;
- take measures to prevent noise, dust and other nuisances from quarries;

- cooperate in the implementation of internationally accepted principles and standards of global environmental concern, such as protection of the ozone layer, endangered species of fauna and flora, conservation of migratory species, and preservation of existing forests and natural resources;
- develop jointly a mechanism for mutual notification and coordination to respond to events or accidents likely to generate environmental pollution, damage or hazards; and
- cooperate to promote public awareness of environmental issues, to combat desertification, to carry out environmental studies, and to control transfer of pesticides.

To ensure effective collaboration on the environmental issues identified, the parties established a Joint Environmental Experts Committee (JEEC). Furthermore, under Annex VI to the Oslo II Accord ('Protocol concerning Israeli – Palestinian Co-operative Programmes') the parties agreed to additional cooperation on economically and environmentally sustainable development. In addition to the JEEC, various other environment-related collaborative committees were established, e.g. the Joint Water Committee.

These committees met and cooperated well until the outbreak of the second intifada in September 2000. Most formal environmental cooperation has effectively been suspended since that time, although the Joint Water Committee continues to meet.



STUART CHAPE

View from the top of Shyukh Municipal Centre

Freshwater

4.1 Water policy, legislation and regulation

■ Background

Successive administrative and legal regimes have had major impacts on the development and management of water resources. Originally, water administration and regulations in the Occupied Palestinian Territories were based on Islamic legal principles.

The basic principles of traditional Islamic water law stipulate that water is available to all and that its sale is prohibited. Islamic water law regulates the right to use water for human and animal consumption and for irrigation and established a concept of protected areas. During the period of Ottoman rule, several areas of Islamic law were codified, including on the legal status water, right to water use, water for irrigation and protected areas. However, little legislation was developed on organization and administration of water resources.

During the British mandate in the 1930s, several relevant laws and regulations were introduced, but most of them merely adjusted existing laws or were formulated along principles established under customary law. Between 1952 and 1967 Jordanian laws were reflected in the West Bank, and laws based on the British system applied in Gaza, although Gaza was under Egyptian administration. Further information on these issues may be found in Issa & Bruijne, 1995.

Israeli Military Order No. 2 of 7 June 1967 stated that all water resources in the newly occupied Palestinian Territories were to be state owned by Israel. Three subsequent military orders in 1967 and 1968 granted full control to the military authority, designated an Officer to be appointed by the Israeli Military Commander for implementation of the orders, established a permit system for the drilling of new wells, fixed pumping quotas, and declared all prior settlements of water disputes to be invalid. The Israeli water companies Mekorot and Tahal were given an important role in planning, implementing and operating water projects in the territories under occupation, to the degree that Mekorot was and still is drilling wells in the territories to sell water to Palestinians. With a few exceptions, Palestinian institutions were only responsible for the delivery of water and the disposal of sewage.

The Oslo II Accord states that: "Israel recognizes the Palestinian water rights in the West Bank. These will be negotiated in the permanent status negotiations and settled in the Permanent Status Agreement relating to the various water sources ... The Israeli side shall transfer to the Palestinian side, and the Palestinian side shall assume, powers and responsibilities in the sphere of water and sewage in the West Bank related solely to Palestinians, that are currently held by the military government and its Civil Administration, except for the issues that will be negotiated in the permanent status negotiations, in accordance with the provisions of this Article."

As the Permanent Status Negotiation has not been negotiated, these responsibilities have not been defined, and therefore are not transferred.

Under the Oslo II Accords, both sides agreed to coordinate the management of water and sewage resources and systems in the West Bank in the interim period in accordance with a set of principles. Under the Oslo Accords, an allocation of water resources was agreed on for the interim period, without prejudice to the Palestinian water rights under the permanent status negotiations. A Joint Water Committee (JWC) for the interim period was also



STUART CHAPE

The Wadi Gaza

established to implement the agreements on water and sewage, which is the only environment-related body that has continued on an irregular basis to meet during the present crisis. According to information provided by the Israeli Government of a meeting of the JWC in December 2002, progress was made on several issues, including an agreement to meet on a more regular basis. This information has not been confirmed by the Palestinian Authority.

On 26 April 1995, the Palestinian Authority established the Palestinian Water Authority (PWA). The PWA derives its authority from By-Law No. 2 of 1996 and Law No. 3 of 2002,

according to which PWA is the official body that regulates, and is responsible for, overall water resources in the West Bank and Gaza.

The PWA has developed the first National Water Plan (PWA, 2000), which has been approved by all involved stakeholders (ministries, authorities, water utilities, municipalities, etc.). It has not been presented to the National Water Council, as no meeting of this body has yet taken place. The National Water Council, however, established by Water Law No. 3, consists of representatives of the most important water-sector stakeholders. It is envisaged that the National Water Plan will be updated at the end of each year taking into consideration all technical, economic, environmental and social aspects. However, due to the prevailing circumstances, no update of the 2000 draft has been undertaken.

■ Policy

The stated vision, goals, policy and strategic principles for the management of the Palestinian water sector, as set out the National Water Plan of the Palestinian Water Authority (PWA, 2000) is as follow:

Vision

Ensure equitable use, sustainable management and development of Palestinian water resources.

Goals

- (i) Optimally manage, protect and conserve existing water resources and enhance new resources to meet present and future demands, and
- (ii) Guarantee the right of access to water of a good quality for both the present population and future generations at costs they can afford.

Policy

- (i) Pursue Palestinian interests in connection with obtaining riparian rights to water resources shared with other countries;
- (ii) All sources of water are public property;
- (iii) Water has a unique value for human survival and health and all citizens have the right to water of good quality for personal consumption at costs they can afford;
- (iv) Water has social, environmental and economic values;
- (v) Water supply must be based on sustainable development of all available and feasible water resources;
- (vi) Industrial and agricultural development and investment must be compatible and optimally integrated with the available resources and based on sustainable development;
- (vii) The development of Palestinian water resources must be co-ordinated at national level and carried out at the appropriate local level;
- (viii) Management of the national water sector should be carried out by one responsible body, with the institutional responsibility for policy and regulatory functions separated from the service delivery functions;

- (ix) Water management at all levels should integrate water quality and quantity;
- (x) Water supply and wastewater management should be integrated at all administrative levels;
- (xi) The optimal development of water supply must be complemented by a consistent water demand management;
- (xii) Conservation and optimal utilisation of water resources should be promoted and enhanced;
- (xiii) Protection and pollution control of water resources should be ensured. The polluter pays principle will be applied in order to guarantee environmental protection;
- (xiv) The government will cooperate with regional and extra-regional parties on programmes and projects in order to promote the optimum utilisation of water resources, to identify and develop new and additional supplies and to collect and share relevant information and data; and
- (xv) Public participation in the water sector should be ensured.

■ Key strategic principles.

- (i) Secure Palestinian water rights;
- (ii) Strengthen national policies and regulations;
- (iii) Build institutional capacity and develop human resources;
- (iv) Improve information services and assessment of water resources;
- (v) Regulate and co-ordinate integrated water and wastewater investments and operations;
- (vi) Enforce water pollution control and protection of water resources;
- (vii) Build public awareness and participation; and
- (viii) Promote regional & international co-operation.

■ Legislation

Legislation for the regulation and management of the water sector is encompassed in the recently approved Water Law No. 3, signed by His Excellency Yasser Arafat, President of the Palestinian Authority, on 17 July 2002. The Water Law includes the above-mentioned vision, goals, policy and strategic principles for the management of the Palestinian water sector and will function in parallel with other relevant legislation, particularly within the sectors of environment, agriculture and health.

The objectives of Water Law No. 3 are to:

- Secure sustainable development of water resources based on environmentally sound and enabling bases;
- Provide and satisfy societal and individual needs for water in an optimal and equitable way;

- Protect all water resources from pollution and secure water quality, an environment not harmful to human health or well-being, and sufficient water for production and self-renewal.

4.2 Institutional framework

■ Organisation of the water sector

The recently proposed organisation of the Palestinian water sector (PWA, 2000) envisages clear separation between regulatory and delivery functions and emphasises that PWA is the key regulator and guardian of Palestinian water resources. A number of other stakeholders (e.g. ministries, authorities, water utilities, water user associations, municipalities and universities) also play important roles in the functioning of the sector.

According to Water Law No. 3, the National Water Council, consisting of representations from the most important water-sector stakeholders, is, among other matters, responsible for:

- Approving the General National Water Policy and submitting it to the Palestinian Authority Cabinet for approval and ratification.
- Ratifying the National Policy for work on developing and exploiting the water resources.
- Ensuring that the PWA implements the National Policy for water resources.
- Approving the tariff structure, pricing system and privileges suggested by the PWA.

■ Role of the Palestinian Water Authority

The PWA was established by Decree 90/1995 and its powers and authorities according to Water Law No. 3 include the following:

- To allocate water for beneficial uses.
- To issue licences and permits for the uses of water resources.
- To charge set fees for issuance of licences and permits as specified in the Water Law and regulations.
- To assure optimal utilisation of water resources for public use.

■ Regulatory framework

Water Law No. 3, in summary, can be divided into three main categories of regulations: environmental, water quality and economic. Each category has its own objectives and functions.

When set up, the environmental regulations will cover the entire field of control for both water abstraction and discharge, including licensing of water abstraction for all demand sectors as well as issuing of licenses related to disposal and/or reuse of wastewater.

PWA is responsible for imposing a set of regulations on the service providers, which should satisfy the requirements of the various stakeholders (including the Ministry of Health) in regard to the quality of drinking water and water for other purposes.

The economic regulations aim at reviewing water prices of water to ensure they meet interests of the customer while ensuring that all cost-related activities are performed efficiently. They should also allow for incentives to reward service providers for managing available capital efficiently.

Drafting and enacting regulations for the water sector are both relatively straightforward when compared with the challenges of enforcement. The PWA is to establish simple and clear institutional arrangements to create conditions favouring the smooth functioning and enforcement of regulations.

■ Service providers

Under the Water Law, a “Bulk Water Utility” is to be established, when appropriate, to manage the development of all inter-regional water supply and the transfer of water and wastewater for re-use when this becomes necessary. This utility will be an entity for the whole of the Occupied Palestinian Territories, with representatives from all regions, and will be vested in the public sector.

Four integrated regional water and wastewater utilities have been established, one each in the Northern, Central and Southern West Bank and one in Gaza. They are responsible for delivering efficient water services to all customers.

The utilities are administratively and fiscally autonomous, although tariffs are reviewed, and water abstractions and discharges are licensed and monitored by PWA. The regional water utilities are required to seek full cost recovery in their operations and to develop a customer charter.

4.3 Water supply

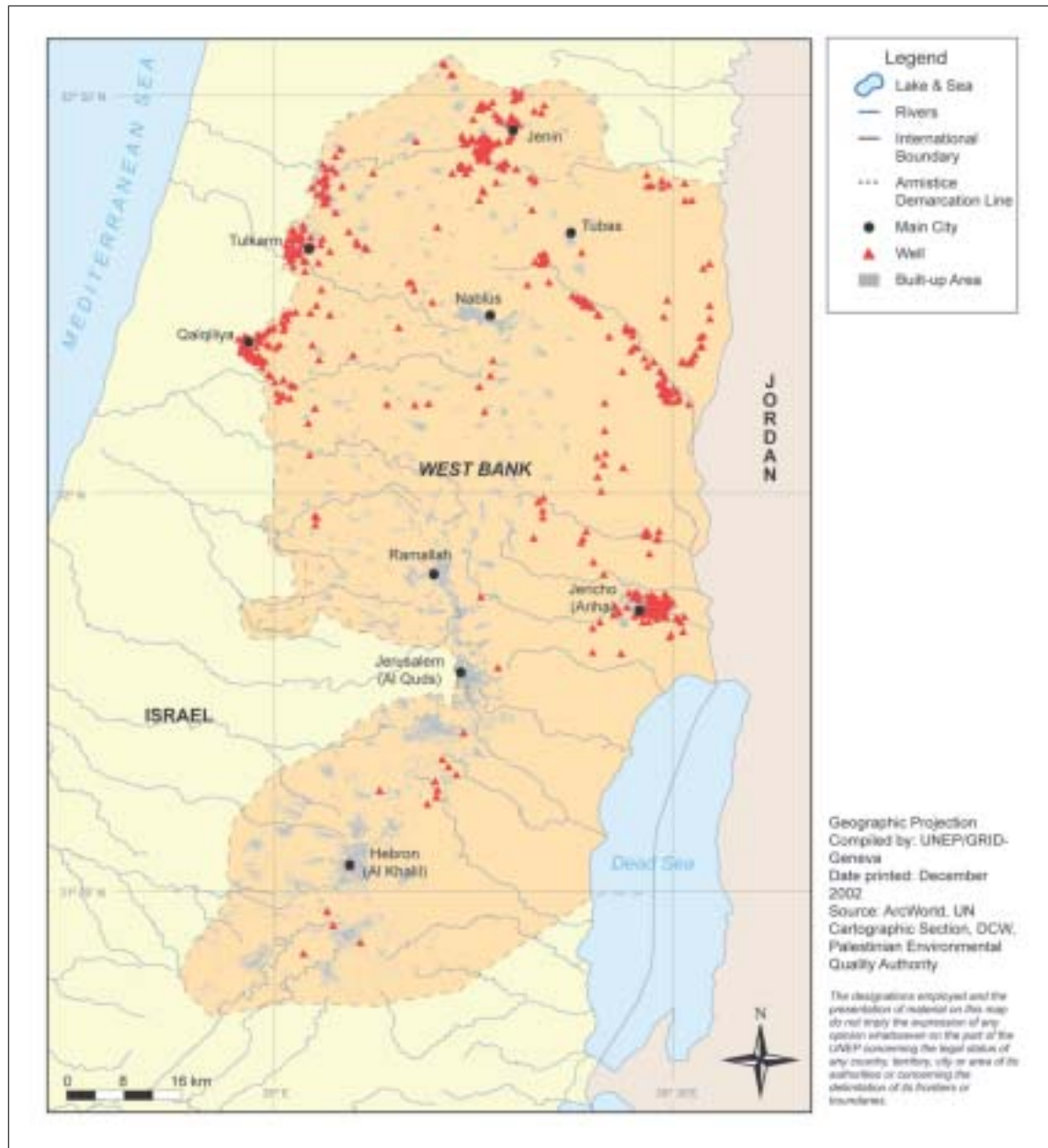
The major water resources in the West Bank consist of groundwater and springs, while additional sources include rainwater harvesting.



SUSAN BRANNON

Water delivery truck in the West Bank

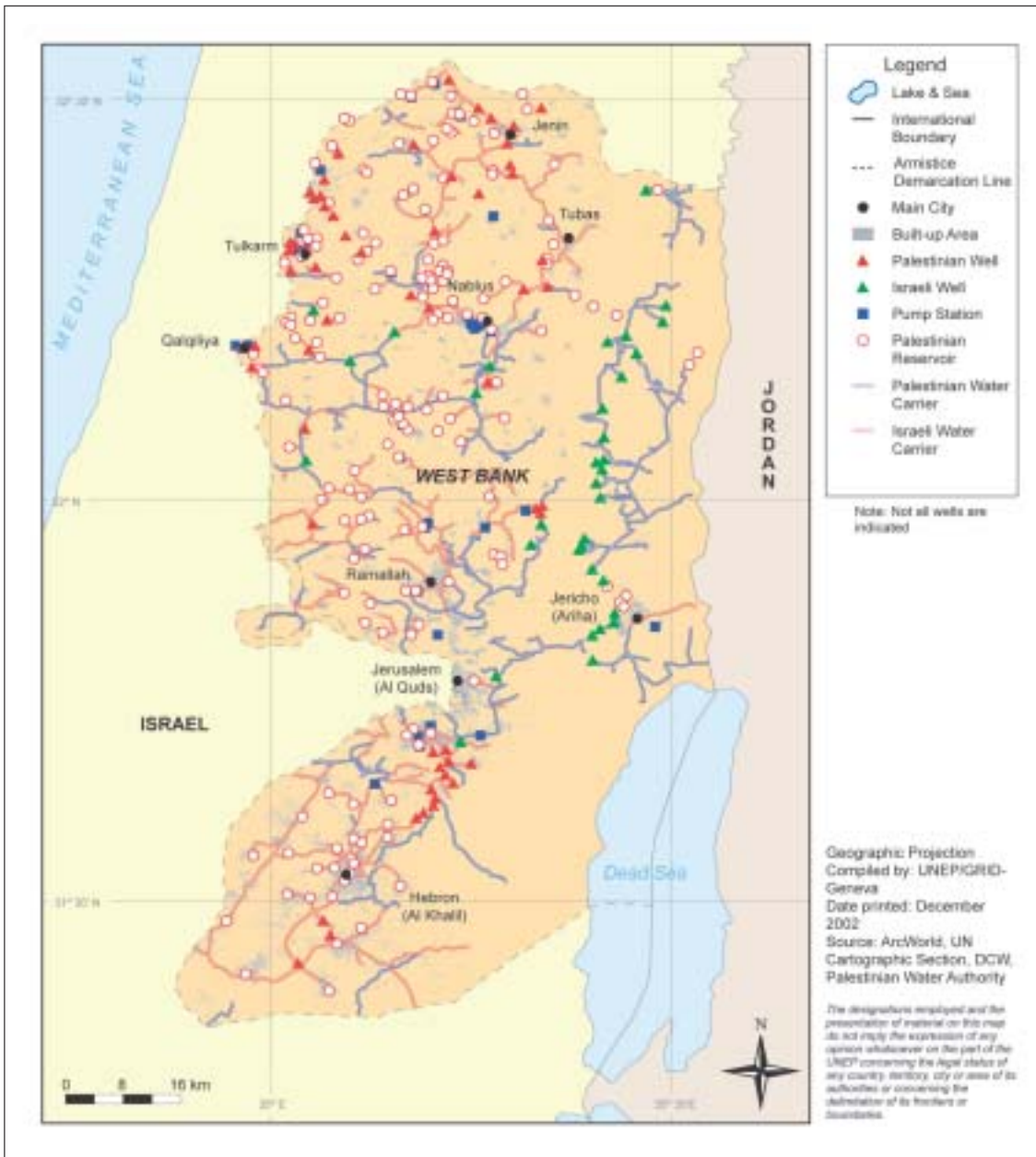
► Well distribution in the West Bank



There are 40 municipal wells in the West Bank that are used either wholly or partially by Palestinians. Their annual yield is around 30 million m³ (EQA, 2002a).

This is insufficient to meet water demand and the deficit is supplied mainly through springs or through Mekorot (the Israeli Water Company). Some agricultural wells are also used for domestic purposes. There are more than 300 springs in the West Bank, of which more than 100 are considered to have substantial yields. The total average annual yield of the springs is estimated to be around 60 million m³. Springs are a secondary, but important, source of water for drinking and other domestic purposes, and they are also used to meet agricultural needs throughout the West Bank. Rainfall cisterns collect around 6.6 million m³ per year from rooftops. The average per capita water consumption is around 70 litres per capita per day. Approximately 88 % of the total West Bank population and 55 % of localities (towns and villages) have access to piped water supply systems (EQA, 2002b). (See map above)

► Water carriers in the West Bank



There is no advance treatment of water in the Occupied Palestinian Territories, except for using chlorine to disinfect domestic municipal wells. This is done simply by adding sodium hypochlorite to the water, just prior to its distribution from tanks and reservoirs. In the case of springs and many private wells, disinfecting is not carried out regularly. Even in municipal wells the efficiency of chlorination is not always up to required acceptable levels, since chlorinating machines are often in bad condition with poorly functioning pumps. Water supplies having a high content of organic material, sulphides, ferrous iron, and nitrites require increased chlorine, but this is not always taken into account. It has been shown that disinfection efficiency has been as low as 28 % in the summer period for some wells in Gaza (El-Mahallawi, 1999).

In most of Gaza's municipalities, there is no balance between water supply and demand. The municipalities are responsible for distributing water for domestic and industrial consumption. (See map above)

Each municipality has its own water source and a separate distribution system. Water consumption averages 75 litres per capita per day. Due to the deteriorating distribution network, water losses are very high, in the range of 35-50 %. Most municipalities use groundwater without any treatment except for disinfection. Some municipalities buy water from Mekorot.

Most houses are served from indoor taps and depend on municipal wells for domestic use. The exception to this is the central and eastern part of Khan Yunis Governorate in southern Gaza, which depends mainly on the Israeli water company Mekorot. (See map, page 29)

According to reports and studies by the Palestinian Water Authority, 95 % of Gaza residents receive service, which means that most of the population has access to an indoor tap. Most of the distribution systems in the municipalities operate a timetable for supplying drinking water. The use of rooftop tanks with a 1-2 m³ capacity is a common practice in all houses in Gaza. Such storage tanks provide at least some security in the case of any failure in the water supply system (EQA, 2002a).

Much before September 2000, most of the existing water supply pipes in the West Bank and Gaza were in urgent need of repair and rehabilitation, with leakage losses in the transmission and distribution network of about 30–40 % (PECDAR, 2001). The urgency of lowering these losses is further underlined by the scarcity of available water resources. Over 1,500 illegal wells are reported to exist (MEnA, 2001a).

In addition to these problems, the Donor Support Group (consisting of the Palestinian Authority, the European Commission, the United Nations Development Programme (UNDP), the World Bank, the Office of the United Nations Special Coordinator (UNSCO), and the United States Agency for International Development (USAID)), has concluded that direct damage to water supply and sewerage infrastructure from actions of the Israeli military in the West Bank Governorates between March and May 2002 amounts to about USD 7 million (The Support Group, 2002).

This figure does not include recently reported substantial damage to local water supply facilities such as cisterns, roof tanks and springs (PHG, 2002d).

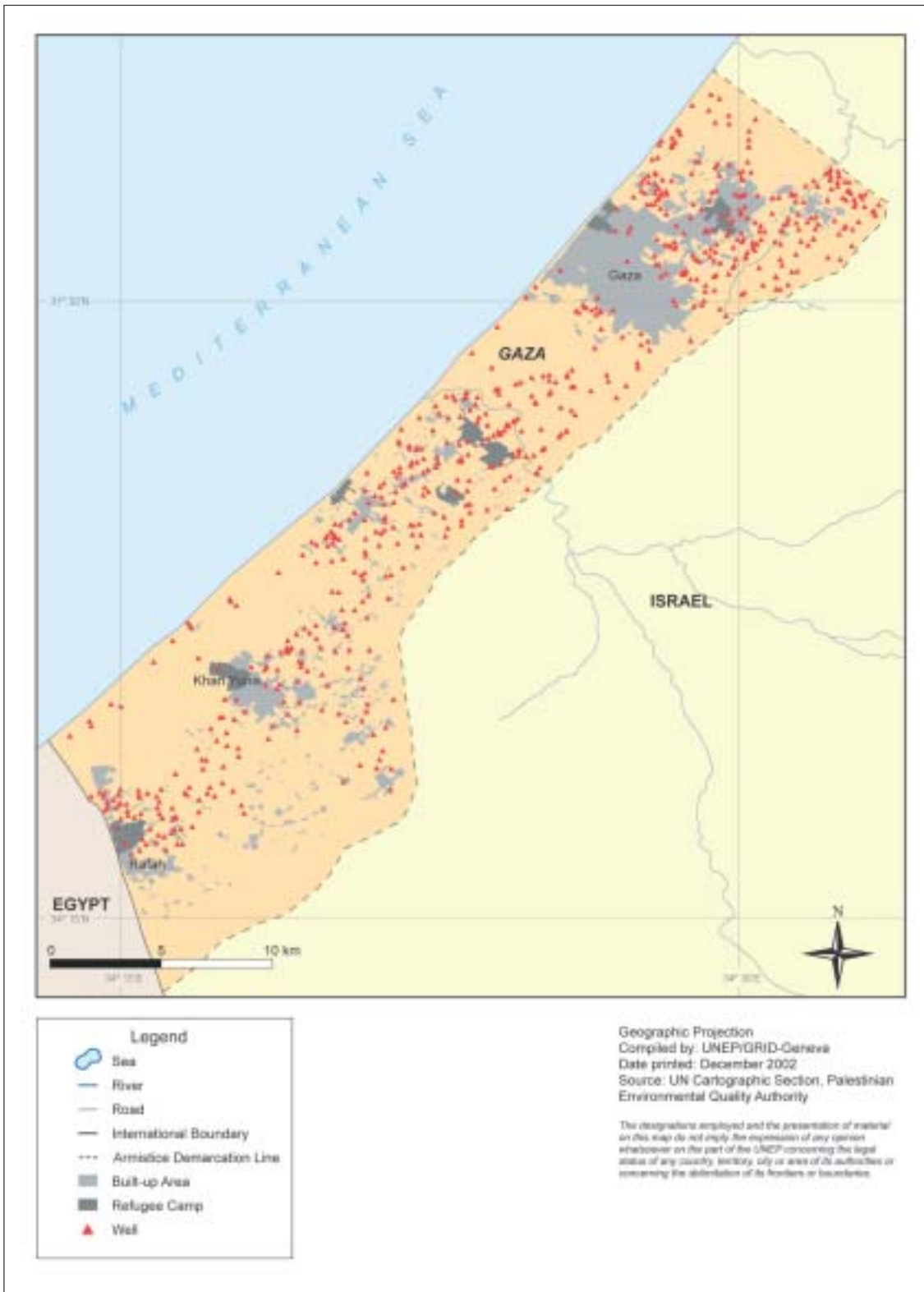
■ Wastewater re-use

Palestinians have recently begun to re-use wastewater as an additional water source. The total quantity of wastewater from domestic and industrial uses in Gaza and the West Bank is estimated to be roughly 40 million m³ per year (WRAP, 1994). In the West Bank, most of this wastewater is used for irrigation without any kind of treatment. In the Gaza City area, sewage from non-functioning treatment plants is discharged onto neighbouring land. In the future, treated wastewater should be considered as a major resource, particularly for agriculture and especially in Gaza. However, the lack of proper sewage collection and treatment systems in most of the Palestinian territories severely limits the potential for developing this vital resource. The lack of wastewater treatment also poses potentially serious risks to the environment and human health (WRAP, 1994). (See map, page 30)

■ Desalination

In spite of considerable declines in unit costs over the last decade or so (as low as USD 0.5 per m³, without transport costs), desalination is still considered as a relatively expensive option for global water supply. However, in water-scarce regions, desalination may be an important element for balancing supply and demand. It is against this background, for example, that Israel has decided to desalinate 400 million m³ per year of seawater and

► Well distribution in Gaza



50-100 million m³ per year of brackish water, beginning in 2004, as part of its National Water Management Plan (Inbar, 2002; IMO, 2002e).

Considering the improving economic viability of desalination and the severe difficulties of meeting the demand for water using available natural resources in Gaza, it seems likely that

► Water carriers in Gaza



desalination will become increasingly important element of future strategies. A seawater desalination plant is currently under construction with support from France, two brackish water desalination plants are already operating in Khan Yunis and Deir el Balah, and another plant has been specially built for the industrial estate in central Gaza. A fifth seawater

desalination plant with a capacity of about 20 million m³ per year is being planned with support from USAID (CAMP, 2000a).

■ Storm-water control and artificial recharge

Storm-water appears to have been overlooked as a potential resource, in spite of the fact that the capture of only a small additional percentage of storm-water runoff could result in an additional 20 million m³ per year for the Occupied Palestinian Territories as a whole, with local variability depending on rainfall characteristics (PECDAR, 2001). This would involve collecting water from urban drainage systems and diverting flows in wadis (a rocky watercourse that is generally dry except in the rainy season) to storage dams or recharge basins. Building regulations in urban areas could also be adapted to require the on-site retention of storm-water. These measures would reduce flooding and increase the recharging of groundwater reserves.

In addition, the feasibility of siting additional dams on wadis should be jointly investigated in accordance with the Oslo II Accords (Article 12, B. and Schedule 2), and the construction of on-site storage ponds for agricultural use promoted. However, it will also be important to ensure that the potential environmental impacts of any new water control structures are fully and adequately assessed in advance, so that possible damage to ecosystem functioning can be avoided.

4.4 Water resources assessment

■ The resource base

In the Palestinian territories, water is a precious natural resource and its relative scarcity is a major constraint to economic development. This applies throughout the region, which is generally characterised by aridity and water scarcity. With the majority of the region's water resources being shared by more than one country, the allocation and management of transboundary water resources assumes great importance. Global climate change may further magnify the pressure on the water system in the Occupied Palestinian Territories through increased temperatures and evaporation rates and lower and more erratic rainfall.

In the West Bank, rainfall averages 450 mm per year. With a West Bank area of 5,879 km², this gives an average total of about 2,600 million m³ of rain per year. Around 680 million m³ of this is estimated to infiltrate into the soil to replenish aquifers, the remainder becoming surface runoff or lost through evapotranspiration (WRAP, 1994).

Gaza receives an annual average rainfall of about 325 mm per year. With an area of 378 km², this gives a total of 120 million m³ rain per year, of which about 40 million m³ per year is estimated to recharge the shallow aquifers that underlie the area, while the remainder is accounted for by surface runoff and evapotranspiration (WRAP, 1994). (See map, page 32)

In the area between the Jordan River to the east and the Mediterranean to the west, groundwater is the major source of fresh water and is thus of primary importance to Palestinians. The area does not have access to any source of surface water, with the exception of small perennial or seasonal streams fed by springs. In addition, as mentioned earlier, rain-water harvested at the household level has long been a significant additional source, while growing water scarcity has resulted in the increasing interest in and use of unconventional water sources.

4

► Watersheds



■ Soil and groundwater – quantity and quality

THE MOUNTAIN AQUIFER SYSTEM

The Cenomanian-Turonian Mountain Aquifer system underlying and largely recharged from the West Bank is by far the most important source of water in this area. The aquifer system is highly permeable due to its geological nature.

The limited soil cover over the water recharge zones makes the aquifers highly susceptible to pollution since there is no natural barrier to contaminants that travel down rapidly to the water. Further, salinization can occur from subterranean saline water bodies, if and when the aquifer is over-pumped. The wastewater chapter includes a map showing vulnerability to pollution. (See map, page 45) The Israeli Ministry of Environment also provided UNEP with a printed version of a vulnerability map.

Groundwater in the Mountain Aquifer system flows in three main directions, according to which three main groundwater drainage basins can be identified, namely the Western, North-eastern and Eastern Aquifer Basins.

The 6,000 km² Western (or Yarkon-Taninim) Aquifer Basin extends from Beer-Sheva northwards to the Carmel Mountain foothills, and from near the centre of the Mountain Belt to the Coastal Belt. Precipitation covering an area of about 1,800 km² recharges the groundwater system at an estimated average volume of about 362 million m³ per year. The actual annual rate of replenishment varies according to precipitation (Guttman, 1988).

► Mountain and coastal aquifers



In 1951, when under Jordanian administration, withdrawal of groundwater from the Western Aquifer, primarily by Israelis, involved 46 wells pumping a total of 24 million m³. By 1971, this had grown to 400 wells abstracting approximately 450 million m³. Over-abstraction, i.e. abstraction exceeding natural replenishment of the aquifer, persisted from the mid-1960s until 1990, when total withdrawals fell to 350 million m³ per year. The present declared Israeli policy aims at balancing abstraction with natural replenishment rates (Weinberger *et al*, 1994).

In the past, the Western Aquifer discharged in Israel through freshwater springs a few kilometres northeast of Tel Aviv-Yafo, and through brackish springs at close to the Mediterranean Sea just south of Mount Carmel. Prior to the 1940s, the freshwater springs discharged 220 million m³ annually, while the brackish springs discharged 100 million m³ per year (Weinberger *et al*, 1994). As a result of spring flow diversion and high levels of groundwater abstraction since the mid-1950s, the natural discharge of the freshwater springs has ceased almost entirely, and the outflow of the brackish springs has been reduced to about 30 million m³ per year (Guttman, 1988). This discharge, as well as groundwater abstracted through deep boreholes, is exclusively derived from the upper sub-aquifer.

The North-eastern Aquifer covers an area of about 1,044 km² and is located in the northernmost part of the Mountain Belt in an area that is generally flat with rolling hills and no obvious topographic features to delineate its boundaries. The groundwater potential of the aquifer system in this basin is estimated to be around 145 million m³ per year, and it generally flows northeast into Israel. The aquifer is estimated to have a total natural discharge of around 140 million m³ per year from four main groups of springs (Beisan, with an average annual discharge of about 10 million m³; Jenin, 20 million m³; Gilboa, 70-80 million m³; and Wadi al Fara'a, 18 million m³). The Jenin springs, which once provided all of Jenin's water supply, are now almost entirely dry as a result of over-pumping from numerous wells (Rabbo *et al*, 1999; EXACT, 1998). Groundwater quality has shown some deterioration over time, primarily due to surface contamination from wastewater and unsustainable agricultural practices. Excessive groundwater pumping has also led to increased salinity due to the rise of saline water from deeper levels.

The Eastern Mountain Aquifer covers an area of about 3,080 km² and includes the eastern part of the Mountain Belt and the steep Western Escarpment of the Jordan Rift Valley. The aquifer is recharged from the high precipitation areas in the mountainous part of the aquifer basin at an estimated average volume of 172 million m³ per year. It flows generally south-east towards the Jordan Rift Valley. (EXACT, 1998).

About 300 springs are distributed throughout the West Bank, from Jenin in the north to Yatta in the south, and from the western border of the West Bank to the Jordan Valley and the Dead Sea in the east. The total average annual yield of these springs is estimated to be around 60 million m³, though as noted above a number of springs have wholly or partially dried up due to over-abstraction. Concentrations of chemicals (such as nitrates) in most of the springs are low, making the water suitable for drinking. However, the presence of coliform bacteria means that disinfection is generally required and that contamination from sewage is occurring (Rabbo *et al*, 1999).

The average annual recharge figures stated above (362, 145 and 172 million m³ per year for the Western, North-eastern and Northern Aquifers, respectively, for a total of 679 million m³ per year for the West Bank) are those officially recognised in Article 40 under the Oslo II Accord. It should be noted, however, that other references (e.g. Guttman, 2000) provide quite different estimates of the recharge figures. This apparent uncertainty about the sustainable yield of the West Bank's most important water resource clearly shows a need for improved understanding of the whole aquifer system. Special attention should be given to enhancing data collection and analysis, notably in relation to soil characteristics, hydrological monitoring, and

aquifer modelling, as well as improved information exchange between the parties. In particular, there is a need for better understanding of the Eastern Aquifer and its potential for sustainable development, involving among other things reliable measurements of the actual outflow from the aquifer via the Dead Sea shore springs (Guttman, 2000; Scarpa, 2002).

SOIL AND GROUNDWATER POLLUTION IN THE WEST BANK

Groundwater in most areas of the West Bank is generally considered to be of good quality, though easily contaminated in some regions, depending on land use and local soil and geological conditions. In general, however, the region's geology is limestone, which has the property of allowing substances to penetrate easily. The attenuation or removal of nutrients and pollutants in wastewater is low, making aquifers vulnerable to contamination. In some areas, groundwater is unsuitable for drinking because of high salinity. This occurs partly as a result of natural factors, but is expected to worsen over the coming years since over-abstraction of freshwater leads to intrusion of salty water from deeper levels.

Soil and groundwater pollution is caused mainly by agricultural practices (notably the use of inorganic fertilizers, pesticides and herbicides), localised industrial activities (organic pollutants, heavy metals), and inadequate or improper disposal of wastewater and solid waste (including hazardous materials).

Pesticides and herbicides are used in large quantities in specific areas of the West Bank. These include chemicals that are imported and used illegally in the Occupied Palestinian Territories, in spite of long-standing international bans on agricultural use on environmental and health grounds. For example, sterilizing soil with methyl bromide is officially banned, yet still practiced extensively in the West Bank, in particular in the Tulkarm area, where greenhouse farming is important (ARIJ, 1998). Pesticide contamination of both soil and groundwater is considered to be a major environmental issue in the West Bank, but data are scarce, given that resources and laboratory capacity are limited. However, a number of relevant studies have been conducted recently, and the Palestinian Water Authority monitoring programme includes biannual pesticide measurements for water samples from domestic wells.

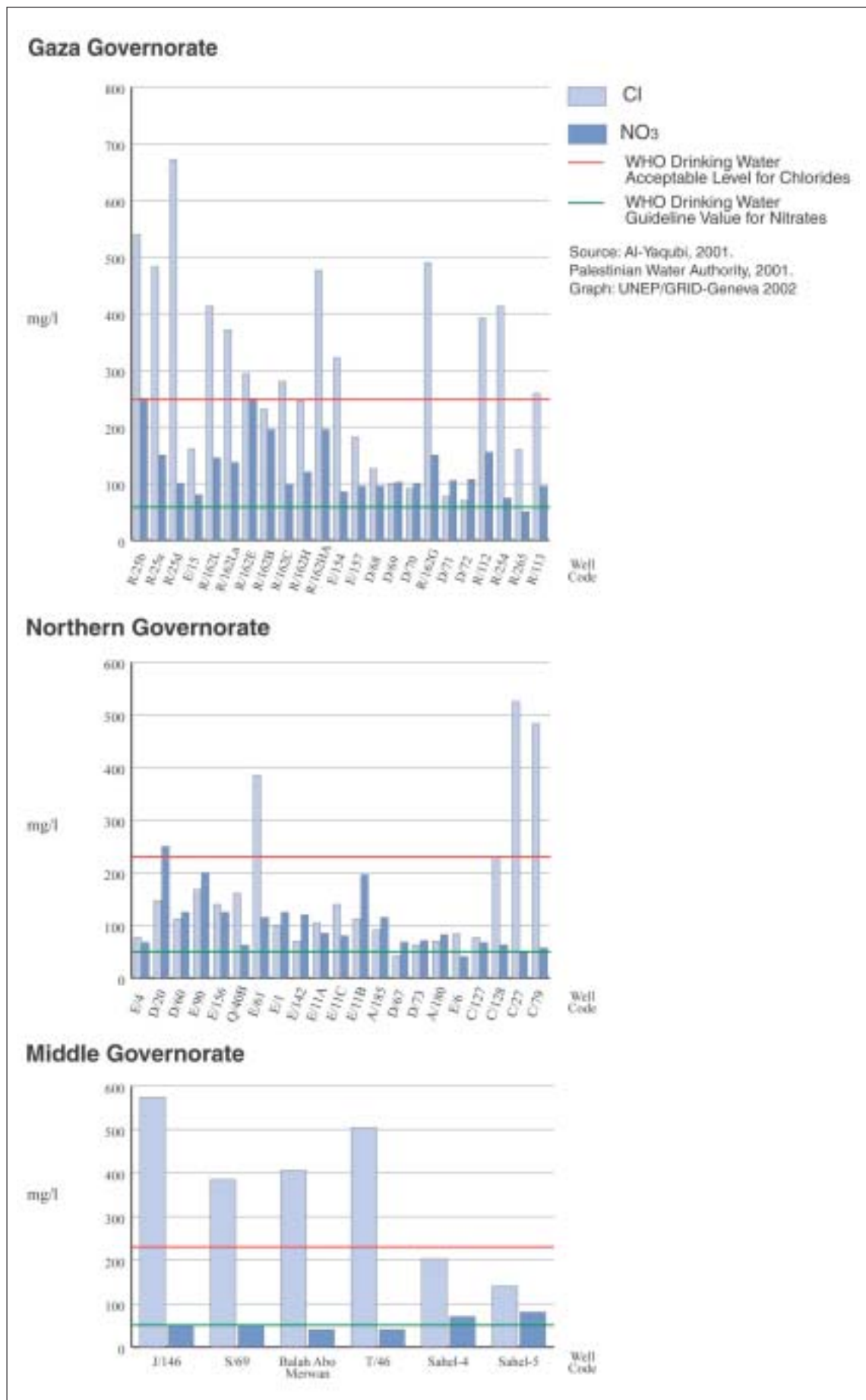
Nitrate contamination of groundwater is caused by infiltration of fertilizers and raw sewage, and elevated concentrations are found throughout the West Bank. A detailed study (Marei & Haddad, 1998) found nitrate levels above World Health Organization standard guideline values for drinking water (i.e. > 50 mg per litre) in up to one-third of samples from wells in the Jordan Valley, Nablus, Jenin, and Tulkarm district. (See pp. 36-37)

Microbiological groundwater quality in the West Bank is of major concern, since there are frequent outbreaks of diarrhoea among the Palestinian population. Ministry of Health data published in 2001 indicated that 600 of 2,721 samples – including water from both wells and tanks – failed to meet WHO bacteriological guideline values for drinking water (Ministry of Health, 2001). Scarpa *et al*, 1998 and Abdul-Jaber *et al*, 1999 showed microbiological pollution to be widespread in all the mountain aquifers. Rather few wells in the Bethlehem (Beit Lahm)-Hebron (Al Khalil) district were found to be permanently contaminated, though all those tested were subject to at least periodic contamination.

There is relatively little information concerning the impacts of industrial pollution in the West Bank, though one recent study (SWEMP, 1999c) provided some insights and identified pollution 'hot spots', including industrial sites such as stone-cutting facilities, olive oil factories, slaughterhouses, and tanneries. While there are no hard data concerning the impact of industrial effluent on groundwater quality in the region, it is a fact that almost all industrial wastewater flows directly into municipal wastewater systems without pre-treatment.

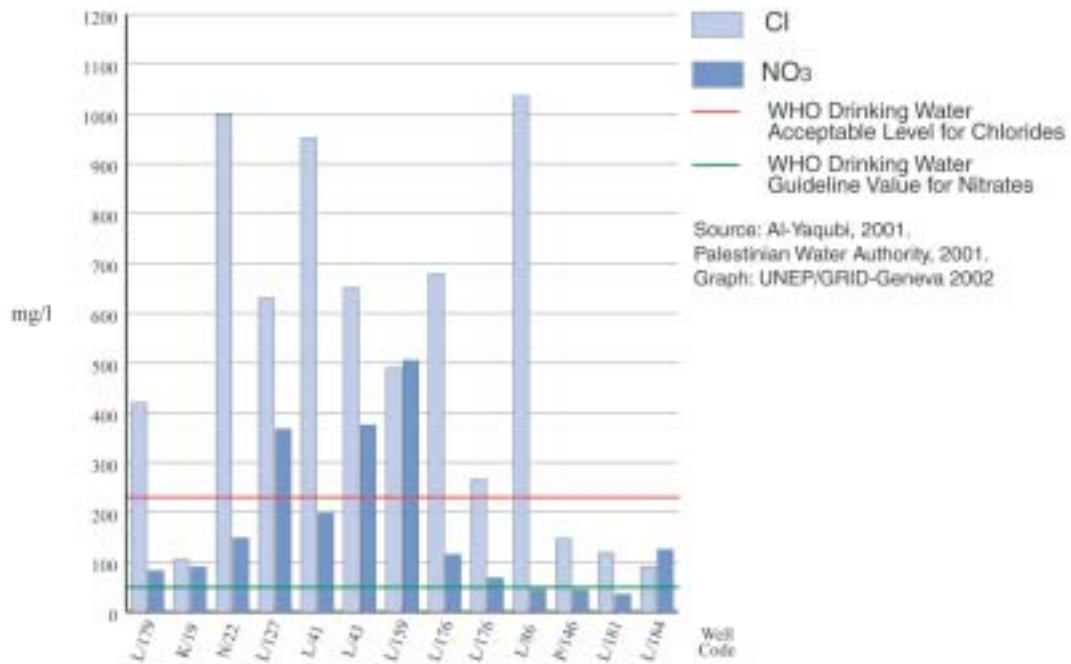
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► Chloride and nitrate concentrations in Gaza wells

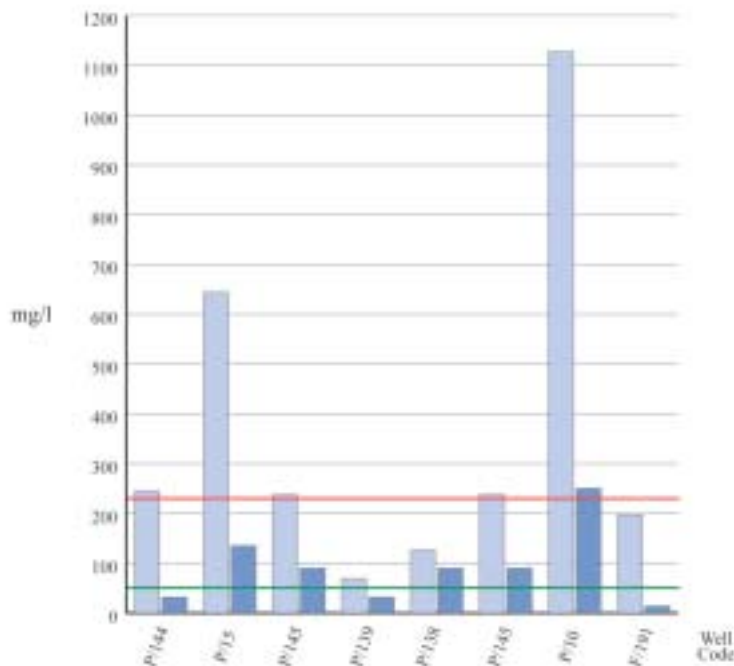


► Chloride and nitrate concentrations in Gaza wells (continued)

Khan Yunis Governorate



Rafah Governorate



SPRINGS AND TANKED WATER QUALITY IN THE WEST BANK

The water quality of West Bank springs was thoroughly investigated in a study carried out from 1995 to 1997 (Rabbo et al, 1999). About 400 samples were collected and analysed, taking into account traditional drinking water parameters.

The main contaminants encountered in spring-water samples are nitrates and coliform bacteria from sewage. Some heavy metals are also found, but in nearly all cases these are below the recommended WHO guideline values. Rather few samples showed nitrate concentrations above the WHO guideline value of 50 mg per litre: two out of four samples in Jenin district, three of 17 in Ramallah, four of 21 in Bethlehem (Beit Lahm), nine of 42 in Hebron (Al Khalil), one of 20 in the Jordan Valley and none of 18 in Nablus district. Conversely, the majority of samples for which microbiological analyses were performed were found to be contaminated by infectious sources.

Only three of all the samples tested showed no signs of either faecal or total coliform bacteria, and 50 % of all samples contained 1,000 mg or more per 100 ml. For this reason, virtually no spring water can be used for household purposes without treatment. It is likely that the contamination is due to most springs being situated close to, and/or downstream from, infectious sources, such as raw sewage from cesspits, sewer leakages, land irrigated with wastewater, or sewage discharged directly to wadis and open ground.

THE COASTAL AQUIFER SYSTEM

The Coastal Aquifer extends from Gaza in the south to Mount Carmel in the north along some 120 km of Mediterranean coastline. The width of the aquifer varies from 3-10 km in the north to about 20 km in the south, where it constitutes the chief resource of water for Gaza. The depth to groundwater in Gaza ranges from 60 m in the east to 8 m or less near the shore. The flow is generally from east to west.

The Coastal Aquifer is composed of sands, calcareous sandstone and pebbles. Semi-permeable and impermeable layers are sandwiched in between, dividing the system into sub-aquifers. This subdivision is especially developed in the western part of the coastal plain, where one borehole may pass through several separate sub-aquifers, each having a different water level and quality. Further inland, the sub-aquifers effectively merge to form one system. All along the coast, there are areas of seawater intrusion due to over-pumping of the freshwater aquifer.

The Coastal Aquifer Management Programme (CAMP, 2000a) established the 1998 water balance of Gaza Coastal Aquifer by estimating all water inputs and outputs. The total estimated inflow to Gaza aquifer of 123.1 million m³ per year is composed of: (a) recharge from precipitation 35 million m³ per year, (b) return flows from leakages, wastewater and irrigation 51.6 million m³ per year, and (c) lateral inflow from Egypt and Israel 36.6 million m³ per year. The total estimated outflow of 154.1 million m³ per year reflects: (a) municipal abstraction 50.3 million m³ per year, (b) agricultural abstraction 90.3 million m³ per year, (c) agreed Mekorot abstraction 5 million m³ per year, and (d) natural discharge to the sea 8.5 million m³ per year. It should be noted that maintenance of adequate outflow to the sea is an important element of minimising saltwater intrusion into the Coastal Aquifer.

The above figures show a deficit of 31 million m³ between total input and output to Gaza aquifer, implying the following adverse consequences: lowering of the groundwater table, reduction in availability of fresh groundwater, and increased seawater intrusion and potential intrusion of deep brines.

It is presently estimated that only 10 % of the total aquifer volume may be considered as fresh water, in terms of meeting the World Health Organization drinking water acceptable level for chloride of 250 mg per litre. If pumping is allowed to continue at the present uncontrolled and unsustainable rate, it will destroy the aquifer's capacity to resist intrusion of seawater thereby making it unsuitable for human consumption or agricultural irrigation within two to three decades (CAMP, 2000). Drastic action must be taken quickly if the Gaza aquifer is to continue supporting human needs.

In order to reverse the situation and eventually achieve environmentally sustainable use of the aquifer, urgent implementation of the CAMP is required. The main elements of this are: (a) introduction desalination, (b) wastewater collection and re-use and (c) improved irrigation practices, including a shift to the use of treated wastewater. To encourage this switch, metering of agricultural wells and application of differential tariffs are recommended.

SOIL AND GROUNDWATER POLLUTION IN THE COASTAL AQUIFER

Pollution of the groundwater in Gaza is a major problem. Not only are there numerous sources of pollution, but also the aquifer is highly vulnerable to pollution. As mentioned above, many years of over-pumping have resulted in seawater intrusion and upconing of saline groundwater. Furthermore, human activities including agriculture and inadequate waste management have increased groundwater contamination levels. Intensive cultivation and efforts to boost production have led to excessive use of fertilizers, pesticides, herbicides and soil fumigants, while collection, treatment and disposal of wastewater and solid waste (including hazardous materials) are wholly inadequate in many areas.

The main groundwater quality problem in Gaza is elevated chloride concentrations. Fifty percent of Gaza municipal wells sampled in 1998/1999 failed the World Health Organization drinking water acceptable level for chlorides of 250 mg per litre (Al-Yaqubi, 2001).



SUSAN BRANNON

Untreated sewage flowing in the Wadi Gaza

These data were confirmed in 2000, when 23 of 41 wells showed chloride levels above the WHO standards (State of the Environment, 2001). Increased groundwater salinity has been attributed to the combined effect of several factors, including surface salinization, seawater intrusion, and possible upconing of deep brines due to over-pumping of fresh water (State of the Environment, 2001). Sewage discharges, leachate from waste deposits, and industrial effluent may also contribute significantly to the elevated chloride concentrations recorded.

Some 123 different pesticides are used in the region, including many illegally imported and obsolete substances. Pesticides detected in well-water samples include DDT, lindane, aldrin, dieldrin, endrin, endosulfan, endosulfan sulphate, methoxychlor, and heptachlorepoxyde (CAMP, 2000a; CAMP, 2000d). While these were found in levels below the WHO guideline values for drinking water, the technical complexity and expense of comprehensive pesticide monitoring mean that the problem is likely to be more serious than currently available data suggest.

Nitrate is a major groundwater contaminant throughout Gaza. There are numerous sources of nitrate contamination, including agricultural fertilizers, waste dumping, and – especially – direct discharge of raw sewage to wadis and soil. This has been shown by isotopic techniques to be the main source of nitrate contamination (Al-Yacubi, 2001; CAMP, 2000d; CAMP, 2000e; Vengosh et al., 2002). Nitrate concentrations have been shown to exceed WHO guideline values in 50 % of the samples collected from domestic municipal wells in Gaza (Al-Yacubi, 2001).

Bacteriological analyses were carried out for a number of groundwater samples in Deir Al-Balah City, but no coliform bacteria were found (El-Mahallawi, 1999). However, the same study found coliform bacteria in tap water and roof-tank samples from Deir Al-Balah City and Jabalya camp, indicating cross-contamination between poorly maintained sewage and drinking-water networks. It should also be noted that many households obtain water from unprotected private wells, where no disinfectant is used.

Although there is a lack of published data, it can be assumed that small-scale industry is another potential source of groundwater pollution. There are an estimated 3,500 small industrial plants in the region, with 65 % located in Gaza City (MEnA, 2001a). Dyeing, leather processing, paint production, and electroplating, among other industries, all produce toxic and hazardous waste compounds.

Nevertheless, industrial pollution does not seem to be of major concern when compared with other sources of groundwater contamination. For example, despite of presumed daily spillages of residual oils and other organic compounds, no hydrocarbons were detected in groundwater wells during the CAMP project, though it should be noted that the detection limit used was 1 mg per litre, which is fairly high (CAMP, 2000d). Heavy metals have been identified in various groundwater samples collected throughout Gaza. However, the concentrations are not alarming, being considerably below applicable WHO guideline values for drinking water.

■ Surface water – quantity and quality

The main sources of surface water available to Palestinians include springs (West Bank only), accumulated rainwater, and seasonal wetlands and wadi flows.

Estimates of Palestinian domestic per capita water consumption vary between 50 and 70 litres per day. This is considerably below the World Health Organization minimum recom-

mended per capita standard for small rural households is 100 litres per day.

■ Pollution of coastal waters

The coastal environment of Gaza represents a valuable resource for the Palestinian population both in terms of recreational and touristic value and also for drinking water exploitation through desalination. However, future sustainable development of the coastal zone is threatened by pollution from discharge of raw sewage effluent. A recent study (UNU/INWEH & IUG/ERRC, 1999) showed elevated levels of faecal coliforms and faecal streptococci along the whole Gaza coastline. These findings are confirmed by data from other sources. Coastal waters are also susceptible to contamination from sources discussed in other sections of this chapter (e.g. agricultural chemicals, industrial effluent), but there is a lack of published data.



SUSAN BRANNON

Gaza port

Offshore pollution is probably of minor importance. The risk of major oil spills is considered to be low (UNU/INWEH & IUG/ERRC, 1999).



SUSAN BRANNON

Sewage outlet at Gaza beach

4.5 Water use and demand

Water use and demand is expected to increase in the future, with related environmental impacts. The Oslo Accords provide that water rights will be negotiated in the final status agreements. Projections of future water demand also depend on other factors to be decided in the final status negotiations. The UNEP Desk Study does not include any assumptions or pre-judgement on these issues. However, owing to the clear link to the environment, the Palestinian projections on water demand, as outlined in the National Water Plan of 2000, is reproduced in Annex G to the Desk Study, Excerpts from the Palestinian National Water Plan.

Wastewater

5.1 Legal and institutional aspects

■ Water Law

While the environmental law of 1999 sets out the legal framework for the sustainable use of all natural resources, including water, the key legal instrument is Law No. 18 of January 1996 establishing the Palestinian Water Authority (PWA). It sets out the functions to be performed by the PWA, as well as the principles for establishing an institutional framework for water management and service delivery. A new water law has recently been adopted, confirming the PWA's responsibility for managing of water resources throughout the Occupied Palestinian Territories and stressing the need for collecting, treating and reusing wastewater. The Palestinians first gained this responsibility in 1995.

■ Palestinian Water Authority (PWA)

The PWA has the task of ensuring that each citizen's right of access to water is fulfilled within the framework of the sustainable development of available resources.

In terms of wastewater management, the major fields of PWA responsibility are: legislation, wastewater planning, effluent standards and sludge handling, areas without sewerage, industrial wastewater, control and monitoring and storm-water drainage.

The PWA grants licences, permits and concessions for any type of water utilization or wastewater end use. The PWA also supervises and monitors individual water projects as well as the preparation of the National Water Plan.

Other key institutions in the field of wastewater management in the Occupied Palestinian Territories are:

- Ministry of Planning and International Cooperation (MOPIC)
- Ministry of Agriculture
- Ministry of Health
- Environmental Quality Authority
- Ministry of Local Government representing municipalities and village councils
- PECDAR (only for the construction and rehabilitation phase).

■ Regional utilities and municipalities

The municipalities and village councils are responsible for providing water and sewerage services. Laws and regulations from different periods all play significant roles.

Finance for operation and maintenance of water supply and sewerage systems is the responsibility of the municipalities and village councils. The operational costs are mainly wages, materials such as chemicals for treatment of wastewater, and spare parts for equipment and infrastructure.



Wadi Gaza outlet channel to the beach

The institutional capacities of the municipal wastewater department and the water and wastewater companies are generally weak. This is due firstly to the organizational structure of the sector, and secondly to human resource constraints. Water supply and sewerage systems are the responsibility of municipal departments, rather than commercially oriented utilities.

In terms of wastewater management, the major responsibilities of public utilities are for:

- industrial wastewater
 - specification of pre-treatment guidelines
 - discharge licence to sewerage network
 - control and enforcement of discharges to the sewerage network
- control and monitoring
 - routine sampling and analysis of effluent
 - flow monitoring
 - supervision, including control and enforcement of emptying practices

Role of UNRWA

United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) was established by United Nations General Assembly resolution 302 (IV) of 8 December 1949 to carry out direct relief and works programmes for Palestinian refugees. The General Assembly has repeatedly renewed UNRWA's mandate, most recently extending it until 30 June 2005. Originally envisaged as a temporary organization, the Agency has gradually adjusted its programmes to meet the changing needs of the refugees. Currently, UNRWA is

the main provider of basic services – education, health, relief and social services – to over 3.9 million registered Palestinian refugees in the Middle East region. UNRWA works closely with the Ministry of Planning and International Cooperation on municipal and regional utility issues and is closely involved with providing of water, and wastewater and solid waste services to refugees.

5.2 Overview of the wastewater situation

In the Occupied Palestinian Territories, wastewater treatment has been neglected to a certain extent, with most attention focused on measures to solve water quantity and supply problems.

■ Wastewater management

Depletion of water resources and deterioration of water quality in the Occupied Palestinian Territories are key environmental challenges that require urgent action. Groundwater resources are suffering due to infiltration of untreated wastewater from leakages, overloaded treatment plants and effluent discharged directly into the environment. Appropriate management of wastewater has been neglected throughout the Occupied Palestinian Territories, both prior to and during the present conflict, and little investment has been made in the wastewater sector since the Oslo Accords. The situation is worsened by the discharge of untreated wastewater from Israeli settlements. Israel states that the majority of wastewater from settlements is treated, but during this Desk Study, UNEP did not receive information on the specific amounts that are treated. Based on a field visit to the Emek Hefer area, UNEP noted that there are cross-border impacts from Palestinian untreated wastewater discharge in cases where Israel is downstream. Therefore the Desk Study team, with reference to the Governing Council decision, recommends further field studies on the cross-border contamination.

During the current crisis, the access of municipal maintenance staff to wastewater treatment plants has, at various times, been difficult or impossible as a result of curfews, partial or full closures, and overall worker safety and security considerations. Israeli security measures have also raised difficulties in obtaining spare parts and disinfectants such as chlorine.

The map opposite is based on information provided by the Palestinian Environmental Quality Authority and shows areas of high, medium and low vulnerability to pollution due to human activities. The map shows that more than two thirds of the West Bank is categorised as being highly vulnerable.

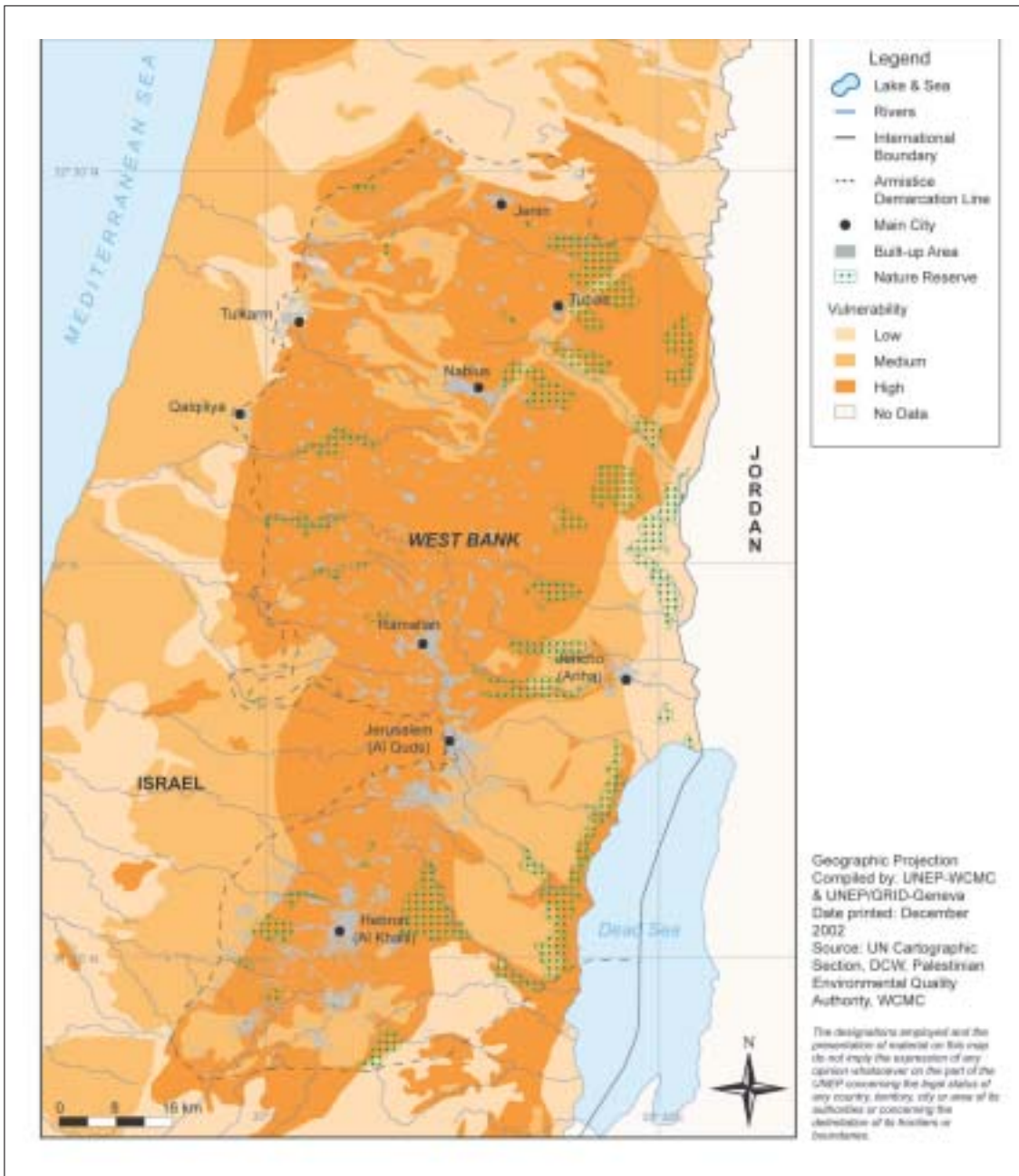
■ Wastewater composition

Total wastewater for the Occupied Palestinian Territories is estimated at 72 million m³ (PCBS, 2002). Low per-capita water consumption within Palestinian households affects the sewage composition by increasing the organic constituents and influent salinity. The biochemical oxygen demand (BOD) level of sewage in the West Bank averages 600 mg per litre. This is higher than the common BOD levels of 200-300 mg per litre in many developed countries.



Untreated wastewater from Tulkarm is deviated into an Israeli emergency treatment plant to prevent pollution to the Alexander River downstream.

► Hydrological vulnerability of groundwater to pollution in the West Bank



■ Industrial wastewater

Though representing a small fraction of overall effluent discharges in the Occupied Palestinian Territories, industrial wastewater is largely discharged untreated into municipal sewerage networks, cesspits, or into the environment, thus polluting soils, groundwater and seawater.

■ Wastewater treatment

There are seven old treatment plants in the West Bank and Gaza. Four are located in West Bank cities, namely Ramallah, Jenin, Tulkarm and Hebron (Al Khalil). Three are in Gaza in the cities of Beit Lahia, Gaza and Rafah. All have operational difficulties and are not functioning effectively, and some are not functioning at all. Most of these plants are overloaded, under-designed or have experienced mechanical failures.

One new wastewater treatment plant has recently begun operating in Al-Bireh. During its visit, UNEP was informed that the sewer system would soon be completed and that 95 percent of Al-Bireh would then be connected. The system is designed to cover a population of 50,000. The treatment plant is an extended aeration plant with a present inflow of 3,200m³ per day.



ANIKET GHAI

Broken aerator at Jenin wastewater treatment plant: spare parts are difficult to obtain

■ Wastewater reuse

The combination of water shortage, contamination of water resources, densely populated urban areas and intensively irrigated agriculture makes it essential to put wastewater treatment and reuse high on the list of priorities. Effluents constitute the most readily available and cheapest source of additional water and provide a viable partial solution to the water scarcity problem, especially in Gaza. Since agricultural irrigation represents approximately 70% of the total water demand in the Gaza and West Bank, significant water-conservation benefits could result from irrigating with re-used or recycled water, provided that the water undergoes treatment beforehand to levels where they will not pose an environmental or health hazard.

The efficiencies of existing treatment plants in the West Bank and Gaza are very low, with only one treatment plant having acceptable effluent (Al-Bireh). The reuse of wastewater can only be feasible in areas that already contain a sewerage collection system and treatment plant. Direct reuse in agriculture is given the first priority in all studies since it is the most feasible solution based on technical, social, economical and institutional development conditions.

■ Potential for sludge reuse

As the residue of wastewater treatment, sewage sludge represents an agglomeration of pollutants originally present in the wastewater. Sewage sludge normally contains organic matter, pathogens, trace elements, toxic organic chemicals, essential plant nutrients and dissolved solids. Treatment and reuse of sludge should incorporate advanced environmental standards for disposal, agricultural reuse, reduction of pathogen levels and prevention of nuisance from flies and odour. Sludge recovered from municipal wastewater can be used as a fertilizer if certain conditions are met (e.g. no industrial discharges into municipal networks and limited concentrations of heavy metals).

■ Wastewater standards and enforcement

Standards for influent and effluent wastewater quality have been elaborated on industrial wastewater and treated wastewater.

■ Wastewater cost recovery

There are a few examples where the costs of investments in, and operation of, the wastewater management system can be recovered. These examples could be generalised and expanded in a future system composed of other direct fees, partial contributions from general government budgets and contributions from international donors.

■ Existing mitigation plans and projects

A series of plans and projects has already been initiated to mitigate wastewater problems. This includes those proposed in the Palestinian Environmental Strategy, the Master Plan for Sewerage and Storm Water Drainage in the Gaza Governorates (MOPIC, 1998b), and the Wastewater Plan for the West Bank (MOPIC, 1998d). However, it will not be possible to implement most of these proposals in the absence of progress in the peace process.

5.3 Wastewater situation in Gaza

Gaza is situated in an arid area with scarce water resources. The extraction of groundwater currently exceeds the aquifer recharge rate. As a result, the groundwater level is falling and chloride concentrations are increasing, making the water unfit for either human consumption or for irrigation. The uncontrolled discharge of untreated sewage to the ground surface and the excessive use of fertilizers has further polluted groundwater resources and led to high nitrate levels in certain areas.

High current and projected rates of population growth will inevitably lead to greater pressure on natural resources, especially water.

A number of wastewater projects were ongoing in several of the Gaza Governorates in the years prior to the outbreak of the second intifada. Most of these projects related to planning, while a few were small implementation projects. Since September 2000, planning and implementation has become increasingly difficult, with many projects temporarily halted.

In Gaza, access to sewerage facilities at present varies from areas where more than 80 % of the households are served by well-functioning sewerage systems, to areas where there is no sewerage system at all. On average, it is estimated that about 60 % of the population is connected to a sewerage network. Cesspits and boreholes are the other wastewater disposal systems in the area.

The larger urban centres, with the exception of Khan Yunis, are equipped to some extent with a sewerage network. The densely populated refugee camps of El Nuseirat, El Bureij, El Maghazi and El Zawida do not have any sewerage facilities, whereas the Jabalya camp is well served.

There are three treatment plants in Gaza, at Beit Lahia, Gaza City and Rafah, but none is functioning effectively. Approximately 70-80 % of the domestic wastewater produced in



Raw sewage flowing into the Wadi Gaza

STUART CHAPE

Gaza is discharged into the environment without treatment, either directly, after collection in cesspits, or through leakages and overloaded treatment plants. Most wastewater is discharged into the Mediterranean via 18 different pipelines.

The effluent from Gaza and Rafah treatment plants is also mostly discharged into the Mediterranean. In the case of the Beit Lahia treatment plant, a substantial quantity of wastewater infiltrates into the ground, contaminating soil and groundwater in the area.

Untreated wastewater discharges can cause public health risks through direct exposure, as well as through being reused on irrigated crops. The total annual wastewater production in the area is estimated to be 30 million m³, of which 20 million m³ passes into sewerage networks and the rest to cesspits or pit latrines. Waste from vacuum tankers used to clear out cesspits should be transported to a treatment plant or to a disposal area designed specifically to deal with liquid waste. The present practice is to dump the waste into the nearest open wadi, into agricultural drainage channels, or onto open fields (EQA, 2002e). The Gaza Wastewater Master Plan projects wastewater volumes to increase four fold between 2005 and 2025, reflecting high population growth in the region and with corresponding pressures on the environment (MOPIC, 1998b).

■ Beit Lahia wastewater treatment plant

The Beit Lahia wastewater treatment plant is located some 1.5 km east of the town of Beit Lahia in the northern part of Gaza. It was constructed in stages, commencing in 1976 during the Israeli occupation, and modifications were made in 1996 as a result of increased sewage inflow. The plant serves the town of Jabalya, as well as nearby refugee camps and the communities of Bait Lahia (part) and Beit Hanun. The area's total population amounts to 190,000 people. The plant has no pre-treatment facilities and has a designed peak flow capacity of 5,000 m³ per day. At present, about 12,000 m³ per day passes through the plant.

The major aim of the plant was to produce effluent of a quality suitable for direct use in irrigation. However, as a result of the poor quality of the treated wastewater, which is far below World Health Organization guidelines for use in agriculture, plans for transporting treated wastewater to agricultural areas were never completed.

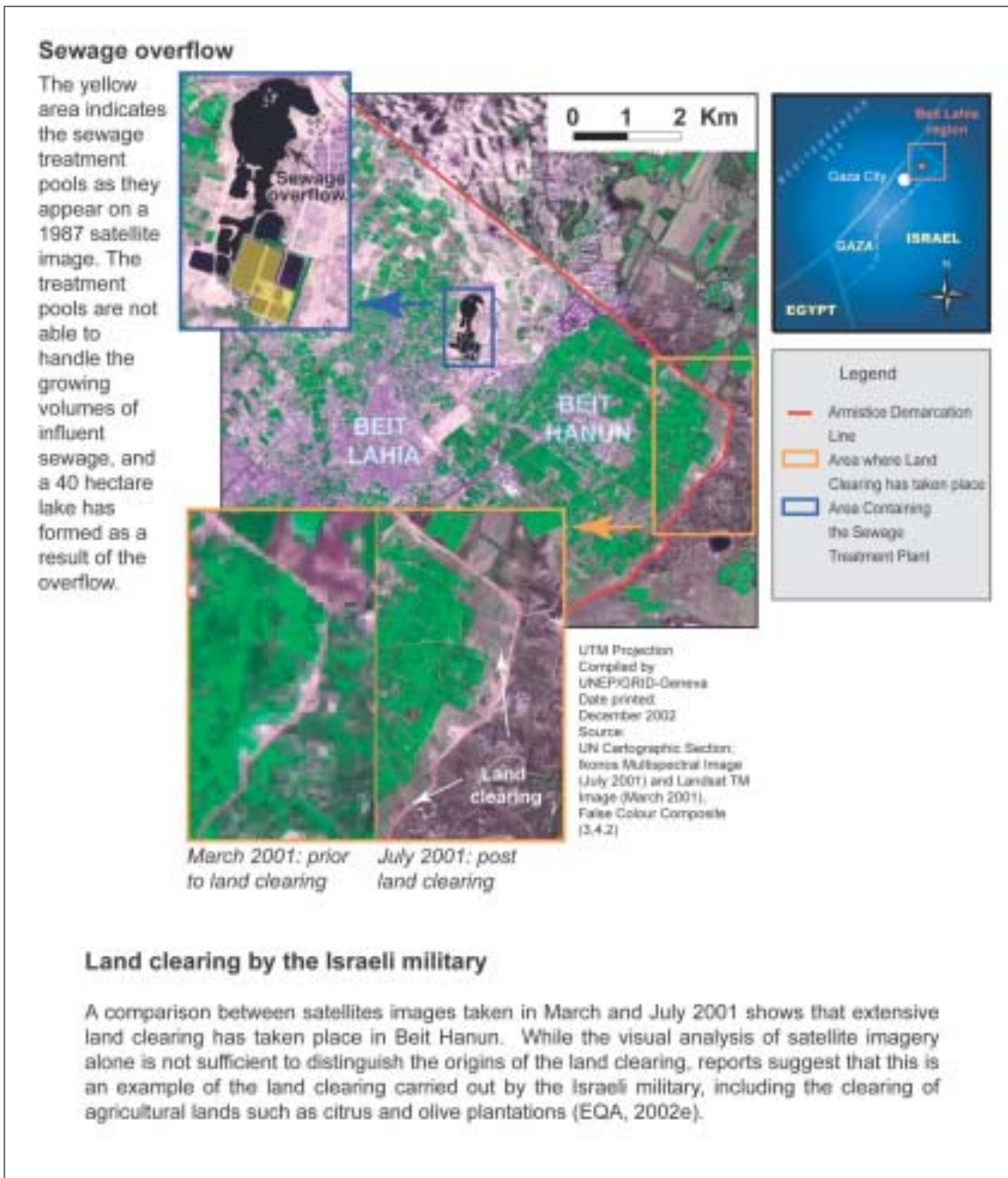
The plant is located in a closed depression without a natural outlet to the sea, although the distance to the sea is only 4.5 km. The original design of the wastewater treatment plant included four original effluent ponds that would recharge the aquifer or evaporate. However as time passed and the volume of effluent increased, the effluent overflow has formed a lake covering 40 hectares, which has become a significant pollutant of the aquifer and a major environmental health problem for the population surrounding the lake. As a result, 14 groundwater wells are no longer being used.

A new wastewater treatment plant for the Northern Governorate is planned at another location some five kilometres from the existing plant. It is to be completed in year 2010 and provide a capacity of 40,100 m³ per day. The use of activated sludge process with nitrification-denitrification is recommended.



Damage sustained to the wastewater treatment plant in Gaza from Israeli military action

► Land clearing and sewage overflow in northern Gaza



Financing, the design details and the location were pending in October 2002. The issue of location of the plant was preventing plans from moving forward, as the necessary approval by the Israeli Civil Administration was not given. The Palestinians had proposed disposing of the effluent by constructing a pipeline into the sea.

This option was not allowed by the Israeli Civil Administration which, concerned about marine pollution, proposed instead diverting the effluent to Israeli treatment facilities for treatment and re-use in irrigation. However, in a situation where water resources are scarce, and some water must be purchased from Israel, the Palestinians did not agree, particularly in the current political climate. According to information on the Joint Water Committee in December 2002 (JWC, 2002a) provided by the Israelis, progress has now been made on this issue. This information has not been confirmed by the Palestinian Authority.

As a general rule, the ongoing and deepening conflict should not be allowed to prevent action to address this critical environmental problem, both in the short-term and the long-term. Construction of the new plant will probably take 2-4 years from the starting date. In the meantime, urgent mitigation measures are required to address the environmental problems caused by the present situation. The issue of the sewage lake and measures to eliminate it should also be urgently addressed by the JWC.

■ Gaza City wastewater treatment plant

The treatment plant is located to the southwest of Gaza City and has recently been rehabilitated with an influent flow rate of 42,000 m³ per day (equivalent to what is normally a population of 300,000). Nevertheless, the plant is still receiving more wastewater than it has capacity to treat (EQA, 2001), and most of the effluent is discharged to the Mediterranean Sea. Consequently, the PWA and Gaza municipal authorities have prepared a study to expand the capacity of the plant to receive around 70,000 m³ per day, sufficient to deal with projected wastewater needs for the next five years until the establishment of a proposed central treatment plant. The wastewater treatment plant reportedly sustained damage from the conflict in early 2002 from Israeli tanks and shelling.

■ Rafah wastewater treatment plant

The Rafah wastewater treatment plant was designed for a capacity of 1,800 m³ per day (equivalent to what is normally a population of 21,000). At present the plant is overloaded and receives in excess of 4,000 m³ per day. As a result, effluent from the plant far exceeds the recommended values. The wastewater treatment plant has reportedly sustained recent damage as a result of the ongoing conflict.

■ Wastewater from Israeli settlements in Gaza

UNEP was not able to visit any Israeli settlements due to security constraints, and little information was provided on treatment of wastewater from settlements.

Palestinian sources report that Israeli settlements in Gaza that are discharging large quantities of wastewater directly into Palestinian land or into coastal waters without treatment (ARIJ, 2001).

Israel sources refute this, claiming that local compact wastewater treatment facilities are used and an effluent recycling system has been installed in one area.

On average, the settlements use four times the amount of water per capita used by Palestinians. To the extent that settlement growth and the attendant increase in water demand are served by increased pumping from the Coastal Aquifer, greater environmental pressures are being exerted in an area where there is already a high projected Palestinian population growth. According to Israel, most of the water used by the settlements originates in Israel. The Oslo II Accord requires that all increased water demand due to settlement growth be met by Israeli sources, outside the Gaza Strip. No information was available to UNEP on whether or not this is being followed.

Under present conditions, there are political obstacles to cooperation. Palestinians state that it is impossible to coordinate efforts with Israeli settlements that are illegal.

Since there are contradictory claims, the Desk Study team, with reference to the Governing Council decision, recommends that field studies be conducted in relation to the treatment of wastewater from Israeli settlements.

■ Industrial wastewater in Gaza

Industrial use constitutes only 2 % of overall water demand in Gaza, and industrial wastewater is correspondingly low as a proportion of overall discharges. At present, most of the industrial wastewater generated in Gaza is similar to domestic wastewater. This is because many industries in the area are small-scale, and 60 % do not use water in their production processes.

Samples taken from industrial wastewater show relatively high concentrations of some metals, such as cyanide (CN), including also heavy metals, such as chromium (Cr) and zinc (Zn) (MOPIC, 1998). According to information from the Environmental Quality Authority, there are three paint factories in Gaza that use substantial quantities of toxic and hazardous materials. Wastewater from some industries is highly contaminated and is discharged to the municipal sewerage system without treatment. To reduce this problem, each factory should be required to carry out pre-treatment before discharge to the municipal sewerage network. However, because the overall volume of industrial wastewater in the region is low, heavy metals and other pollutants are sufficiently diluted for treatment processes to continue functioning and for effluent to be re-used for crop irrigation or groundwater recharge. If the overall volume of industrial wastewater were to grow, this would cause major problems in terms of further groundwater contamination.

■ Wastewater projects and investment in Gaza

There is currently little significant investment in Gaza's wastewater sector, although international donors have supported several small infrastructure projects. It can therefore be expected that the already heavy burden of environmental contamination – and associated health risks – will continue to grow. The ongoing conflict has effectively delayed the approval of many wastewater projects on the ground in Gaza. In addition, since September 2000, municipal personnel encounter severe difficulties in carrying out maintenance tasks due to restrictions on movement and access.

In February 2001, less than 5 months after the outbreak of the intifada, the JWC issued a joint call to for keeping the water infrastructure out of the cycle of violence. However, Palestinian water and wastewater infrastructure has been damaged on several occasions by the Israeli military since that date. Annex D contains the text of this joint declaration.

According to the Palestinians, difficulties have been experienced in obtaining permits or commencing actual construction of plants. These issues are addressed under the Israeli-Palestinian Joint Water Committee (JWC), a body established under the Oslo II Accord. The JWC is the only joint body that continues to meet, although up to now on an irregular

basis. The JWC members include technical staff as well as military personnel. In this declaration, they "reiterate their commitment to continue cooperation in the water and wastewater spheres". However, the agenda has focussed more on water management than on environmental considerations. There are reportedly difficulties in obtaining authorisation from the Israeli Civil Administration for the construction of planned wastewater treatment plants for security reasons or because the planned sites are located in Israeli-



ANIKET GHAI

Sewage cover damaged by tank in the Jenin city centre

controlled areas C, and make the criticism that Palestinian efforts to treat wastewater are inadequate. Information provided by the Israelis on the December 2002 meeting of the JWC received from the Israelis makes reference to progress on the Hebron wastewater project and Gaza wastewater treatment plant construction.

5.4 Wastewater situation in the West Bank

■ Overview

In the West Bank, only 30-35 % of the population as a whole is connected to sewerage networks. The majority of the population uses individual or communal cesspits for temporary storage of wastewater. Cesspits are emptied by vacuum tankers, which usually dump their contents onto open ground, or into wadis, sewerage networks, irrigation channels, or solid waste disposal sites.

In spite of the low overall percentage of access to sewerage, approximately 70 % of houses in the main West Bank cities are connected. On the other hand, in refugee camps sewage flows through open drains originally constructed to convey rainwater. Most villages have no sewerage system and wastewater is discharged into soak-away (infiltration) pits. The existing wastewater treatment plants in the West Bank are inadequate to serve the volume of wastewater being discharged (EQA, 2001).

■ Jenin wastewater system

Jenin has a small wastewater treatment plant, constructed in 1972 and modified in 1993, the capacity of which is 760 m³ per day. The existing treatment facilities consist of three ponds with a total surface area of 10,500 m² and a depth of 3 metres. The plant has not been operating effectively for some time; among other problems, the aerators are broken. Untreated effluent is draining into wadis resulting in potentially serious environmental and health risks, including groundwater contamination. The untreated (or inadequately treated) effluent is also being used for irrigation. Approximately 13 % of Jenin's population is connected to the wastewater treatment plant through the sewerage network, which has a total extent of 20.6 km. A large proportion of the network is old, undersized and/or broken (ARIJ, 2002a).

During the UNEP visit in October 2002, Jenin Municipality reported that, owing to the ongoing conflict, it had been unable to purchase essential spare parts from Israel. A large number of manhole covers had reportedly been broken, and other damage caused to the wastewater system by Israeli tank patrols.

There are proposals for a new wastewater treatment plant within Area B on the outskirts of Jenin. This would also include construction of 130 km of sewerage lines. The plan also



Manhole damaged by tank in the centre of Jenin



During the Israeli military incursion of spring 2002 in the Jenin Refugee Camp, buildings were destroyed and the sewage system was heavily damaged

envisages reuse of effluent for irrigation. The current stage of planning is unclear and it is therefore uncertain when construction (projected to take 3-5 years) could begin and where financing would come from. The German cooperation agency, GTZ, is currently working on upgrading of the existing sewerage network for Jenin and has been mentioned as a possible investor in the proposed new wastewater treatment plant.

UNEP visited the wastewater treatment plant and is able to confirm that it is not functional. UNEP was also surprised that permission had been given to construct houses in the immediate neighbourhood of the wastewater treatment plant, as normal land-use planning does not locate residential areas near such plants. The mission also noted that a solid waste dump site had been established next to the treatment plant and therefore also close to houses. However, the latter is likely to have been out of necessity rather than choice, as curfew and closure measures are a severe constraint to the transport of solid waste to locations further away.

■ Nablus wastewater system

Nablus district sewerage system is a combined system collecting sewage and storm water. In Nablus city itself, the network covers 70 % of households. The remaining part of the population uses cesspits. The western sewerage pipeline, within the municipal boundaries, discharges into wadi Nablus, as does the wastewater from several villages located close to Nablus. A permit has been issued to establish a treatment plant with German government funding. On the eastern side of the district, the present pipeline discharges into wadi Al-Sajoor, from where sewage flows through wadi El Badan and into the Jordan valley. In this way, wastewater either pollutes the aquifer through percolation or is used by farmers for irrigation. Israel has reportedly invested in an emergency facility to capture and treat wastewater from Nablus that flows to the Alexander stream in Israel.

Cesspits are the most common form of sewage collection in villages, accounting for more than 60 % of the district's overall population. The use of cesspits has led to environmental and health risks, with leakages polluting wells and springs. In most refugee camps, wastewater flows through open channels liable to overflow during heavy rain. The untreated wastewater is used for irrigating vegetables, fodder crops and fruit trees with no consideration of water quality (ARIJ, 1996b).

■ Tulkarm wastewater system

Tulkarm district is in the same situation as other parts of the West Bank. Wastewater is either collected and discharged into wadis or temporarily stored in cesspits prior to dumping (ARIJ, 2002a). A survey carried out by ARIJ in 1996 showed that 70 % of the population depend on cesspits for wastewater disposal and only 30 % benefit from connection to a sewerage system, and that these only exist within the borders of Tulkarm municipalities and refugee camps.

The sewerage network in Tulkarm city extends to 25 km, while that in Qalqiliya has a length of 40 km, covering 75 % of the population. Only 50 % of the wastewater flows into the stabilization ponds operated by the municipalities; the other half flows into Israel where an emergency treatment facility has been constructed to prevent pollution of the Alexander stream. According to the ARIJ survey, leakage of wastewater from the sewerage networks in both Tulkarm and Qalqiliya reaches 50 %.

Most of the cesspits in the Tulkarm district are built without concrete linings in order to encourage sewage infiltration to the ground and thereby minimize emptying costs (ARIJ, 1996e). However, this can also cause further groundwater pollution.



JENS JENSEN

Ramallah wastewater treatment plant

■ Ramallah wastewater system

The existing treatment plant was constructed in 1974. It has been overloaded for many years, and treatment therefore has little effect. Mechanical failure of some of the equipment has also been reported. Effluent from the plant is discharged into the nearby wadi. The Ramallah municipal authorities informed the UNEP mission that German funding has been made available for some upgrading of the wastewater treatment plant, though the level of planned investment is unclear and a technical study would be needed before the work could take place.

There are plans for constructing a new wastewater treatment plant for Ramallah. The plant would be located in Area C, meaning that Israeli approval of the plans is required. Oral approval was reportedly given in August 2000. However, as a result of the renewed conflict since September 2000, no further progress has been made.

Though delayed by the conflict the construction of a new wastewater treatment plant has recently been completed in Al-Bireh, close to Ramallah. Ninety-five per cent of the population of 50,000 have been connected. One of the reasons why it has been possible to construct this plant is that it also serves an Israeli settlement. Israelis and Palestinians have agreed that the party producing wastewater shall reimburse the other party for the full real cost of treatment. However, as no metering device has been installed and no institutional mechanism set up, the Al-Bireh municipality is unable to measure the proportion or volume of wastewater received from the Israeli settlements. According to the municipality, no payments for treating wastewater from the settlement have been received.

■ Jericho (Ariha) district

Wastewater disposal and management in the district is inadequate and could be considered the worst in the West Bank. There is no collection network in the district, with all residents depending entirely on cesspits for wastewater disposal. There is minimal industrial activity and therefore disposal of industrial wastewater is not a major concern.

■ Bethlehem (Beit Lahm) district wastewater

Several types of industrial wastewater are generated in Bethlehem (Beit Lahm) district, which has a mixture of small, medium and large industries located in residential areas. These include stone cutting, and textile, detergent, paint, tobacco, food and beverage factories. Most of the factories here, as in other areas of the West Bank, discharge their wastewater into wadis and open areas, much of which flows to the Dead Sea. Israeli sources report that a major part of sewage is treated at the Soreq wastewater treatment plant. The many stone-cutting facilities use large quantities of water for cooling of cutting blades. A recycling system could help save water in this industry.

■ Hebron (Al Khalil) wastewater

At present there is no functioning wastewater system for domestic or industrial purposes in Hebron (Al Khalil). Domestic and industrial effluent is discharged untreated into wadis on the outskirts of Hebron (Al Khalil).

USAID is financing an ongoing sewerage system project for Hebron (Al Khalil) Governorate. Sewerage pipelines and household connections are currently being installed in Hebron (Al Khalil) city, and a second phase, also supported by USAID and planned to commence in 2004, will involve construction of two wastewater treatment plants to be located at Bani-Naim and Adh Dhahiriya. The total project cost is estimated at US\$ 45 million. In the meantime, an Israeli emergency facility is planned to treat some of this sewage.

■ Estimated physical damage to wastewater systems in the West Bank

The rapid needs assessment carried out between March and May 2002, within the framework of the joint UNDP/World Bank mission for the appraisal of infrastructure damage in the West Bank, produced the following data on damage to wastewater systems in the main West Bank cities as a consequence of the renewed conflict since September 2000.

The UNEP team visited the UNRWA Jenin refugee camp in August and October 2002. In August, in the area where most Israeli military operations had been carried out, there was evidence of damage to sewerage systems in the camp, although it was not possible on either visit to obtain an accurate estimate of the extent of this damage. Where pipes had been broken, untreated sewage was forming small puddles and seeping directly into the ground. On the second visit, there was evidence that repair work undertaken by UNRWA had advanced.



UNDP/PAPP provided support to the UNEP mission

■ Wastewater from Israeli settlements in the West Bank

According to some of the literature, many Israeli settlements in the West Bank have no form of treatment for domestic or industrial wastewater, the number of settlements and settlers has increased and no apparent measures have been taken to solve the environmental problem of untreated wastewater. According to these sources, effluent flows freely into nearby wadis without consideration of its environmental impacts. Much of the effluent affects area C, which is under Israeli control (ARIJ, 2001).

Table 5.1 UNDP / World Bank damage assessment

Area	Estimated damage in US\$	Type of infrastructure damaged
Jenin	330,000	Manholes, sewerage lines and treatment plant
Nablus	375,000	Manholes, collection basins, sewerage cleaning, sewerage lines, construction work
Ramallah	467,500	Sewerage lines, pump station (4), treatment facilities
Bethlehem (Beit Lahm)	100,000	Sewerage lines, manholes
Hebron (Al Khalil)	400,000	Manholes, sewerage lines, wastewater pumps, reservoir

Source: Estimate of physical and institutional damage, West Bank. March – May 2002, www.support-group.org.

Israel provides a conflicting account of the situation, stating that the majority of the 11 million m³ of wastewater from settlements in the West Bank is treated. Sixty-six percent of the settlements are reported to have wastewater treatment plants, but no information was available to this Desk Study on the actual volume of wastewater that is treated. Plans are reportedly underway for the wastewater from settlements currently untreated.

Under present conditions, there is no coordinated approach to wastewater management between the Israeli settlements and the Palestinian population. UNEP was not able to visit any Israeli settlements in the West Bank due to security constraints. Since there are contradictory claims, the Desk Study team, with reference to the Governing Council decision, recommends that field studies be conducted.

■ Effluent from West Bank olive oil production and olive mills

Olive growing and oil production is important to the Palestinian economy. Production of olive oil is located mainly in northern parts of the West Bank, but the industry's influence and impacts extend throughout the Occupied Palestinian Territories.

There are more than 200 olive oil mills in the West Bank, which operate for a maximum of two months per year. During this processing period, the amount of effluent ('zebbar') discharged can reach an estimated 1,000 m³ per day, though annual crop yield variations mean that such a high level only applies once every few years. The liquid waste generated is generally drained untreated into the sewerage network, cesspits or open areas, without any consideration as to its environmental impact on groundwater, surface water, soil, flora or fauna.

When the waste is discharged into aquatic systems, the high content of carbohydrates and other nutrients causes a rapid increase in micro-organisms, which need dissolved oxygen. This reduces the oxygen available to other organisms and may severely impact on ecosystem functioning. The liquid waste also contains phenols, which require special attention.

When the waste is discharged to terrestrial systems, the non-soluble compounds can form a film on the ground surface and on plant leaves, as well as on the surface of sandbanks or riversides. This reduces the ability of sunlight, oxygen and water to penetrate into the ground, and plant growth is therefore reduced, contributing to the stresses that cause and/or accelerate desertification.

Recent investigations concluded that there is no currently available, appropriate and feasible pre-treatment technology that would result in anything other than minor improvements to the situation (SWEMP, 1999a). Rapid progress in developing increased wastewater collection and 'end of pipe' treatment capacity is therefore required.

☞ **Effluent from West Bank tanneries**

Tanning is the process of transforming animal skins into leather, involving the removal of hair, flesh, blood and fat by mechanical and chemical means. The effluent from the tanneries in the south of the West Bank, loaded with organic substances, salts and other chemicals, has led to the area being identified as an environmental 'hot spot' (SWEMP, 1999c). The corresponding feasibility study looked at potential treatment for the effluent and means of minimizing impacts on the environment and on public health. The proposed long-term solution is to relocate all of the tanneries into a single site with enough space for construction of a common treatment plant.

In the short term, it is recommended that existing lagoons east of Hebron (Al Khalil) be used as natural evaporation ponds for tannery effluent. A small pumping station with a pressurized conveyance line should be installed to transport the effluent. Recycling measures within each tannery could also alleviate some of the problems and help to minimize wastewater production.

■ **Wastewater projects and investment in the West Bank**

As in Gaza, there is currently no significant investment in the wastewater sector and therefore little or no progress towards solving the heavy environmental burden – and associated health risks – resulting from inadequate handling and treatment of wastewater in the West Bank. However, international donors have financed some relatively small infrastructure projects. The ongoing conflict has effectively led to the suspension of project implementation since September 2000, while associated mobility and access restrictions mean that existing facilities are not being maintained properly.

Within the cities of the West Bank, suitable sites for major infrastructure projects such as wastewater treatment plant construction, are available only in area C. These plants require relatively large areas of land close to densely populated areas. The issue of connecting Israeli settlements to new treatment plants is problematic, often being cited as a precondition for Israeli approval of Palestinian proposals (such approval is required for all construction in Area C). Palestinians are opposed to Israeli settlements in the West Bank and Gaza, and critical of supporting infrastructure that might give any permanency or legitimacy to these settlements.

According to Israel, connection to settlements is not a precondition for approval. Israel states that it wishes to increase the capacity and efficiency of wastewater treatment in the region, and combining infrastructure can lead to reduced operational and maintenance costs.

6

Solid waste

6.1 Institutional and organizational arrangements

The Ministry of Local Government is the main coordinating agency for solid waste management within the Occupied Palestinian Territories, having overall responsibility for the relevant functions of local authorities. The Regional Solid Waste Councils is responsible for the construction of solid waste plants, under the supervision of the ministry of Local Government. The Ministry of Planning and International Cooperation is responsible for the overall planning and fund raising, while the Environmental Quality Authority is responsible for licensing of sites, environmental monitoring, provision of expertise and ensuring environmental protection. However, as a result of the current crisis and related Israeli security measures such as closures and curfews, these central responsibilities are largely inactive.

Most of the day-to-day processing of solid waste (collection, transportation and disposal of waste, and operation and maintenance of facilities) is the responsibility of the local authorities. In larger towns and cities, this is usually the local municipality, while in smaller localities the village councils play a key role, often with coordination provided by the district authorities.

Since the outbreak of the second intifada, the access of municipal maintenance staff to solid waste dumps has, at various times, been difficult or impossible, as a result of curfews, partial or full closures, and overall worker safety and security considerations. Israeli security measures have also created difficulties in obtaining spare parts.

However, according to Israeli information, there are also cases where there is some cooperation, for example, sites operated jointly or where solid waste from Palestinian towns is disposed of at Israeli waste disposal sites (for example, the Adumim receives waste from several Palestinian municipalities).

Though subject to severe constraint under the prevailing conditions, local authorities continue to perform solid waste management functions. Most recycling, as far as it exists, continues to be carried out by the private sector.



Solid waste container in Ramallah

In the refugee camps, most solid waste collection and transport is carried out by the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA), using its own equipment and management procedures. UNRWA normally uses disposal sites operated by local authorities.

In recent years, several regional solid waste management councils have been established, for example in northern and central Gaza, Bethlehem (Beit Lahm), Hebron (Al Khalil), and Jenin, grouping together all municipalities, villages and rural areas in a given region into a single entity. These councils have focused mainly on developing proposals for regional waste management solutions.

According to Israel, within the Israeli settlements, solid waste collection and disposal in the settlements is monitored by the Israeli Associations of Local Councils for Environmental Quality. Israel affirms that the major part of its solid waste legislation, as well as accompanying inspection and enforcement, is applicable to Israelis living in the settlements. UNEP was not able to verify this information during the Desk Study.



Solid waste truck in state of disrepair



Gaza solid waste dump site

6.2 Existing municipal solid waste management situation

■ Solid waste types and generation

Local surveys and estimates indicate that household waste accounts for 45-50 % of the total solid waste, with the construction and industrial sectors together constituting 20-25 %, and remaining types (e.g. commercial, institutional) 25-30 % (Al-Hmaid, M., 2002).

Hazardous material is to some extent present in all these waste types, although such material is only a significant component of industrial and hospital waste. There is virtually no separation of hazardous waste, except for some limited treatment of infectious waste, for example in Jericho (Ariha), Nablus, Gaza city and Khan Yunis cities, and disposal of old medicines (Gaza city). Hazardous waste is mixed with municipal solid waste during both collection and disposal. There are few available data on quantities of hazardous waste.

Several studies in the Occupied Palestinian Territories over the last decade have included pilot surveys and/or professional estimates of solid waste generation and composition.

These suggest that levels of solid waste generation are as follows: in refugee camps: 0.5-0.8 kg per capita per day; in rural areas: 0.4-0.6 kg per capita per day; in towns/villages and rural areas: 0.6-0.8 kg per capita per day; in cities: approximately 0.9-1.2 kg per capita per day. It is difficult to obtain adequate population data for calculating overall levels of solid waste generation. Nevertheless, it is estimated that total annual solid waste generation in exceeds 300,000 tons, while that for the West Bank altogether is likely to approach 500,000 tons (Al-Hmaid, M., 2002).

For the Israeli settlements it is assumed that general solid waste generation figures from Israel may apply. According to recent statistics for Israel, the average municipal solid waste

generation in 2000 was 2.21 kg per capita per day in urban areas and 1.96 kg per capita per day in rural areas. An overall figure of approximately 2.0 kg per capita per day has been applied here. Exact population figures for Israeli settlers were not available, so best estimates have been used. Somewhere between 150 and 200 settlements have been established within the Occupied Palestinian Territories, of which approximately 10 % are in Gaza (Gabbay S., 2002).

On this basis, it is estimated that total annual solid waste production by Israeli settlements in Gaza could be of the order of 15,000 tons, with the corresponding estimate for West Bank settlements being 131,000 tons.

■ Solid waste composition

Detailed figures from various pre-September 2000 studies and surveys indicate the composition of municipal solid waste in the Occupied Palestinian Territories to be as follows: organic materials 60-70 %, paper/cardboard 7-10 %, plastic 5-10 %, glass 3-6 %, metals 2-3 %, and others 3-7 %. The high content of organic materials is notable (Al-Hmaid, M., 2002).

For the Israeli settlements it is assumed that the composition to a large extent reflects recent composition data for municipal solid waste in Israel, i.e. organic materials 43 %, paper/cardboard 22 %, plastic 14 %, glass 3 %, metals 3 %, others 15 % (Gabbay S., 2002).

■ Solid waste projections

When scoping and designing future solid waste collection, transport, recycling, treatment and disposal systems, it is important to use projections of future waste quantities and estimated composition. Any projection of quantities must take into account population increases (currently 4.0 % per annum in Gaza and 3.4 % in the West Bank. PCBS, 2001), service coverage and changes in the types of waste generated (e.g. due to increased income and changes in consumer practices). In addition to projecting solid waste quantities in terms of weight, it is also useful to estimate likely volumes in order to determine future landfill capacity needs.

■ Solid waste service fees

Currently, the provision of solid waste collection and disposal services consumes a large portion of the budgets of the municipalities and village councils. However, the contribution through fees from the people served in general is marginal and varies from one city or village to another; many have no fees at all. Collection fee coverage in a non-conflict situation is in the range of 10-20 % of the real municipal solid waste management costs. There are no disposal fees collected in the Occupied Palestinian Territories.

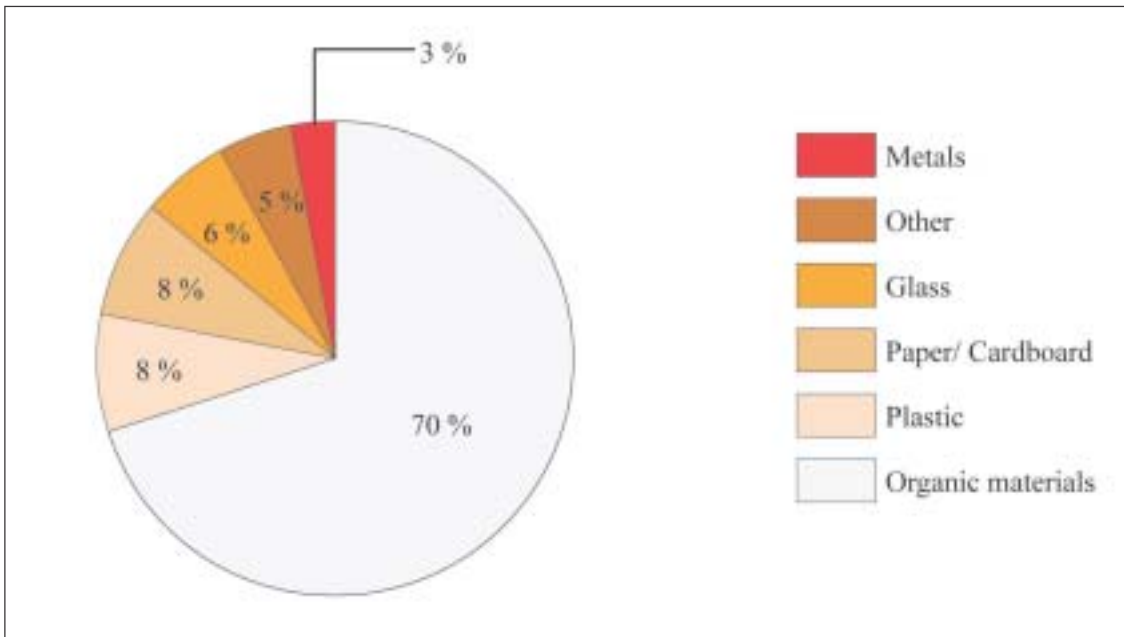


Skip-lift truck undergoing repair in a Palestinian workshop

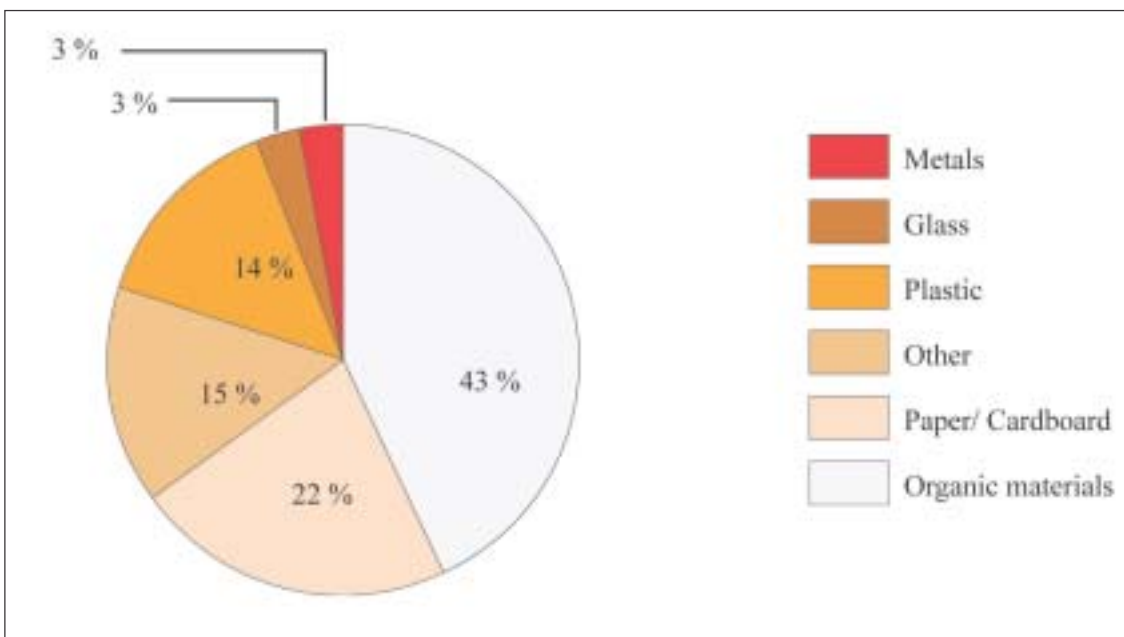
■ Existing systems and technical status

The urban collection system is based on three systems: (a) compacting trucks and 800-1,000 litre steel containers (mostly in the city centres); (b) larger 5-6 m³ communal containers collected by skip-lift or roll-on trucks; and (c) 800-1,000

► Composition of municipal solid waste in the Occupied Palestinian Territories



► Composition of municipal solid waste in Israel



litre steel containers emptied by tipper crane trucks. There is currently no urban door-to-door collection. Smaller communities and villages normally use manual door-to-door collection combined with truck transport.

Many of the trucks have been provided through various donor programmes over a period of some years. As a consequence, the model of equipment varies quite widely, causing challenges for maintenance. However, the receptacle system (containers and bins) appears to have been standardized in a way that allows most trucks to collect the various containers used. In the refugee camps, the United Nations Relief and Works Agency for Palestine

6

Refugees in the Near East (UNRWA) uses 800-1,000 litre steel containers and 5-6 m³ communal containers collected by trucks.

GAZA

Under non-conflict conditions approximately 95 % of the population in Gaza is serviced by a collection system.

Over the past two years, the curfews and road-blocks have resulted in the use of alternative routes to reach destinations, thereby increasing transportation distances and operational costs. As a result, transfer and haulage systems have been introduced (e.g. in Gaza city), utilizing a state-of-the-art truck and trailer system with two large non-compacting containers.



ANIKET GHAI

Damaged solid waste collection bin

There are currently three landfills in Gaza; one each in south, central and northern Gaza respectively. All have been established through donor-funded projects and have basic infrastructure and equipment, including weighbridges to measure the weight of trucks. According to the Environmental Quality Authority, the landfills in southern and northern Gaza are located on impermeable ground outside the recharge area for the coastal aquifers, and thus do not have liners or leachate collection systems. The landfill in central Gaza has a liner and leachate collection and treatment system installed. According to the Palestinian Authority, all of the locations were selected on the basis of appropriate studies. During the Desk Study, Israel claimed that the Beit Hanun landfill was posing a risk, and submitted a letter to Israeli officials from GTZ in which concerns are raised about environmental safety



UNEP

Restrictions to access seriously disrupt the collection and transport of solid waste

(IMoE, 2002g). Since there are contradictory claims, the Desk Study team, with reference to the Governing Council decision, recommends that field studies be conducted.

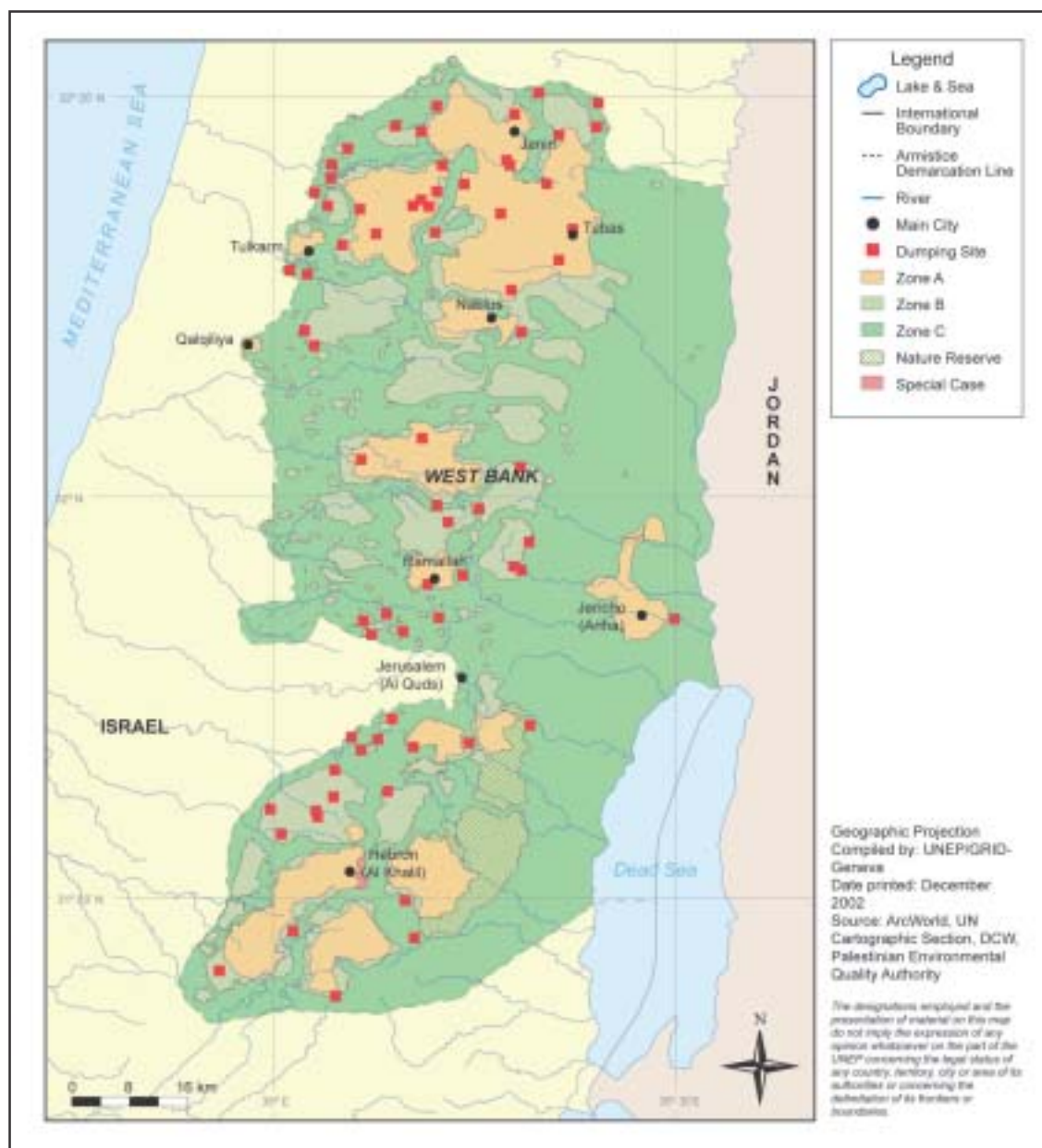
Pilot composting plants have been established in connection with the northern and central landfill, but neither is currently functioning. At the Gaza city plant, the cover has been destroyed by gunfire, while the structure and paved surface remain. In these conditions, workers are also at risk of being harmed.

At the Gaza city landfill, a designated site for disposal or storage of hazardous waste has been established.

WEST BANK

Under non-conflict conditions, approximately 67 % of the West Bank population is served by a municipal solid waste collection system.

► Solid waste dumping sites in the West Bank



However, no acceptable disposal sites were in operation or under construction in the West Bank, even before September 2000. Prior to this date, some of the 80-100 sites in use, such as Al Bireh, were suitably located, but lacking in infrastructure and mitigation measures. Since December 2000, the Palestinian have been prevented from using the Al Bireh site, and so the Ramallah municipality has had to re-open its abandoned and overloaded dumpsite. Bulldozers are used at some sites, either through municipal ownership and operation, or through occasional rental. A municipal solid waste compactor is in use near Nablus.

In the various refugee camps, the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) uses 800-1,000 litre steel containers emptied by tip-per crane trucks.

Only basic information was available to this Desk Study on the disposal of solid waste from Israeli settlements. Israel refutes reports by Palestinians that Palestinian sites are used and that their own sites were not operated in accordance with newer Israeli environmental standards. Since there are contradictory claims, the Desk Study team, with reference to the Governing Council decision, recommends that field studies be conducted.

There have reportedly been situations where private Israeli contractors have disposed of both hazardous waste and municipal solid waste in parts of the Occupied Palestinian Territories outside official Israeli control. Hazardous waste is discussed in the next chapter.

■ Operational conditions and problems

Overall problems in solid waste management in the Occupied Palestinian Territories can be summarized as:

- Disruption of normal solid waste transportation routes due to a number of checkpoints being closed to Palestinian vehicles;
- Lack of access to normal disposal sites for the same reason;
- Lack of access to maintenance equipment and spare parts due to delays, transport difficulties caused by roadblocks, curfews and closures, and current import restrictions;
- Dramatic increase in the waste generated from the destruction of buildings and infrastructure;
- Introduction of open burning under the current situation;
- Creation of emergency dumpsites within the urban areas, with the associated negative environmental and health impacts;



Emergency dump site in Ramallah

- Increase in operational costs, adding to the financial burden on municipalities whose revenues have fallen sharply since September 2002.

In general, the municipal solid waste agencies appear to be operating well despite the difficult conditions. When reviewing the number of available collection trucks in some areas and the quantities of waste generated, there appears to be scope for more efficient utilization of the equipment notably through extending the period of time it is in use each day.



Solid waste collection container damaged by the Israeli military in Jenin

On the whole, the collection trucks have not sustained direct damage arising from the ongoing conflict, though the receptacle system (containers and bins) has been partially destroyed over the last two years.

A damage survey was conducted by the Donor Support Group during March to May 2002. This included a list of reported damage to the solid waste system on a district-by-district basis and the cost of returning it to a pre-September 2000 status (Donor Support Group, 2002d).

The present situation, with strictly enforced mobility restrictions, makes it impossible or very difficult to reach the network of disposal sites in operation before September 2000. For many municipalities, this has resulted in the establishment of emergency sites closer to collection areas. For others, re-routing of waste transport has been necessary, often using poor, unpaved roads, causing increased wear-and-tear to vehicles.

During periods of full closure and/or curfew, disposal of solid waste in the usual designated sites is not possible, and random temporary disposal takes place, often within city and town limits. The high temperatures over the summer months give rise to immediate problems, including rotting of waste, and related health and environmental risks, as well as problems related to the odour. To reduce volumes or to eliminate accumulating and rotting waste, inhabitants resort to burning solid waste within city limits, a practice that carries serious environmental and health dangers.

The closure and curfew conditions have also made it difficult to obtain the necessary products to control pest and vermin outbreaks arising from this disposal within city limits. The Jenin Municipality officials reported that it was with the utmost difficulty that they managed to keep the vermin situation under control.

In Gaza, the three main disposal sites are, in principle, well located, but all are close to the Israeli border. This causes general access and security problems both for waste transport and for landfill operation. This situation has in some places led to the establishment of temporary emergency sites close to collection areas. Furthermore, open burning is imposing environmental and – potentially – health risks for both Palestinians and Israelis.

Dioxins and furans are released from open burning, especially from any polyvinyl chloride (PVC) contained in the waste. These hazardous substances cause long-lasting damage to the environment – to the air, soil and eventually groundwater. People living in the vicinity of these sites may seek to close the site altogether, which will further worsen the problems of lack of space for disposal.



SUSAN BRANNON

Dump site in Jenin

The practice of open burning of solid waste was previously quite widespread throughout the Occupied Palestinian Territories, although the Environmental Quality Authority and the local waste management agencies made attempts to control it prior to September 2000. Under present conditions, this practice has been reintroduced more or less as a necessity according to the local authorities, to avoid smell and health hazards and to reduce the volume of waste. At all sites visited by UNEP, open burning was taking place.



JENS JENSEN

Burning of solid waste within Bethlehem city limits

In both Gaza and the West Bank most of the trucks and municipal workshops are fairly intact. However, due to re-routing on poor roads, the equipment is deteriorating rapidly. Combined with a lack of spare parts due to import restrictions, this is creating increased capacity problems in the collection system.



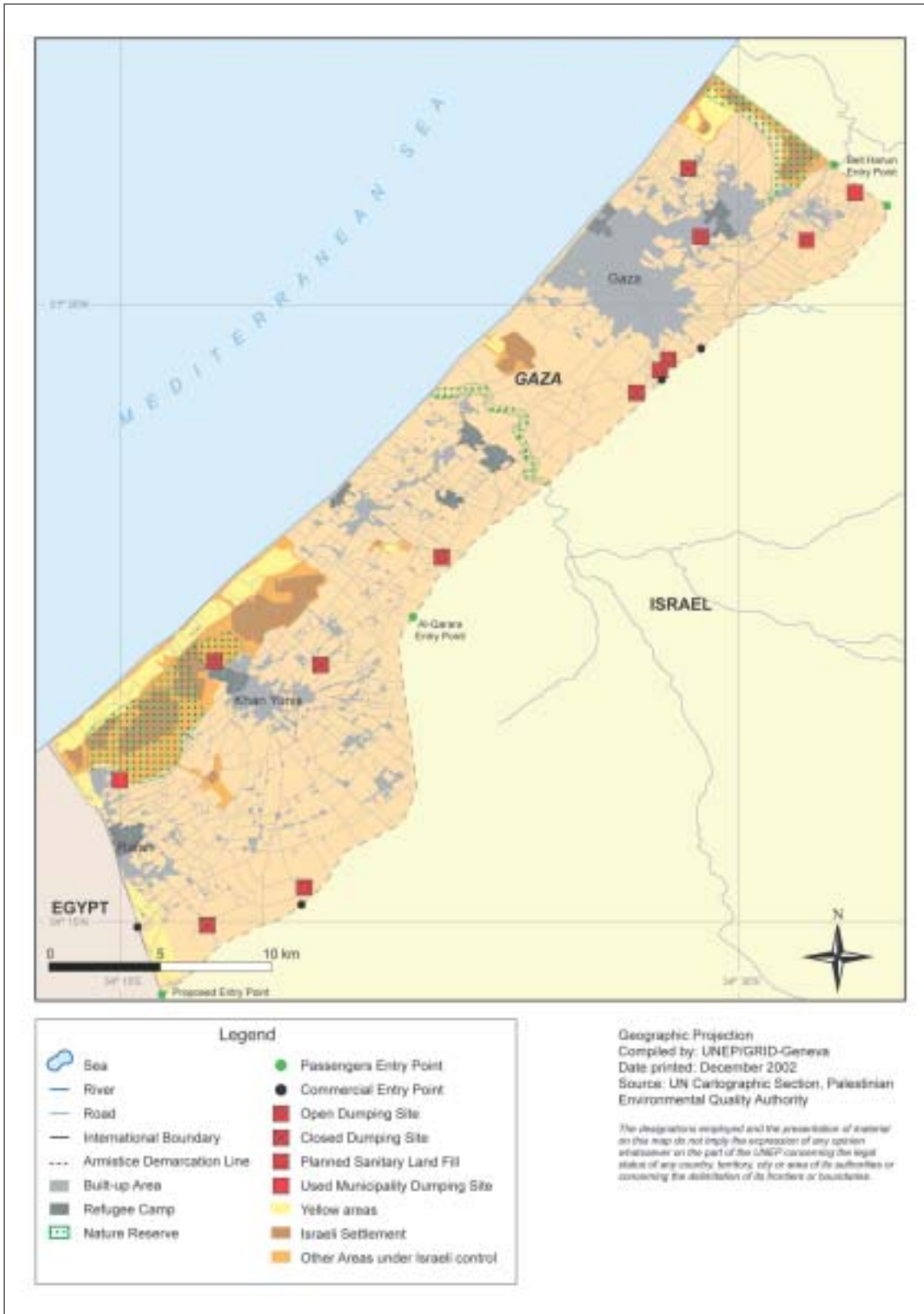
ANIKET GHAI

Solid waste collection bin crushed by tank, Jenin

The receptacle system (containers and bins) has been partially destroyed. Detailed information on the extent to which this has taken place in the various regions in Gaza is contained in a damage report prepared by the Support Group.

Many of the municipalities report severe operational and maintenance problems due to lack of access to spare parts caused by current import restrictions. Lack of funding may also be a

► Solid waste dumping sites in Gaza



problem in some areas – it was mentioned as a priority need during UNEP interviews with Jenin municipal authorities.

The single designated temporary storage site for hazardous waste in Gaza has until now only been used for small quantities of old medicines. However, the facility is functional. The current situation has apparently caused delays in establishing a separate hazardous waste handling system, since the municipal solid waste agencies are more or less occupied with finding day-to-day solutions for the major portion of the waste stream. The same applies to the pilot composting schemes in north and central Gaza, both currently on hold.

The West Bank totally lacked disposal sites of an acceptable standard prior to September 2000, which pose a risk of pollution to the aquifer. As a consequence, an initial and temporary upgrading of the disposal site system must be an urgent activity. Furthermore, many of the cities and communities have been forced to use temporary emergency sites close to the collection area, resulting in somewhere between 200 and 450 emergency sites, depending on the source of information used throughout the area.



Solid waste accumulating by the roadside in the West Bank

Many of these temporary sites are in locations that cause unnecessary impacts and problems (e.g. on hilltops). Minor relocation to adjacent valleys or depressions might improve the situation substantially. It was evident that proper environmental impact assessments had not been carried out.

Under current circumstances, the Israeli environmental authorities appear to have limited control over solid waste management within the Israeli settlements. On the one hand, recent cases have shown that some settlements overrule internal Israeli decisions (e.g. the Al Bireh situation); on the other hand, the ability to move around safely and to provide control and guidance is reduced. Consequently, the extent of uncontrolled solid waste disposal has increased. However, many of the sites now closed to Palestinians are still in use by Israelis (e.g. the Al Bireh site visited during the UNEP mission). Implementation of

costly upgraded solid waste management solutions that comply with Israeli standards may be unrealistic in the present crisis situation.

Although costly investments are made in housing in settlements and in security road construction, it has not been a priority to invest in protecting the environment. Palestinian sources claim that Israeli settlements are generally located on the top of hills, and that wastes are dumped, causing pollution to the wadis below.

■ Environmental impacts

The present deepening crisis has several general impacts in the Occupied Palestinian Territories:

- Lack of mobility during curfews and other special restrictions cause municipal solid waste to pile up during the periods in question. This is both an environmental problem and – even more – a health problem;

- Lack of site access causes the use of emergency disposal sites close to or inside the cities and villages, resulting in emissions to water and air, as well potential health hazards;
- The widespread practice of open burning causes additional environmental and health risks;
- Handling of both hazardous waste and infectious waste mixed with municipal solid waste also causes environmental and health risks;
- Large quantities of construction debris are generated by the destruction of houses, public buildings and infrastructure;
- Many cars, trucks and vehicles were damaged during the Israeli occupation incursions generating large amounts of this type of waste;
- Different types of military waste were generated by the use of bullets, tear gas, bombs, rockets and other types of ammunitions.



Solid waste dumpsite near Ramallah

In Gaza, the main impacts are:

- Air emissions from open burning on both emergency sites and normal sites, with impacts to soil and groundwater resources. Since the population density is extremely high, this is of particular relevance;
- Other local impacts from smaller emergency sites close to residential areas;
- Local impacts from uncollected waste caused by inadequate available equipment and by curfews and special restrictions in certain periods.

The same impacts apply to the West Bank. An additional impact is the pollution of groundwater, since many of the existing sites are located on permeable ground and recharge zones of major aquifers. Since the West Bank currently has no operational landfills, many of the negative environmental impacts will continue even in a non-conflict situation.

■ Existing studies, plans and projects in the solid waste sector

Many studies in the Occupied Palestinian Territories have been carried out in recent decades by Palestinian environmental authorities, foreign consultants or local NGOs and consultants. In addition, in 1995, ARIJ carried out a major survey of the existing municipal solid waste situation in the West Bank (ARIJ 1995a-1995c). The German government-owned corporation for international cooperation, GTZ, has been responsible for many of the projects in Gaza, while the World Bank has focused mainly on the West Bank. The EU has also carried out many solid waste projects throughout the Occupied Palestinian Territories.

The general advice emerging from these studies has been to develop a limited network of sanitary landfills as the main disposal system, comprising three sites in Gaza and three to five in the West Bank. Studies have also focused on separation of hazardous and infectious waste, and on composting as an additional treatment due to the prevalence of organic



ANIKET GHAI

Slurry from quarries is dumped in temporary landfill outside Bethlehem



ANIKET GHAI

Stone quarries near Hebron create dust and spoil the landscape

and closure/removal of emergency disposal sites. This level of expenditure would be 100 % covered by donor contributions within the overall infrastructure funding for the West Bank. The corresponding figures for Gaza were not available as at December 2002.

The Palestinian environmental strategy and action plan identifies the following solid and hazardous waste projects at an estimated cost of US\$ 3 million: closure and rehabilitation of several old municipal dump sites; reuse of construction debris; management of used motor oil; and medical and hazardous waste management.

It is still unclear to what extent several of the proposed disposal sites in the West Bank can be activated in a non-conflict situation. Some are in areas that have become sensitive in the current situation and others, such as the Hebron (Al Khalil) /Yatta site, have been experiencing problems with Palestinian neighbours. As anywhere else in the world, there are cases where the “not in my back yard” principle has been problematic in locating sites.

The regional site to be developed south of Jenin is currently the subject of a tendering process, and Jenin Municipality officials hope that construction will begin in the near future.

An NGO pilot project on composting is in preparation in Bethlehem (Beit Lahm) district, but is experiencing severe location problems due to Palestinian neighbour protests.

matter in the waste stream. Although several projects have included design and initial land acquisition for landfill sites in the West Bank, none has been established so far.

A large portion of the existing operational equipment (such as containers and bins, trucks and bulldozers) throughout the Occupied Palestinian Territories has been provided through donors but there is room for improvement on coordination, standardization or prioritization.

In general, and particularly in the West Bank, solid waste projects seem to be less coordinated than, for instance, projects within the water supply sector. No overall solid waste strategy has been presented recently. However, work undertaken by the Donor Support Group in March-May 2002 included a financing section with prioritization of activities and proposals for donor coordination (Donor Support Group, 2002d). According to this, there is a need for approximately US\$ 2.8 million for initial measures within the solid waste sector in the West Bank, to be split between the replacement of containers and bins, removal of debris

6.3 Assessment

■ Solid waste assembly, collection, transfer and transport

The existing procedures seem to be based largely on international or local professional planning, resulting in systems and equipment that are appropriate and quite modern. With a focus on serving adequately as large a portion of the population as possible, while keeping costs low, key elements would usually be:

- To minimize the number of truck trips to disposal sites;
- To optimize the collection routing, thus minimizing the travelling distance and time;
- To maximize the number of fully loaded trips to the disposal site (two trips per day should be an average minimum for trucks collecting small containers, but three or more trips would be preferable);
- To utilize to the maximum extent possible the available equipment;
- To provide a suitable and accessible receptacle system for the population served.

With the present composition and high density of municipal solid waste, the need for compaction may be limited when the transport distance to the disposal site is short.

In the short term, the existing combination of equipment will remain relevant. However, the use of small 5-6 m³ communal containers and skip-lift or roll-on trucks is not the most efficient, resulting in a high number of trips with small loads. A system of medium or large back-loading compacting trucks for unloading a number of containers during each trip may be more efficient. For planning purposes, one truck for every 10,000 to 20,000 inhabitants served (depending on the container system and vehicle size) would be appropriate.



Roll-on truck

When gross domestic product (GDP) per capita increases, the density of the waste is reduced due to the lower content of heavy organic matter and increased content of lighter paper, plastics, and other packaging material. Consequently, as a long-term solution, compacting collection systems must be more or less the standard.

Door-to-door systems, or at least additional more dispersed manual collection, could still be a relevant solution in a situation with a large unemployed workforce. This system is active (using donkey- and hand-carts) within some town areas and where vehicle access is limited. To introduce this system in more high-income suburban areas would be dependent on the people in such areas paying fees that would fully cover the costs.

The location of larger communal containers must take into consideration the walking distance involved. International experience indicates that this should not exceed approximately 100 m if uncontrolled local disposal is to be avoided. Furthermore, planning should be based on a collection of containers two or three times a week, depending on the season.

■ Transfer and haulage systems

When a network of fewer disposal sites is established, the travel distances will increase, particularly in the West Bank. This will make a transfer and haulage system financially and technically viable in many regions. Transfer and haulage will be increasingly viable as the number of people in the collection area increases. With the existing rather high density, compacting before haulage may not be necessary, but this must be introduced in long-term transport systems. State-of-the-art systems are already in extensive use in Israel, so regional experience is available.

It is questionable whether transfer and haulage is appropriate with the short transport distances in Gaza under a non-conflict situation. Normally, transfer and haulage is not viable with average transport distances less than approximately 15 km one way.

■ Solid waste recycling

In municipal solid waste management, a principal priority is to reduce in waste generation and promote reuse, recycling, and resource recovery. Waste reduction is mainly an educational and awareness challenge and can be encouraged in most societies. In the present crisis situation (and prior to September 2000), there are very few incentives for recycling in the Occupied Palestinian Territories, except for components having a potential net value through recycling. The almost complete absence of disposal fees fails to take advantage of the most common rationale for recycling, namely saving on disposal costs. The Occupied Palestinian Territories constitute a relatively small community and the industrial sector is very limited. Thus, the domestic potential is limited for industrial processing of many fractions that can potentially be recycled, and will probably continue to be so at least in the short and medium term.

The rationale for recycling could be pollution reduction, volume reduction, commercial use or substitution of virgin raw material. Another important aspect of recycling is that the specific costs for this go up with the increasing degree of recycling. In the Occupied Palestinian Territories, the best way to start recycling is with the fractions having a net value (metals), or those that supply a local demand (soils/compost), solve a particular problem (debris) or correspond to a domestic processing capability (metals and glass).

One low-cost approach is to focus on voluntary schemes based on incentives and education. This could bring the recycling rate up to 10-12 %. To be able to achieve more, mandatory schemes and higher costs must be introduced. In the Occupied Palestinian Territories, such measures will be mainly applicable to the long term.

Some recycling activities previously took place in the Occupied Palestinian Territories, mainly in the private sector, and focusing on metals, glass and to some extent paper. Metals and glass were handled in Nablus and Hebron (Al Khalil), respectively, while other fractions were brought to Israel. Car wrecks were recycled in Nablus.

In the region, the recycling industry is extensive in Israel, with some 1,100,000 tons recycled domestically in 2001, equating to a national rate of approximately 16 %. In a non-conflict situation, cooperation with this industry would be a natural option. There are currently some possibilities for financially viable export of certain fractions (e.g. cardboard, high-quality paper etc.) to Turkey. Egypt also has a very extensive recycling activity and could be another option for export.

In the proposals for future measures, the conditions mentioned above have been taken into consideration. An initial, low ambition of material recycling of, for instance, 5 % may be

set, increasing to 10 % in the medium term and 25 % in the long term. If seen as recycling, low-tech composting can increase the recycling rate substantially.

One particular fraction – debris – has become a major problem in many areas owing to the destruction of buildings and infrastructure. Most of the debris is in fact inert material (concrete, bricks, plaster etc.), which could be seen as recyclable and not as waste. Such material can be used in road-building, construction foundations and landscaping, or be crushed to gravel. The challenge is to extract minor problem fractions such as reinforcement, wood etc. This may be achieved through using special cutting equipment designed for environmentally-friendly demolition. Such equipment is inexpensive and can be fitted on existing excavators.

■ Municipal solid waste treatment and disposal

INTRODUCTION AND SELECTION

The most common treatment and disposal options are: incineration, composting, advanced central sorting and disposal in sanitary landfills.

It must be stressed that any municipal solid waste management system must have a landfill for the remaining portion of the solid waste stream. Furthermore, recycling activities must be complementary to other treatment and disposal and not in competition.

Under normal conditions, sanitary landfills will be the least expensive disposal method, followed by (low-tech) composting. Incineration and advanced central sorting are the most expensive. Furthermore, all treatment and disposal methods have a clear economy of scale.

An indicative illustration of these principal conditions is presented in the table below, which summarizes non-economic aspects of different solutions.

► Treatment cost of solid waste by waste volume and treatment method

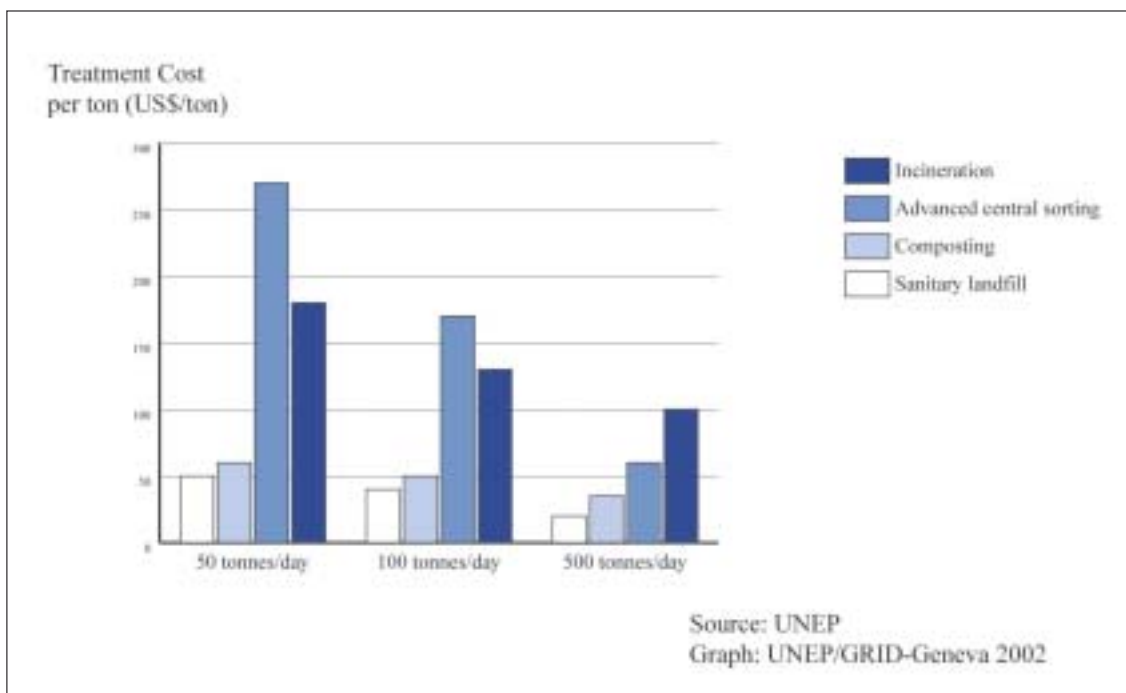


Table 6.1 Design criteria for sanitary landfills

Aspect	Sanitary landfilling	Incineration	Composting	Advanced central sorting
Environmental impact	Acceptable (assuming proper operation)	Good to very good	Acceptable to good	Good to very good (high % rejects)
Resource recovery	Acceptable (landfill gas - LFG)	Good to very good	Barely acceptable (soil conditioner)	Good
Local operation and maintenance capability (appropriateness)	Good to very good (appropriate technology)	Not or barely acceptable	Good (assuming low-tech solutions)	Acceptable
Need/market for end-product	Good to very good (LFG electricity + reclaimed land)	Very good (electricity)	Good (compost as soil conditioner)	Acceptable to good (difficult market for recycled materials)
Efficiency (% of total municipal solid waste stream handled)	Very good (~ 100%)	Good (~ 70-80%)	Good (60-70%)	Acceptable to good (30-40%)

For new landfills, the following design criteria should be mandatory:

- The useful life of the landfill should preferably be a minimum of 20 years, with an absolute minimum of 10 years;
- The site should be sealed with a natural soil liner having a minimum thickness of 0.5 m and a permeability of not more than 10^{-7} cm per second or an artificial membrane of high-density polyethylene (HDPE) or similar quality;
- On top of the liner there should be a drainage layer of minimum thickness 0.3 m;
- The site should have the following infrastructure and facilities: guarded gate and perimeter fence; weighbridge; all-weather access road with hard surface; leachate collection, treatment and disposal system; surface runoff cut-off, collection and drainage system; landfill gas collection and flaring system; gas utilization facilities when found economical; workshop, laboratory and storage buildings with equipment; administration and staff buildings; and the following minimum operating equipment: one solid waste compactor (20-40 tons depending on the size of the landfill) plus one extra compactor for backup/peak loads at larger sites, and one additional soil handling dozer;
- High-standard operational routines and practices should be in place, including planned development, frequent cover, etc;



Open burning of solid waste can cause serious negative environmental impacts

- Extensive monitoring, supervision and enforcement schemes should exist;
- Legislation and administrative / institutional arrangements should be made to follow project implementation.

7

Hazardous waste

7.1 Introduction

An essential tool in the management of hazardous waste is an inventory of national hazardous waste substances. No such inventory exists in the Occupied Palestinian Territories, and its absence makes it difficult to determine what types of waste are being generated, and where they are being disposed of.

While Palestinian legislation provides definitions of hazardous substances and hazardous waste, an inventory would make explicit the substances and wastes that are concerned. In practice, material disposed of in solid waste dumps and landfills contains a mixture of hazardous and non-hazardous substances and wastes.

Environmentally acceptable methods of disposal of hazardous material also need to be made explicit.

Hazardous substances used in the Occupied Palestinian Territories are mainly purchased from Israel, in accordance with Israel's permit system regulating these substances. Any purchase from other countries is also subject to Israel's permit system.

Israel's legislation prohibits the import of hazardous substances by anyone not holding a permit or authorization by the appointed official. Israel's legislation on the import and export of goods prohibits the release from customs of a hazardous substance before customs officials confirm that the importer possesses the necessary permit.

According to the Oslo II Accord, the facility at Ramat Hovav in Israel should be used to dispose of and treat Palestinian hazardous waste.

7.2 Overview of hazardous substance use and waste generation

There is practically no separation of hazardous and non-hazardous waste in the Occupied Palestinian Territories, with hazardous substances entering both the wastewater and solid waste streams. There are local and cross-border environmental risks.

There is no system in place for inventorying or identifying hazardous wastes. Any such system could distinguish between physical characteristics of waste - solid, liquid, sludge or gas - and whether waste is organic or inorganic, as these distinctions have implications for the type of safe treatment and disposal that is necessary. Other indicators such as flash point, calorific content, water content, and ash content have implications for transport, storage and handling.

There are currently no facilities in the West Bank for temporary storage, treatment or long-term storage of hazardous waste. The UNEP mission visited the hazardous waste cell in



Hazardous waste temporary storage facility in Gaza

Gaza that is used for expired medicine and chemical laboratory waste, and is currently operating. The concrete cell has a life span of eight years only and the chemical wastes involved are both liquids and solids. These wastes are not treated before permanent storage.

There are very few estimates of the amounts of hazardous waste generated in the Occupied Palestinian Territories, in part because of the absence of separation and inventories. In the West Bank, the amount has been estimated at 2,500 tons per year (EQA, 2002f). This amount refers to waste that has been explicitly identified as hazardous. The true amount is likely to be much higher, but is not apparent since there is no separation (and collection) or inventory.

UNEP has compiled information contained in several reports to come up with approximate estimates for the West Bank (ARIJ, 1995a-1995c & 1996a-1996e). UNEP used an alternative method for estimating quantities of hazardous waste produced in the West Bank. This method uses coefficients of hazardous waste production, industry type and number of employees (UNEP, 1982; MEnA, 2002a). These two methods produce similar figures. Where data are available, these are provided in the primarily qualitative analysis that follows.

7.3 Industry in the West Bank

UNEP was able to obtain more data on hazardous waste for the West Bank than for Gaza, particularly on industrial hazardous waste. However, many of the findings for the West Bank are also valid for Gaza. (See map, page 78)

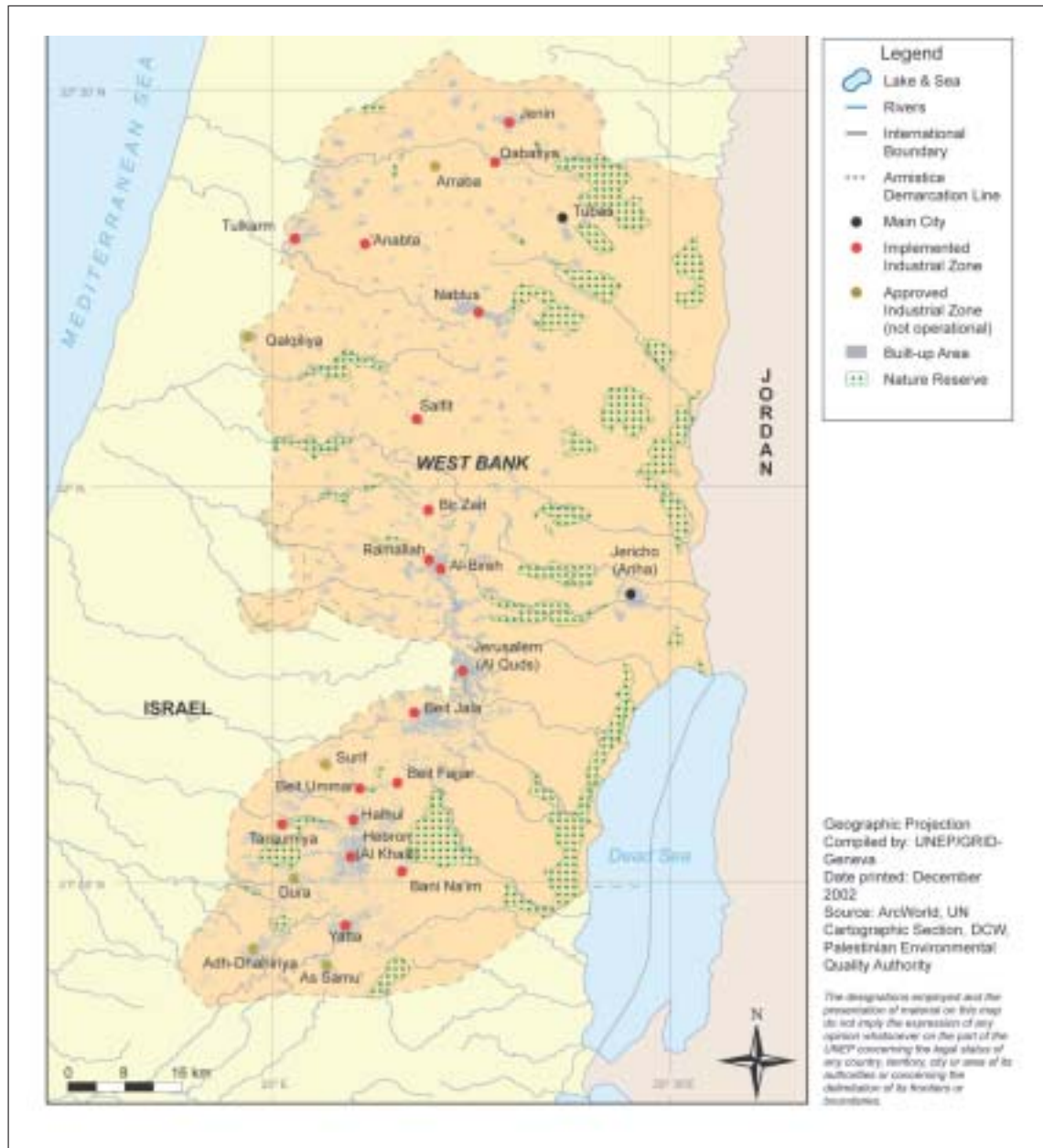
■ Food processing

Food processing generates solid and liquid organic effluent that contributes to raising the biological oxygen demand (BOD) content and suspended matter in liquids. This effluent may also contain traces of pesticides from the washing of fruit and vegetables. In addition, liquid effluents are highly saline, affecting their potential for re-use, especially in agriculture.

Slaughterhouse wastes can be used to produce ingredients in the manufacture of fertilizer, animal feed, and glues. The traditional methods of sun-drying, breaking up bones manually, composting in pits (sometimes with the addition of household organics), and steam digestion carry various health risks, and should not be considered a sound practice. Small-scale aerobic composting of animal wastes, including manures, hide scrapings, and tannery and slaughterhouse wastes can also produce fertilizers, but carries some risks in terms of spreading pathogens. All of these activities generate leachate and associated bad odours, and are typically associated with poor working conditions and risks to worker health, but may be profitable and provide subsistence income. Sound practice could involve introducing technical and health improvements, rather than eliminating the activities themselves.

■ Textiles

There are 71 textile-dyeing facilities in the West Bank producing both printed and dyed fabrics. The specific processes used by each enterprise vary considerably. The main sources of environmental pollution typically arise from the finishing phase (pre-treatment, dyeing, printing, finishing, etc.), and heat treatment (drying, reticulation and thermo-fixing on the stenters). Effluent from these industries contains high concentrations of ionic substances, organic colour and reactive dyestuffs. Heavy metals, which are used for fixing colours in the dye, are also present. Estimates of annual solid and liquid hazardous waste are 290 and 600 tonnes respectively (ARIJ, 1995a-1995c & 1996a-1996e). In addition, liquid effluents are highly saline, affecting their potential for re-use, especially in agriculture.



■ Tanneries

There are 19 small-scale tanning facilities within the West Bank, 10 concentrated in Hebron. Tanneries consume large quantities of scarce freshwater, and generate and release corresponding amounts of wastewater with significant pollution loads, and sometimes with extreme pH values.

The disposal of wastewater containing untreated tannery effluent in open valleys presents a high risk of groundwater pollution, as wastewater infiltrates through the limestone into the aquifer. Tannery effluent also has a high salt content, which cannot be removed by biological treatment. When effluent is recycled for agriculture, these salts can affect the texture of soil and reduce crop yields. Chromium is particularly problematic, since it accumulates in residual wastewater treatment plant sludge and makes sludge disposal more difficult. Hexavalent chromium salts are particularly dangerous, as they are water-soluble and potentially highly toxic and carcinogenic. Tanning also produces toxic gases, such as

hydrogen sulphide (H₂S), which are released to the environment when emptying the tanning drums.

The preservation of animal skins might include the use of insecticides or bactericides, which may be washed out during a soaking process and later drained to the wastewater system. Should this be the case, the reuse of the wastewater could lead to absorption of these insecticides and bactericides by plants and entry into the food chain.

Estimates of annual liquid and solid hazardous waste generation from tanneries are 30,000 and 690 tonnes respectively (ARIJ, 1995a-1995c & 1996a-1996e).

■ Shoe manufacture

A range of hazardous substances are used in the manufacturing of shoes, including the process of shoe/sole surface preparation (e.g. manually cleaning and conditioning surfaces using numerous solvent-based and water-based cleaners), adhesive/primer application (e.g. using a chlorinated solvent mixture which produces ethyl acetate emissions), and spray finishing and coating, or polyurethane molding. Equally, a variety of hazardous wastes are produced, ranging from ammonia compounds to arsenic, boric, phenol and chromium compounds, to mention a few. An estimated 100 tonnes of solid hazardous waste are produced annually (ARIJ, 1995a-1995c & 1996a-1996e).

■ Metal construction

The mini steel mills operating in the Occupied Palestinian Territories normally use an electric arc furnace to produce steel from steel scrap and direct reduced iron. Such facilities use a range of hazardous substances, such as heavy metals, phenol (and its salts), dioxins, furans, cyanides, and several dangerous halogenated hydrocarbons. Many different hazardous wastes are generated, in gaseous, liquid and solid form. Estimates of annual solid and liquid hazardous waste generation are 1,016 and 1,200 tonnes respectively (ARIJ, 1995a-1995c & 1996a-1996e).

■ Wood furniture

Wood furniture manufacturing involves preserving wood, as well as applying paint. Three main types of preservative are used: water-based, organic solvent-based, and tar and oil. Different oil-based and solvent-based paints are commonly used for furniture. Many of these are hazardous, such as formaldehyde and glue plant sludge. Nitrocellulose lacquer, thinner, and panel cut-offs are among the hazardous wastes potentially generated. No quantitative data on hazardous wastes from this activity are available.

■ Aluminium manufacture

Raw materials for secondary aluminium production are scrap, chips and dross. The main process for secondary aluminium production is smelting in rotary kilns under a salt cover. For demagging (removal of magnesium from the melt), hazardous substances such as chlorine and hexachloroethane are often used, which may produce dioxins and dibenzofurans. Other hazardous substances are used and hazardous wastes produced, such as salt slag and alumina. While sources indicate that aluminium is manufactured in the West Bank, no quantitative data on aluminium production or on hazardous wastes from this activity are available.



YVES GUIBERT

Hazardous waste temporary storage facility in Gaza

■ Electronic component manufacture

Semiconductors are produced by treating semiconductor substances with boron or phosphorus, using silicon and gallium arsenide. Printed circuit board is made by producing patterns of conducting material, usually copper, on a non-conducting substrate (the base can be pressed epoxy, Teflon, or glass). Printed wiring assemblies consist of components attached to one or both sides of the printed circuit board. A range of hazardous substances may be used in the production process (formaldehyde, various acids, arsenic, various heavy metals and their compounds, etc.). Various hazardous wastes are produced, in solid and liquid form (alkaline solutions, contaminated kerosene, cleaning and cutting fluids, hydraulic and other oils, polychlorinated biphenyls (PCBs), polychlorinated terphenyls (PCTs), solvents, slurry, metals, cyanides, sulphates, etc.), but also hazardous gaseous by-products (e.g. acids, solvent vapour). No quantitative data are available.

■ Electroplating and surface-coating industry

Electroplating involves the deposit of a thin protective layer (usually metallic) onto a prepared metal surface, using electrochemical processes. The process involves pretreatment (cleaning, degreasing and other preparatory steps), plating, rinsing and drying. The cleaning and pretreatment stages use a variety of solvents (often chlorinated hydrocarbons) and surface stripping agents (including caustic soda and a range of strong acids). Plating solutions are acid or alkaline and may contain agents such as cyanides. Organic solvents and thinners are required for many of these operations. A range of hazardous substances is typically used in these processes (alcohols, dioxins, furans, metals, organic compounds such as ethylbenzene and trichloroethylene, etc). Hazardous wastes produced include cyanide compounds, sludge, acids and alkalis. Estimates of annual solid and liquid hazardous waste generation are 1.8 and 96 tonnes respectively, for all electrical industries (ARIJ, 1995a-1995c & 1996a-1996e).

■ Paint

The paint manufacturing process involves the mixing of different agents such as pigments and solvents. A range of hazardous substances are used in the processes such as ethylbenzene and similar organic compounds, various acids, metals, acrylates, hazardous isomers, and alcohols, as well as particulates. Some of the wastes generated include wastes from paint and varnish, halogenated solvents, sludge (aqueous and other) from paint or varnish removal containing halogenated solvents, adhesives and resins. Estimates of annual solid and liquid hazardous waste generation are 8 and 201 tonnes respectively (ARIJ, 1995a-1995c & 1996a-1996e).

■ Used oil

About 2,500 million m³ of used mineral oil are released annually in the Occupied Palestinian Territories without any collection systems, but no adequate treatment facility is available (ARIJ, 1995a-1995c & 1996a-1996e). No reliable data are available concerning disposal methods.

Used mineral oil is recycled as lubricant in stone factories and metal processing, or used thermally as a secondary fuel. Used oil may be obtained in the Occupied Palestinian Territories by filtering used car oil and other used oil. It is also reported to be imported illegally from Israel.



YVES GUIBERT

Greenhouse treatment facility damaged by the Israeli military in Gaza

The environmental impact of discharged used mineral oil depends on its physical and chemical properties, the amounts disposed of in an uncontrolled way, the features of the underlying soil and local hydrological characteristics. Disposing of used motor oil by pouring it into storm or sewage drains, dumping it onto the ground, or disposing of it with household waste may create significant risks to human health and the environment.

Human health is affected if rainwater carries oil contaminated with metals into underground streams and therefore into drinking water. It is almost impossible to clean up groundwater once it has been contaminated. Surface runoff from ground disposal and oil poured down drains often goes to water treatment plants, streams or rivers, which can also affect drinking water supplies. Used oil from a single oil change can ruin a million litres of freshwater, a year's supply for 50 people.

Used oil contaminating surface water also harms wildlife. Oil depletes the oxygen supply of fish and other aquatic life, and hinders the ability of birds to fly. When plants are grown in soil or fed with water contaminated by used oil, they absorb (or bioaccumulate) high concentrations of heavy metals. Plants used for food or fodder should never be grown in soil contaminated with used oil. One of the indirect risks of such environmental pollution is the poisoning of the food chain, which ultimately affects human health. The geological and hydrological features and soils in most areas in the West Bank have a 'good' infiltration, as there is no significant natural barrier, and hence little protection for the groundwater.

There are several ways in which used mineral oil is being recycled, including: dumping on vacant land or in sewage systems; sale to construction companies to coat the wood used for building; burning with oil in traditional cooking ovens; and sale to the pottery or food industry for use as fuel.

■ Israeli settlements

Israeli settlements are located in areas C, which are under Israeli control. Concern has been expressed that, for reasons such as fiscal incentives, weak enforcement and monitoring of environmental regulations in the settlements, polluting industries have migrated from Israel to the settlements and have proliferated. The case of the relocation of Geshurei Industries has been cited, a manufacturer of pesticides and fertilizers. Reportedly, the site was closed down in its original Israeli location of Kfar Saba in 1982 for environmental concerns, but subsequently set up operation in the West Bank town of Tulkarem, because of laxer controls on waste disposal and air pollution. Other Israeli industries have reportedly relocated to the Tulkarem area, including asbestos, glass fiber, pesticide, and flammable gas industries (ARIJ, 2001b).

Israeli settlements are also reported to release quantities of hazardous waste without treatment. The Barqan industrial zone are said to release 810,000 cubic metres of industrial wastewater per year, including hazardous waste (ARIJ, 2001c).

Israel refutes these reports, claiming that Israeli settlements follow Israeli legislation on disposal, and that in a few cases where illegal activities were discovered, enforcement measures were taken to close down the industry and prevent environmental degradation. Israel claims further that there is no evidence to support a trend of relocation of pollution industries.

Israel states that only 4 of the one hundred factories in the Barqan industrial zone produce hazardous waste, which is disposed of at the Israeli Ramat Hovav site, and that the industrial wastewater is not hazardous. Some of the other claims mentioned above are also refuted.

The UNEP Desk Study was not able to resolve these conflicting statements. If polluting industries are indeed relocating from Israel to take advantage of weaker environmental controls and standards, this situation should be addressed urgently, as it constitutes a "loop-hole" in overall efforts to protect the environment in the region. As is the case with the non-separation and treatment of hazardous waste generated by Palestinians, in the longer term, this could be detrimental to Israelis and Palestinians alike, given that many key environmental resources, such as aquifers, are shared. Since there are contradictory claims, the Desk Study team, with reference to the Governing Council decision, recommends that field studies be conducted.

According to information from the Palestinian Environmental Quality Authority, the Kiryat Arba settlement releases polluting effluent from the alcohol industry into the sewerage system of the Hebron municipality.

7.4 Industry in Gaza

Industrial hazardous waste in Gaza is generated from print and photography shops, from the use of printer toner, chemicals, and film degrading. Mechanical workshop produce wastes from oil, grease, break fluid and batteries. The textile garment industry generates waste from dyes, chemicals, oil, grease, and auxiliary chemicals. Paper factories use bleaching chemicals, glues, and auxiliary chemicals. Other industries producing hazardous waste include construction materials, woodwork, plastics, batteries, leather tanning, metalwork, and food processing. (See map, page 83)

7.5 Medical waste

Medical waste covers several categories: infectious waste, pathological waste, pharmaceutical waste, genotoxic waste, chemical waste, wastes with high heavy metal content, pressurized containers, and radioactive waste. Such waste may be generated at hospitals, clinics and other health care facilities, but also at research laboratories, mortuaries and blood banks.



ANIKET GHAI

Expired medicines



YVES GUIBERT

Expired medicine in storage facility, Gaza

In the West Bank, 330 tonnes of contagious waste, 65 tonnes of biological waste and 2 tons of sharp objects are generated each year (ARIJ, 1995a-1995c & 1996a-1996e). The quantity for Gaza has been estimated at only 0.2 tonnes (PCBS, 2002). One explanation for the low value of this figure is that it refers to amounts that are collected, rather than total amounts including the waste that enters the domestic waste stream. This waste stream is disposed of in open dump sites.

In a few cases, some chemical or thermal treatment takes place. The Nablus and Hebron (Al Khalil) hospitals use site incineration treatment, but these centres are not properly equipped with combustion gas treatment. Incineration treatment also takes place in Khan Yunis, Gaza and Jericho (Ariha). Some of these use thermal treatment processes, such as autoclaving, for the sterilization of specific biological waste. Hazardous air pollutants are released from these treatment facilities such as hydrochloric acid from polyvinylchloride (PVC) medical equipment, or noxious gases from incomplete combustion.

► Industrial sites in Gaza



7.6 Special wastes

Special wastes include hazardous waste not directly linked with a type of industrial activity, including: pesticides in agriculture, polychlorinated biphenyls (PCBs) in electrical installations, dioxins, asbestos in building material, household waste, radioactive waste, and used tyres.

■ Pesticides

Both the Palestinian Authority and Israel have in place legislation to regulate the import and export of pesticides (EQA, 1999a; IMoE, 2002b). The Environmental Quality Authority informed UNEP that, in the Occupied Palestinian Territories, a total of 123 pesticides are currently used, some of which are internationally suspended, banned or regulated by the Stockholm Convention. Although the Palestinian Authority is not a Party to the Stockholm Convention, the Environmental Quality Authority's chemical regulations department prohibits the passage of internationally banned chemicals. Despite these efforts, illegal chemical still may find their way into the market.

DDT is reportedly used for fishing and used oils employed as herbicide. As acquisition of these substances from Israel requires authorization from both Israeli and Palestinian administrations, one may assume that the banned pesticides are distributed outside the official channels, and their sale driven by the profits to be made from this trade. Measures should be taken to ensure that these pesticides are not used.

The total quantity of pesticide used is estimated at 730 tons in the West Bank (ARIJ, 2002b). During the Desk Study mission, the Environmental Quality Authority indicated that in Gaza more than 900 tonnes per year of authorized pesticides are imported from Israel and used, but that over 100 tonnes per year of obsolete, banned or restricted pesticides are sold and used by Palestinian farmers, the latter entering Gaza through unauthorized channels.

■ Polychlorinated biphenyls

Polychlorinated biphenyls (PCBs) are widely used as additives to oils in electrical equipment, hydraulic machinery, and other applications where chemical stability is required for safety, operation, or durability. Although the chemical stability of many PCBs has been a benefit from the standpoint of commercial use, it has created an environmental problem because it translates into extreme persistence when the PCBs are eventually released into the environment.

Prior to establishment of the Palestinian Authority, the Israeli national electrical company managed the electrical system in the Occupied Palestinian Territories. The Israeli Ministry of Environment informed UNEP that no PCBs had been used during this period. To date, no PCB inventory has been carried in the Occupied Palestinian Territories, although the quantity of PCB transformers is not expected to be very high since local suppliers of electrical transformers mainly use mineral oil transformers. All of the ten transformers in a Gaza workshop were examined by UNEP and found to use mineral oil.

Owing to the large market for second-hand transformers in the Middle East, it would nevertheless be useful to survey the transformers, both in use and decommissioned, to check if there is PCB contamination.

■ Dioxins and furans

Polychlorinated dibenzo-p-dioxins and dibenzofurans, hexachlorobenzene and polychlorinated biphenyls may be unintentionally formed and released from, among others,

the open burning of waste (especially if this contains polyvinylchloride, or PVC), residential combustion sources, motor vehicles, particularly those burning leaded gasoline, and textile and leather dyeing. No measurement of dioxin emissions has been carried out in the Occupied Palestinian Territories. The practice of open burning is very dangerous for the environment, both the air and soil, and ultimately the groundwater.

■ Asbestos

Asbestos cement building products have frequently been used in construction in the Occupied Palestinian Territories, particularly as a covering material. While undisturbed asbestos cement presents no threat to human health, when buildings are bombed, dust containing asbestos fibre could be produced, which would be dangerous to persons living in the proximity of the destroyed buildings. Many of the buildings destroyed by the Israeli military in southern Rafah and the southern part of Gaza have roofing covered with asbestos cement.

■ Household hazardous waste

Household hazardous waste includes substances such as oil-based paints, paint thinner, wood preservatives, pesticides, household cleaners, used motor oil, antifreeze and batteries. No data are available for the quantities.

■ Used tyres

Stockpiles of used tyres create not only land-use problems but also environmental hazards. Stockpiles can self-ignite and create long-lasting fires resulting in negative human health impacts. When tyres are disposed of in landfills, they often rise to the top and make it difficult to maintain the soil cover on the landfill. Tyre fires are extremely dangerous. They are difficult to extinguish, pollute the air with hazardous compounds and potentially toxic gases (for example, anthracene, aromatics, arsenic, benzene, butadiene and cadmium, to mention a few), and contaminate the ground with the oil and ash created during fires, thus endangering ground and surface waters. Further, tyre dumps and improperly discarded tyres are ideal breeding grounds for disease-carrying mosquitoes and rodents.

■ Waste batteries

Hazards from waste batteries are associated with improper handling and disposal. Improper handling can result in spillage of corrosive fluids that can cause chemical burns and damage to a wide variety of materials. Metals in batteries, including lead, mercury and cadmium, are toxic. Improper disposal of batteries in landfills may result in the release of corrosive fluids and dissolved metals into groundwater and the environment. They bioaccumulate in plants and animals and persist in the environment.

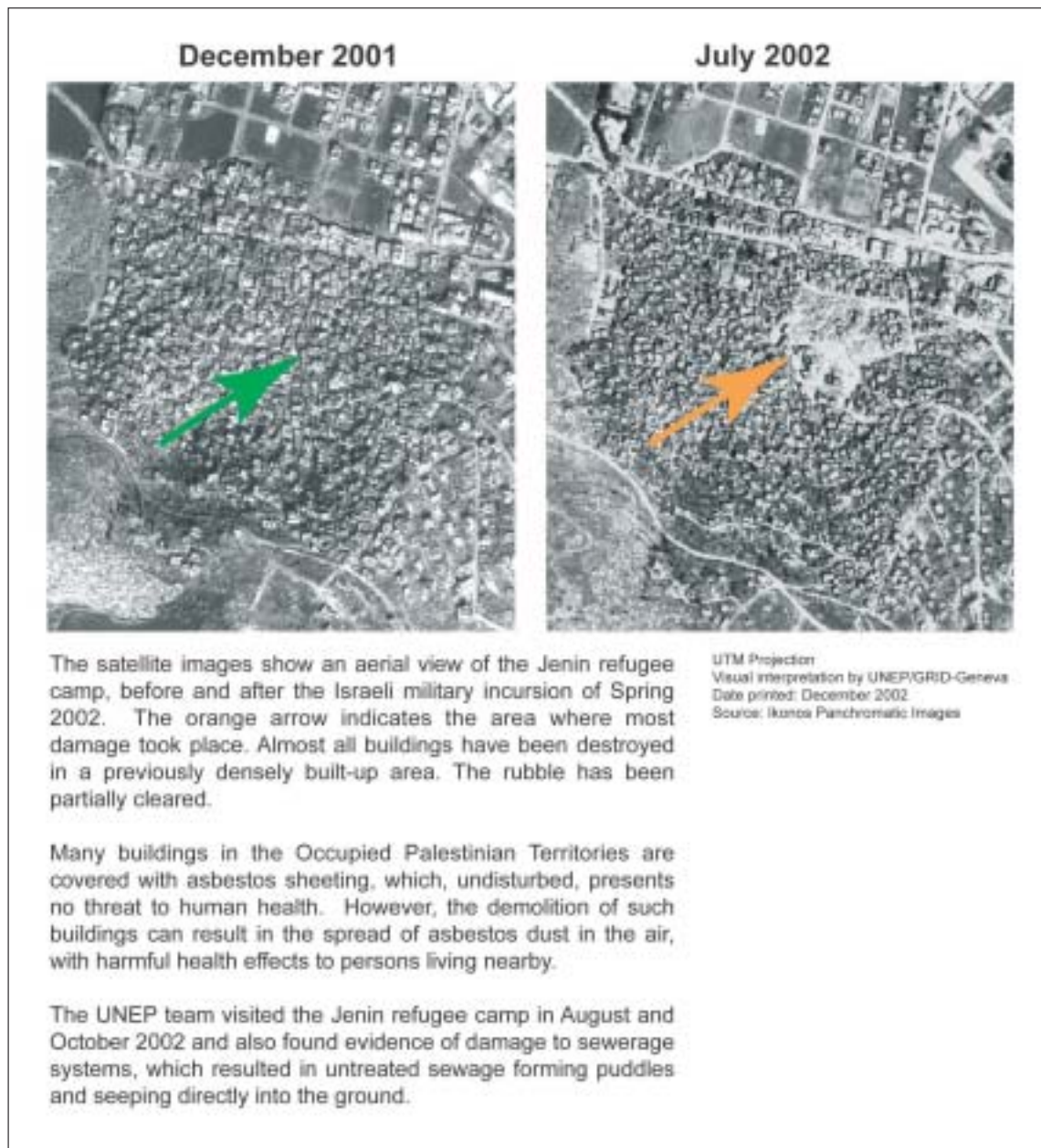
■ Sewage sludge and septage

Sewage sludges are generated in sewage treatment plants, while septage is the material pumped from septic tanks. Both of these materials contain large quantities of pathogenic



STUART CHAPE

Damage sustained to the headquarters of His Excellency, President of the Palestinian Authority Yasser Arafat, in Ramallah



organisms and, often, chemical contaminants too. They therefore require proper treatment and disposal. The Palestinian Environmental Quality Authority reported that sludge from the Al Bireh wastewater treatment plant is being disposed of next to the plant owing to closure of the Al Bireh dumpsite, and that septage from the Deir Dibwan community have been discharged into wadis since closures and curfews have prevented usual disposal.

■ Illegal dumping of hazardous waste

Several cases have been reported of illegal dumping of hazardous waste in the Occupied Palestinian Territories. In March 1998, 28 barrels of hazardous waste were found dumped on the Gaza Beach at the Mawasi area. These barrels have been taken back by Israel. In March 1999, about 250 barrels of unknown chemical waste were dumped near Um El-toot village in Jenin (MEnA, 1999c).

In April 2001, a truck unloaded 80 barrels containing oil and paint wastes. Sixty-three barrels were returned to the waste producer and 17 barrels were spilled in a storage site (MEnA, 2001b). Some 50,000 tons of waste suspected to be hazardous was buried on the beach south of Deir El Balah (EQA, 2002h). The Environmental Quality Authority informed UNEP that the source of the dumped hazardous waste was Israeli. If the waste originated from Israeli companies, even though the Occupied Palestinian Territories are not a party to the Basel Convention, the Convention binds Israel, which is a party. Such dumping is also contrary to Israel's national legislation.



ANIKET GHAI

UNEP Desk Study expert inspects Gaza hazardous waste facility

Any waste of Palestinian origin should be disposed of according to the Oslo II Accord, namely that pending the establishment of appropriate alternative sites by the Palestinian side, disposal of chemical and radioactive wastes should be only to the authorized sites in Israel.



YVES GUIBERT

Barrels containing an unknown substance found by Palestinians are temporarily stored at the Gaza facility

7.7 Radioactive waste

There are no nuclear facilities in the Occupied Palestinian Territories, but there are some sources of radioactive waste, including radioactive hospital waste, potentially radioactive waste from industry, lightning rods, fire alarm equipment, and potentially radioactive material from military sources.

Special attention should be paid to all radioactive waste because of the potential negative impacts on the environment and human health.

During the UNEP Desk Study, the Environmental Quality Authority raised concerns on three specific types of radioactive material: potentially radioactive construction waste; radioactive components from helicopters; and the possible use of depleted uranium munitions. It is important that all radioactive material is separated and disposed of in a safe manner. When needed, the International Atomic Energy Agency (IAEA) should be consulted.

■ Radioactivity in construction material

All building materials contain varying amounts of natural radioactive nuclides. Materials derived from rock and soil mainly contain natural radionuclides of the uranium (U 238) and thorium (Th 232) series, and the radioactive isotope of potassium (K 40). Radiation exposure due to building materials can be divided into external (caused by direct gamma radiation) and internal exposure (caused by the inhalation of radon, thorium, and their short-lived decay products). The Environmental Quality Authority indicated that it had analyzed construction materials imported from European countries through Israel with a level of radioactivity four times higher than the normal level, and that the risks associated with such materials had been reported in Israeli newspapers, *Yedi'ot Ahronot* of 8 June 1999, and *Ha'aretz* of 4 July 2002. Examination for radioactivity should be at the first port of entry.

Equipment should be made available to the EQA to enable it to undertake a survey to measure and examine radiation in buildings with suspect materials.

■ Radioactive components from helicopters

During the mission, the Environmental Quality Authority informed UNEP that radioactive components of Israeli helicopters had been found on the ground in parts of the Occupied Palestinian Territories. Copies of related correspondence from the company that manufactured these components were provided to UNEP (General Nucleonics, 2001; MEnA, 2001d). The document indicates that these components (Serial No. 24494 MER./PN 12210-1, Indicator: FO 9603-96-D-0513-0062 and Sock No. 6620-01-125-8904, Refurnished Jan 1297) are IBIS Pressure Indicators, which are part of the in-flight rotor blade inspection system installed on Israeli Air Force CH-53 helicopters. Many modern helicopters are now equipped with devices which do indeed emit beta radiation. Such components are fairly strong sources of radiation, and are potentially dangerous. For example, keeping such components close to a person's skin (e.g. in one's pocket) for 2-3 days could result in serious skin irradiation. Due to the potential risks to health and the environment, in all case of where material suspected to be radioactive is found, there should be proper analysis, clean-up if required, handling and storage.

■ Depleted uranium

During the Desk Study, the Palestinian Environmental Quality Authority requested UNEP to undertake field studies related to depleted uranium (DU) at targeted sites in the Occupied Palestinian Territories.

DU is a by-product of the process used to enrich natural uranium ore for use in nuclear reactors and in nuclear weapons. Like naturally occurring uranium, DU is an unstable, radioactive, heavy metal that emits alpha, beta and gamma ionizing radiation. DU is less radioactive than natural uranium and also less radiotoxic. DU has multiple uses by military forces. It can serve as counter-ballast in both aircraft and missiles, may be used in the armour of tanks, or as anti-armour ammunition.

There has been concern that depleted uranium has been used by the Israeli military against Palestinian targets (EQA, 2002). During the UNEP mission, the Environmental Quality Authority submitted to UNEP a report from a laboratory it had commissioned to carry out an analysis of ammunition thought to contain DU. UNEP



Material disposed of in solid waste dumps contains a mixture of hazardous and non-hazardous wastes

transmitted this report and its accompanying spectrometer analysis for review to Spiez Laboratory AG, which had worked with UNEP on earlier DU assessments in the Balkans. This laboratory determined that the spectrum was consistent with a natural soil spectrum, and provided no indication of the presence of DU. Only naturally occurring radioactivity was identified.

As a general rule, UNEP recommends that all claims on radioactivity should be investigated seriously and measurements carried out, provided adequate information is available on locations where such material has been used. Relevant United Nations agencies should be consulted on the issue of radioactivity.

Conservation and biodiversity

8.1 Introduction

Interrelated biodiversity conservation and natural resource management issues are essential for the future environmental integrity and sustainable development of the Occupied Palestinian Territories.

The Palestinian Authority and Palestinian NGOs have made considerable progress in identifying, analysing and evaluating key environmental concerns over recent years, though lack of capacity for natural resource management is critical. This lack of capacity has increased since the start of the intifada in September 2000, through the slowing down and, in many cases halting, of important programmes and initiatives, and most direct Palestinian-Israeli cooperation. The overall result has been a worsening of the long-term degradation of biodiversity and natural resources. In some cases the international funding planned to support implementation has also been suspended.

Furthermore, the establishment of areas A, B and C under the Oslo II Accord, under current conditions, has reinforced fragmentation of landscapes and made coherent and integrated approaches to effective conservation management virtually impossible.



Date palm

STUART CHAPE

8.2 Biogeographical context and biodiversity values

■ Regional biogeographical context

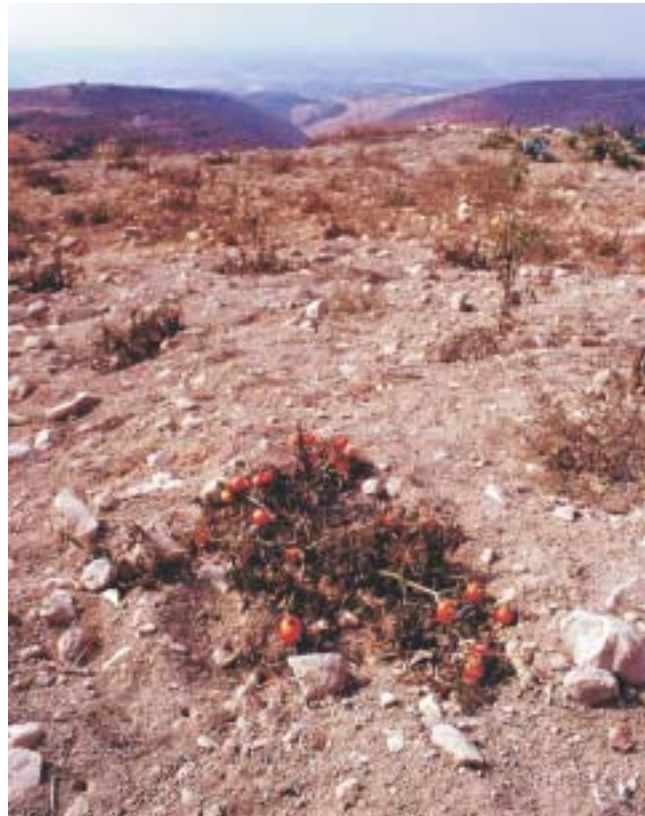
The Occupied Palestinian Territories and Israel lie at a biogeographic crossroads between the European, Asian and African continents, the Mediterranean and Red Seas and a number of botanical zones. This biogeographic convergence is reflected in the region's high biodiversity values: 2,780 plant and 730 animal species (Gabbay, 1997; Frankenberg, 1999) and 530 species of birds (Leshem & Bahat, 1999). The Occupied Palestinian Territories and Israel also share with Jordan and the Syrian Arab Republic one of the Earth's major geological and biogeographic features: the Great Rift Valley, which stretches to eastern Africa and which is currently the subject of international discussion on its potential nomination as a continuous World Heritage Site covering areas in several countries.

As well as being a centre of wild plant biodiversity, the region is also an historic centre of crop diversity and cultivation, highlighting the importance of its “agrobiodiversity” (PA, 2002).

■ **Biophysical characteristics of the West Bank and Gaza**

CLIMATE

The Mediterranean climate has four months of hot dry summer and a short winter with rain from November to March. The central highlands collect orographic rainfall and cast a rain shadow over their eastern slopes. They have occasional frosts, snow and hail. The Jordan valley is warm and very dry in the south, while Gaza by the sea is more temperate but borders the desert. The average summer temperatures range from 30°C at Jericho (Ariha) through 25°C at Gaza to 22°C at Hebron (Al Khalil) at 850 metres above sea level; and in winter from 13°C at Jericho (Ariha) and Gaza to 7°C at Hebron (Al Khalil). The average annual precipitation, which tends to fall in intense storms, is between 450 mm and 500 mm, decreasing from north to south and from high to low altitude.



STUART CHAPE

Tomatoes from Hebron

PHYSICAL FEATURES

The West Bank comprises four subregions:

- (a) Plain: a fringe of upper coastal plain in the west and north to about 250 m above sea level (7 % of the area);
- (b) Central highlands: a chain of low highlands, the Nablus-Jerusalem (Al Quds) - Hebron (Al Khalil) Mountains, with western slopes between 250 metres and 800 metres in altitude and the central heights reaching from 800 metres to 1,020 metres, their surface drainage being basically to the east and west (60%);
- (c) Eastern slopes: the dry highlands below the watershed ridge and slopes from 800 metres above sea level to 200 metres below sea level in the Jordan valley (26 % of the area);
- (d) Jordan valley and the Dead Sea: a narrow rift from 200 to 410 m below sea level (7 % of the area).

Gaza is a line of sand dunes with old alluvium and loess over a series of calcareous beach ridges along the eastern Mediterranean Sea. It forms a foreshore plain that slopes gently up to 90 metres elevation. The soils are sandy, sandy loess and loess with some ancient alluvium. The sea is warm and saline (39.5 g per litre) and is influenced by water outflow from the river Nile.

VEGETATION

The Occupied Palestinian Territories are located where Mediterranean, Irano-Turanian, Sudanian and Saharo-Arabian plant geographic zones intermingle in an area of varying climates and soil types, from semi-humid fertile coast, to semi-arid.

The area is transitional between the Mediterranean sclerophyll forest, now mainly cropland and maquis, and desert. At least 12 rare endemic plant species have been recorded, with 49 other species reported to be endemic.

On the Gaza coastal plain the original Saharo-Sindian flora has been almost completely replaced by farmed land and buildings. The soils are suited to intensive horticulture, and where there is enough water, citrus orchards.

In the highly modified Mediterranean flora of the upper coastal plain, upper Jordan valley and west slopes and highlands with over 350 mm of rain, there are remnants of former forest, though these fragments only cover a total area of 51.5 km².

The dry southern West Bank, eastern slopes and central Jordan valley support Mediterranean savanna, with rainfall of between 150 mm and 300 mm, and grade into land dominated by xeric steppe brush and spiny dwarf shrubs. There is a comparatively large number of endemic species among this flora, especially in the Jordan valley. However, past tree cutting and long-term, ongoing overgrazing has caused the spread of invasive, inedible species over large areas.

The flora of the hammada, sands and salines of the semi-arid desert in the south with rainfall of 50 mm-150 mm is Saharo-Sindian with succulents and other drought-adapted plants.



STUART CHAPE

Ditrichia viscosa grows along roads and in fields in rural areas. It is used as a traditional medicine for blood disorders, and also as a natural pesticide



STUART CHAPE

Vegetable gardens grown in the sandy soils of Gaza, where agricultural production is essential to livelihoods of thousands of people in this small territory

WILDLIFE

The mix of Mediterranean, Oriental and African desert influences, with a wide variety of habitats and climates, together with one of the world's major routes of migratory birds, has resulted in exceptionally high faunal values: 530 bird species, 116 mammals, 96 reptiles and seven amphibians have been recorded. (Table 8.1)

Every year, millions of migratory birds pass through the region following three main migratory routes: the coast and coastal plain, the mountains, and the Jordan valley. The area is of particular strategic importance for large soaring birds, such as storks and birds of prey. These birds avoid sea crossings during their migrations between Africa and Eurasia since they depend on land-based thermals and are thus concentrated in the narrow corridor between the Mediterranean and the desert. (Table 8.2)

Table 8.1 Mammals considered of special conservation importance

Species	Latin name
Bicoloured white-toothed and common white-toothed shrew	<i>Crocidura leucodon</i> and <i>C. russula</i>
Savi's dwarf shrew	<i>Suncus etruscus</i>
Greater mouse-eared bat	<i>Myotis myotis macrocephalus</i> EN
Indian crested porcupine	<i>Hystrix indica</i>
Badger	<i>Melis melis</i>
Ratel	<i>Melivora capensis</i>
Eurasian otter	<i>Lutra lutra</i> VU
Wild cat	<i>Felis sylvestris tristrami</i>
Sand cat	<i>Felis margarita</i>
Hyrax	<i>Procavia capensis</i>
Mountain gazelle	<i>Gazella gazella</i>
Nubian ibex	<i>Capra nubiana</i> EN

Source: Harrison, D.L. and P.J.J. Bates, 1991.

Note: those marked with VU and EN are also considered globally "vulnerable" or "endangered", respectively, by IUCN – The World Conservation Union.

Table 8.2 Bird species of international conservation concern occurring in the region

Species of bird	Latin name
Ferruginous duck	<i>Aythya nyroca</i>
Marbled teal	<i>Marmaronetta angustirostris</i> VU
White-headed duck	<i>Oxyura leucocephala</i> EN
Imperial eagle	<i>Aquila heliaca</i> VU
Lesser kestrel	<i>Falco naumanni</i> VU
Corncrake	<i>Crex crex</i> VU

8.3 Relevant international treaties and agreements

Many of the biodiversity conservation challenges in the Occupied Palestinian Territories (for example, desertification, sustainable management of water, forests and rangelands) are regional in extent, giving special importance to the potential role of multilateral environmental agreements (MEAs). Although the Palestinian Authority is unable to adhere to such treaties, there are clear environmental benefits from participation, not only for to the Occupied Palestinian Territories, but for the region as a whole, as well as for the global community (for example, biodiversity).

The Palestinian Authority is committed to supporting the principles and objectives of many of these agreements. It has, for example, prepared a *National Biodiversity Strategy and Action Plan* (NBSAP), with international support, in anticipation of becoming a party to the Convention on Biological Diversity (CBD). However, implementation of the NBSAP is effectively on hold as a result of constraints related to the current conflict.

Israel is a party to many MEAs of special relevance to conservation and sustainable development, and which have an important regional significance. In chronological order of Israeli adherence, these are (IMoE, 2002e):

- Convention for the Protection of the Mediterranean Sea Against Pollution (1978) and its Protocol Concerning Mediterranean Specially Protected Areas;
- Convention on International Trade in Endangered Species of Wild Fauna and Flora – CITES (1980);
- Convention on Migratory Species – CMS (1983);
- Convention on Biological Diversity – CBD (1995);
- Convention to Combat Desertification – CCD (1996);
- United Nations Framework Convention on Climate Change – UNFCCC (1996);
- Ramsar Convention on Wetlands of International Importance (1999);
- Convention Concerning the Protection of the World Cultural and Natural Heritage (2000).

8.4 Impacts on conservation of biodiversity, protected areas and semi-natural landscapes

■ Biodiversity

Biodiversity can be interpreted as an indicator of environmental health. Measurement of its loss or degradation is a task that can be undertaken comprehensively only through a field study. While the loss of elements of agrobiodiversity, for example, has been tabulated since 2000 by various parties (Palestinian Authority, United Nations Development Programme (UNDP), World Bank, ARIJ, etc.) the data remain limited to tree and crop counts for loss of livelihood and economic valuation purposes. Any such valuation, however, should consider not only the loss of livelihood, but also the historical, cultural and environmental losses, despite the fact that these costs are difficult to quantify, or may indeed be immeasurable. Erosion and land degradation could have further impacts on the existing water problems.

The impact of the conflict on ecosystems or individual species has not been evaluated. The exception to this is the recording of losses of natural forest, losses that are especially significant given that forests make up only a small proportion of the natural landscape. The impacts on natural systems and wild biodiversity may appear to be of low priority when compared to the parallel human suffering caused by the escalating conflict. However, the impacts on ecosystems should not be set aside, as these impacts can themselves have economic consequences, while there are also losses at the cultural level that may be irreplaceable.

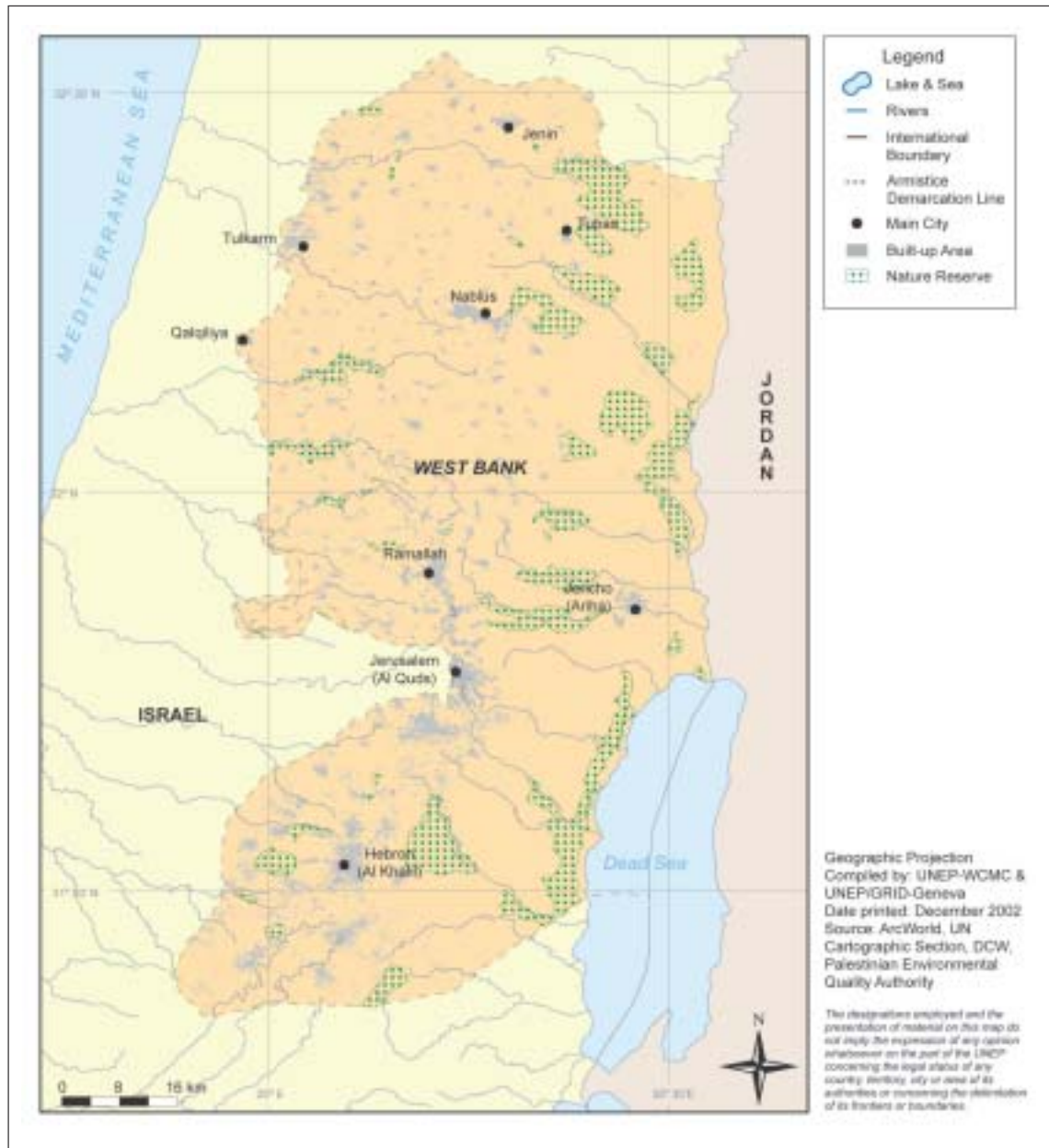
Biodiversity is one of the pillars of future sustainable development in the Occupied Palestinian Territories but it is currently at risk due to:

- Direct degradation arising from military operations;
- Increasing of human population pressure on natural systems from high population growth and the long-lasting refugee crisis;
- Rapid growth of Israeli settlements and supporting roads in areas where land is already scarce;
- Restrictions on communications, movement and access, limiting implementation of environmental management measures;
- Construction of separation fence and wall that effectively block movement of terrestrial fauna, and cut the natural ecological corridors;
- Threats from solid waste and wastewater pollution;
- Clearing of land of vegetation by Israel for security purposes and as a result of other causes.

■ Protected areas and landscape conservation

Increasing human populations and the need for economic development mean that natural and semi-natural landscapes are under significant pressure, regardless of the additional impacts of the ongoing conflict. Such pressure increases the significance of protected areas but also increases the risk that such sites will become ecological 'islands' or 'museums', isolated from surrounding fragmented and degraded areas. Furthermore, in many cases, the protected areas established thus far are too small to maintain their ecological integrity and long-term viability.

► Nature reserves in the West Bank

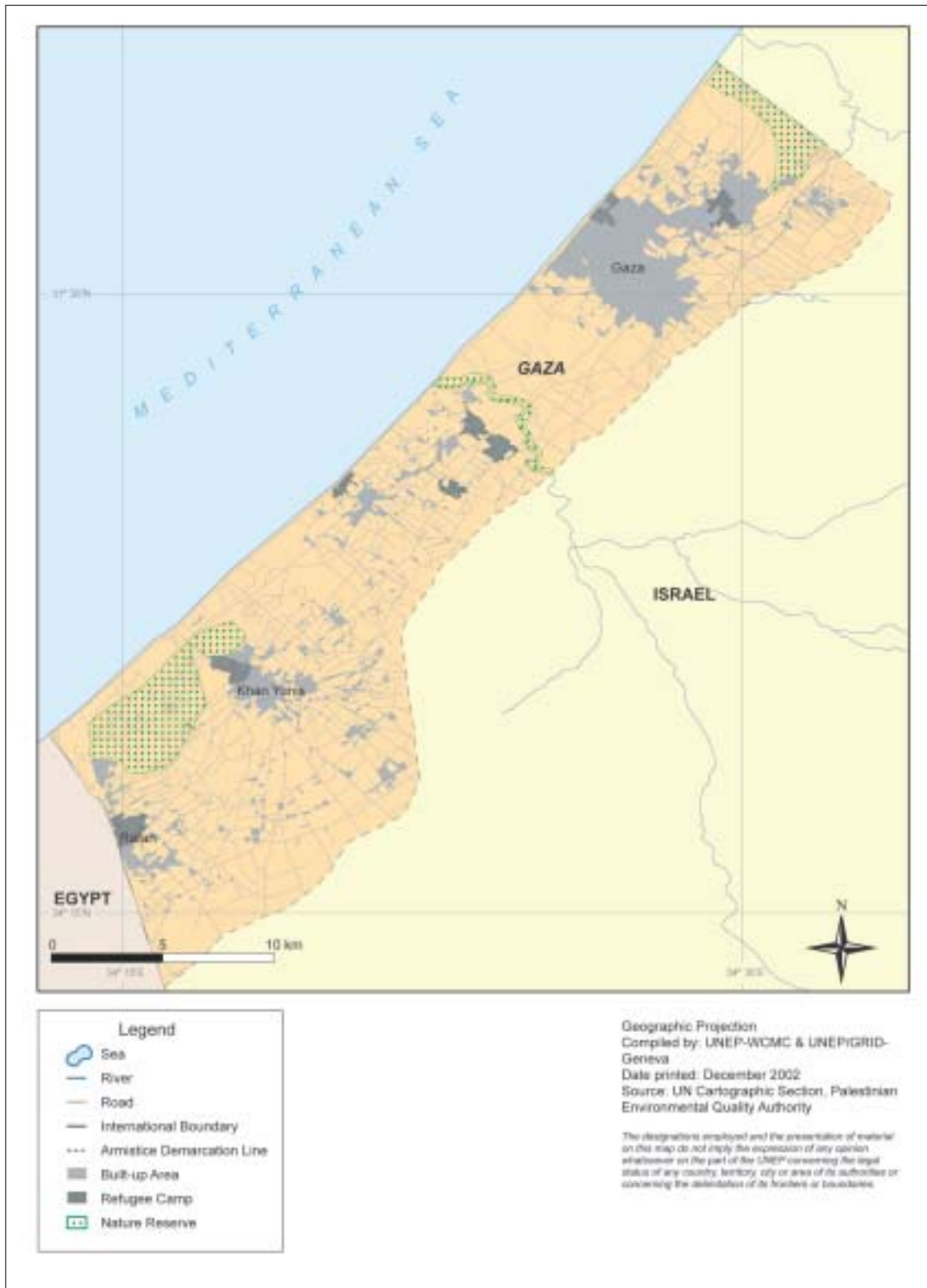


Concern has been expressed over the potential impacts of ongoing development in the transition zone between the Mediterranean and desert regions (Frankenberg, 1999). In view of their even smaller size and commensurately greater development pressures, the Occupied Palestinian Territories are facing major challenges in conserving representative ecosystems and landscape/habitat linkages between protected areas.

Most of the reserves on the West Bank lie in area C and are controlled fully by the Israelis. Only 13 reserves (or 11.3 % of the total reserve area) are within area B and, in a non-conflict situation, subject to Palestinian control (PA, 1999b).

Since the events of September 2000, Palestinian access to area B has also been restricted by Israel. This means that the Palestinian management agency, currently the Ministry of Agriculture, cannot access most of the protected areas on the West Bank for management purposes – although enforcement activities in some reserves may be possible. Another impact has been the suspension of a protected areas project for the Occupied Palestinian Territories.

► Nature reserves in Gaza



This was a key recommendation of the National Biodiversity Strategy and Action Plan. The present crisis has also meant that much-needed *in situ* protected area management training and capacity-building cannot take place effectively.

Israel commenced establishment of its protected areas system in the 1960s and now has around 200 reserves. Under Israeli legislation, nature reserves are established for the protection of 'natural' values (landscape, habitat, wildlife) and national parks primarily to



SUSAN BRANNON

The separation wall

protect cultural heritage and associated landscapes. Since 1967, Israel has designated 48 nature reserves in the West Bank covering about 5.7 % of West Bank territory. The Palestinian Authority has expressed concern that some of these nature reserves have been established mainly for Israeli security and military objectives, rather than conservation goals.

No nature reserves have been designated by Israel in Gaza, but the Palestinian Authority established the Wadi Gaza nature reserve in June 2000.

UNEP visits to accessible Palestinian nature reserves during its mission suggest that the lack of management control is already having an impact, with localized dumping of solid waste in reserve areas and extension of agricultural activities by local people into reserve areas, contrary to Article 44 of the Palestinian Environmental Law.

■ Transboundary conservation efforts

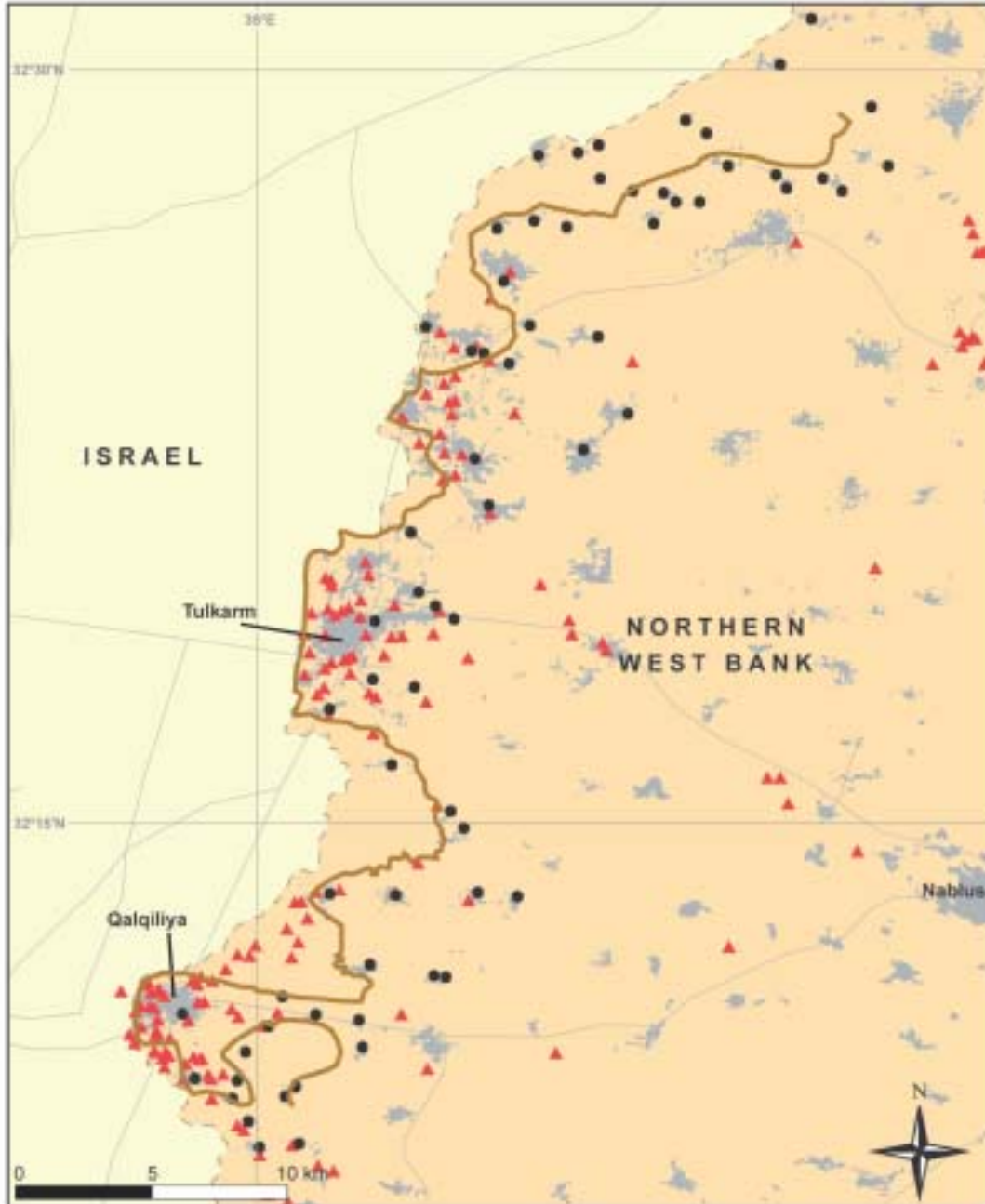
Several protected areas within the Occupied Palestinian Territories are adjacent to Israeli reserves; similarly Israel has reserves along its borders with Jordan and the Syrian Arab Republic. For example, Israel and Jordan cooperate successfully in managing the Red Sea reserve near Eilat. Coherent ecological linkages need to be strengthened, for example, the establishment and management of protected areas that include water catchments and aquifer recharge areas.

■ Israeli separation fence and wall

The existing separation fence around Gaza already prevents movement of wildlife to and from the surrounding regions. The Israeli military have commenced building a new separation wall (see map, page 99) approximately 300 km in length and several metres high, with a parallel cleared zone, along the Israel-West Bank border.

This wall is likely to have significant repercussions for wildlife movement, by adding further to the fragmentation of ecosystems and habitats in both Israel and the West Bank and by cutting the natural ecological corridors. In addition, according to Palestinian NGOs, it

► Israel separation wall



Legend	
---	Armistice Demarcation Line
—	Road
—	Proposed Separation Wall
●	Palestinian Community
▲	Well
■	Built-up Area

Geographic Projection
 Compiled by: UNEP/GRID-Geneva
 Date printed: December 2002
 Source: Boundary from the UN Cartographic Section, Roads from DCW, Well location from the Palestinian Environmental Quality Authority, Location of Palestinian communities and security fence (or separation wall) is according to the Palestinian Environmental NGOs Network (PENGON)

The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the UNEP concerning the legal status of any country, territory, city or area of its authorities or concerning the delimitation of its frontiers or boundaries.

prevents access by Palestinians to a number of their wells (PENGON, 2002b). Recent PENGON information also refers to the demolition of buildings to enable construction of the wall, which could also have negative environmental impacts. According to the information received by the UNEP Desk Study team, the overall environmental consequences of construction of the new wall will be very negative. During its visit, the UNEP Desk Study team was able to visit a section of the wall where construction had begun. The wall, built out of concrete, rose to at least 4 metres high at that place.

■ Wildlife protection and management

Current movement restrictions imposed on the Palestinian Authority by the Israeli military make it difficult to enforce Article 41, on the prohibition of hunting, of the Palestinian Environment Law. However, while this may be true in the West Bank and some parts of Gaza, the law should be enforced along the Gaza coastline where scores of fine nets are erected illegally to catch migratory passerine bird species.



Nets along the Gaza foreshore trap migratory passerine bird species in contravention of Palestinian law

■ Israeli settlement construction and land clearing

The Palestinian Authority has recorded numerous instances of forest and other vegetation clearances in relation to Israeli settlement establishment and/or expansion, and strip clearing of land for security purposes. Most of these forests were planted during the British mandate, although a small percentage was made up of remnants of natural forests. This has exacerbated the long-term regional trend of degradation of planted and natural forests. Isaac and Ghanyem (2001) state that officially designated forest areas decreased from 301 km² in 1971 to 232 km² in 1999. They attribute 80 % of this loss to the conflict (settlements 78 %, military bases 2 %, bypass roads <1 %). They record a 95 % loss in Gaza in the same period, and state that only 14 % was cut by Palestinians.

Since September 2000, the World Bank (2002) has recorded a loss of 14,196 forest trees at a total value of US\$ 2.13 million (World Bank, 2002). The environmental value of trees

should also be added to this direct economic value. Although the biodiversity value of plantation forests tends to be much lower than that of natural forests, loss of all forest types can have a significant impact on biodiversity. Plantation trees are also a usable commodity and provide an alternative to harvesting or using natural forests for fuel, construction and furniture, which are likely to come under increased pressure in the area where afforested areas have been destroyed. Apart from their economic value, forests have aesthetic, recreational and local climatic benefits – especially in arid areas.

■ Pollution

It is important to underline that, in addition to posing risks to human health and well being, pollutants from solid and liquid waste may have major impacts on biodiversity. Nutrient-rich effluent causes eutrophication of wetlands and high biological oxygen demand (BOD) resulting in changes in ecosystem functions and loss of species, and, especially in arid ecosystems, changes in plant communities along flow channels and flooded areas.

Additional threats to the Gaza coastline are posed by the 18 sewerage pipelines, and measures should be taken to address this.

The Wadi Al Nar (Kidron River), now effectively a permanent sewage disposal channel, flows for about 30 kilometres to the Dead Sea, passing through a nature reserve.

Changes in animal populations can also occur, with an increase in pest species and scavengers at exposed solid waste sites and untreated sewage outflows, and an increase in invertebrate disease vectors. The build-up of toxins, including pesticide residues and heavy metals, in food chains is another significant potential threat to biodiversity in the region.

■ Agrobiodiversity

Palestinian farmers have developed crop varieties through centuries of selection and management, which has resulted in a rich local agricultural biodiversity, with varieties benefiting



STUART CHAPE

Wadi Gaza

from earliness, disease and pest resistance, nutritional quality, and resistance to drought and other stresses (PA, 2002). Agrobiodiversity is also recognized as an important component of the Convention on Biological Diversity.

As with other aspects of biodiversity conservation, implementation of protection and management measures at the country-wide level depends on the capacity of governance: policies, laws, planning, extension and education services, *in situ* and *ex situ* practical conservation mechanisms, etc.



Solid waste dump site above the Wadi Al Nar (Kidron River) east of Bethlehem

The ongoing crisis presents threats to preserving agrobiodiversity. The inability of many farmers to reach their fields for cultivation because of movement restrictions means that large areas are falling into disrepair through neglect, and crops are being lost. The Israeli practice of clearing agricultural fields for security purposes is in all probability having an impact on agrobiodiversity, especially in the intensively cultivated areas of Gaza.



A vineyard in Wadi al Hassaka in Hebron

It has been reported, for example, that thousands of hectares of old olive trees have been destroyed, along with at least one grape variety cultivated on the sandy soil of the Gaza coastline (MENA, 2000f; World Bank, 2002; EQA, 2002h).

The recent World Bank report (2002) provides the following list (Table 8.3) of damage in the Occupied Palestinian Territories to end-December 2001, which is the gross impact and estimated economic loss, but not the measurement of loss of any genetic values (World Bank, 2002). (See Table 8.3)

The World Bank report estimates the cost of topsoil rehabilitation at US\$ 25.97 million.

■ Rangeland management

About 35 %, or 2,180 km², of the West Bank and Gaza are considered natural grazing areas. The eastern slopes agro-ecological region in the West Bank

Table 8.3 Damage to agricultural crops to December 2001

Tree/vine	Number destroyed/damaged	Value (US\$ million)
Olive	155,343	38.84
Citrus	150,356	37.59
Almond	54,223	8.13
Date palm	12,505	12.51
Grape	39,227	5.88
Banana	18,400	0.92
Other fruit	49,851	7.48

Source: World Bank, 2002

comprises 1,500 km² or 69 % of the total Palestinian rangeland (Isaac and Ghanyem 2001; PA, 1999b). It is the eastern slopes region that is considered the most valuable rangeland in Palestine, with an arid to semi-arid climate and an average annual rainfall of 150-350 mm and elevation of 450-750 m above sea level. Of the total area, only 225 km² are reportedly accessible to Palestinian livestock owners as a result of the current Israeli restrictions (Sa'adeh, 1999). The National Biodiversity Strategy and Action Plan (PA, 1999b) reports that the accessible area of the West Bank has a carrying capacity of 35,000 head of stock (goats and sheep), while the actual figure is in the order of 200,000 head. As a result of overgrazing the area accessible to Palestinians has been impacted by loss of vegetation, spread of inedible plant species and erosion.

Protection of Palestinian rangelands is a regional as well as a national issue and conservation initiatives were part of regional and subregional programmes prior to September 2000. These included the 1996 'SRAP for Combating Desertification in the Al 'Aqaba / Elat - Jericho (Ariha) Section of the Jordan Rift Valley', which was a cooperative effort between the Palestinian National Authority, Jordan and Israel (though, as noted earlier, Israel did not participate in a recent SRAP update). Between 1997 and 1999 a rangeland rehabilitation and livestock project was implemented under the Initiative for Collaboration to Control Natural Resource Degradation (Desertification) of Arid Lands in the Middle East. Palestinians also attended the Jacob Blaustein Institute for Desert Research in Israel.



STUART CHAPE

Land cleared by Israeli military

■ Gaza coastal zone management

The Gaza Strip is one of the most densely populated areas in the world, with an estimated 1.3 million people living in an area of 365 km², or around 3,600 people per km². If one deducts the land that is taken up by Israeli settlements, this yields an even higher population density, which is one of the highest in the world. With a Palestinian population growth rate of around 4.8 per cent per annum, which would result in a doubling of the population in 20 years, effective management and sustainable development of Gaza's resources will be a huge challenge for the Palestinian Authority (UNDP, 2002).



STUART CHAPE

Sewage outflow onto the beach

The 42 kilometres of shoreline and 74 km² coastal zone is already under intense pressure, with substantial environmental degradation of terrestrial and marine resources. About 48 km² are occupied by Israeli settlements (MOPIC, 1996).

Gaza's coastal management issues are a reflection of its development problems: large population, limited space, poor infrastructure, and intense pressure on the natural resource base. Within this narrow physical space and demanding developmental framework, it is the Palestinian Authority and the Palestinian people, with appropriate international support, who must resolve these fundamental issues.

Israeli security measures limiting the sea area available to Palestinian fishing boats to within 12

miles of the shore, result in intensified overfishing of near-shore marine environments (MEnA, 2001b).

In December 2001, the Palestinian Ministry of Environmental Affairs published the comprehensive "Gaza Coastal and Marine Environmental Action Plan", prepared with the Netherlands consulting company DHV with European Commission funding through the LIFE Third Countries programme. The plan identifies key coastal and marine issues for Gaza, such as:

- Depletion of sand resources through commercial and informal extraction for building purposes;
- Erosion caused by coastal infrastructure construction that disrupts longshore sand movements, and threatens buildings and roads constructed close to the shore;
- Disturbance of marine and coastal ecology through intense fishing pressure, including trawler damage to the seabed;
- Impacts of liquid and solid waste;

- Lack of cooperation among different Palestinian authorities and coastal zone stakeholders. "Coordination between different parties... does not take place sufficiently... As a result, different authorities and stakeholders may have different agendas on coastal and marine development issues";
- Lack of information. "Currently, data and information on coastal and marine environmental matters are scattered throughout different authorities' project offices and donor organizations. An information system on the coastal and marine environment is needed to support actions and coordination among the different agencies".

The Action Plan makes a number of recommendations to address these concerns, the importance of which was verified during the UNEP mission.

■ Wadi Gaza

Wadi Gaza was mentioned earlier in the context of protected areas in the Palestinian Territories, notably as an area only recently designated for protection status by the Palestinian Authority. Although Wadi Gaza, by that name, only traverses seven kilometres of the Gaza Strip, it is part of a large catchment that reaches to the Hebron (Al Khalil) Mountains, and covers 3,500 km² of the Negev Desert. Historically the wadi is reputed to have been an area rich in biodiversity, and it is still important as a stopover point for birds on the Africa-Eurasia migratory route. However, its most recent status is that of a wasteland, and as an effluent channel for the raw sewage from refugee camps adjacent to the watercourse, estimated at 6,000-8,000 m³ day (Anon, 2002). On the Israeli side, the wadi reportedly has a weir or levee across it that prevents most of the natural water flow from reaching Gaza, although flooding occurs during high winter rainfall events.



A meagre catch



Use of beach seine net

The Coastal and Marine Environmental Action Plan recommended permanent opening of the mouth of the Wadi Gaza to alleviate shoreline stability problems and to revitalize the wadi

as a natural system. The channel has been opened and, during the UNEP mission, water was flowing to the sea. These and other activities have been supported by projects implemented by the United Nations Development Programme's Programme of Assistance to the Palestinian People (UNDP/PAPP). The largest is the 'Emergency Employment Generation Program (EEGP) on the Development of the Wadi Gaza' with US\$ 3.8 million funding provided by the Global Environment Facility and USAID, and in collaboration with the 'MedWet' Initiative of the Ramsar Convention (GMCG, 2002). The project is highly ambitious in scope. It aims to rehabilitate the Wadi Gaza to re-establish its biodiversity values, protect and promote archaeological sites, develop recreational and tourist activities, and deliver socio-economic benefits to the 10,000 people living adjacent to the wadi in Bedouin settlements, refugee camps and Al Zahra town. However, 'on-the-ground' progress to date appears to be limited.

The Wadi Gaza does indeed have great potential as an intensively managed, semi-natural landscape feature, but unless current project activities can more adequately address urgent issues, environmental quality will continue to decline. While the Wadi Gaza project has an important role in the short-term generation of local income, it will not alone solve the key issues that are causing the degradation.

■ Regional and international issues

The ongoing Palestinian-Israeli conflict has environmental and natural resource management repercussions that go beyond the territorial boundaries of both parties. A number have been raised in the preceding discussion.

■ Dead Sea

The Dead Sea is one of the world's unique geomorphological features, and is located within another of the world's great landforms: the Great Rift Valley. Unfortunately, the Dead Sea is suffering from unsustainable exploitation of water and mineral resources, with levels dropping at a rate of 80 cm to 1 m per year (IMoE, 2002). In addition, sewage is entering the Dead Sea via the Wadi Al Nar (Kidron River).

Collaborative approaches between Israel, the Palestinian Authority, and Jordan will be critical if the continuing degradation of the Dead Sea and loss of its unique value is to be halted. Recently a meeting was convened to examine the possibility of nominating as World Heritage site the Great Rift Valley from Africa up to the Syrian Arab Republic, that would logically include the Dead Sea, given its unique value. A serial



STUART CHAPE

The Dead Sea, an internationally significant landscape and regionally shared resource

► Decline of the Dead Sea

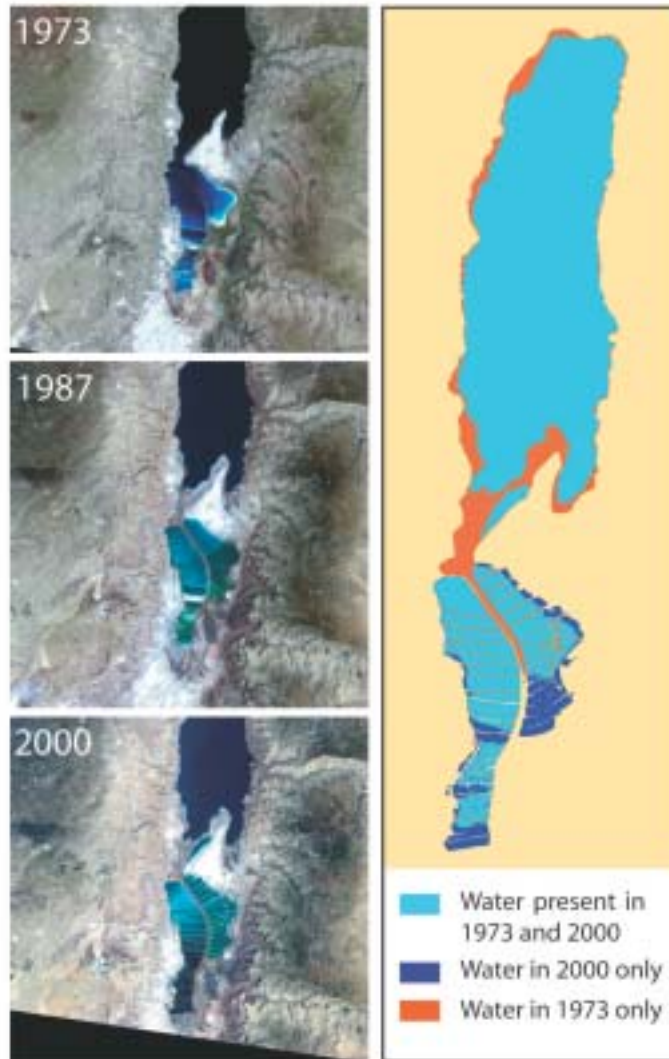
Satellite imagery taken in 1973, 1987 and 2000 depicts the decline in level of the Dead Sea.

Due to abstraction taking place both on Israeli and Jordanian sides, the water now feeding the Sea no longer compensates for evaporation.

Salt works, installed in what was the shallow southern basin of the Sea prior to its separation from the northern basin in the 80s, also contributes to the shrinking of the Sea.

The evaporation ponds fed by water pumped from the main water body are said to be responsible for 25% of the total evaporation of Dead Sea water.

Compiled by UNEP/GI6D-Geneva
 Date printed: December 2002
 Source: "Dead Sea Region: Water Resources under High Stress", UNEP Atlas of Global Change (forthcoming)



The building of dikes and shoreline changes are well depicted on these three images displayed in true color, RGB (3,2,1). The Dead Sea water level is falling down at a rate of 1m per year.

World Heritage Site of such huge dimensions is an exciting concept, one that would promote the international cooperative aspects of the World Heritage Convention. However, in the case of the Dead Sea, such cooperation will call for fundamental changes in the way States manage the resource that is regionally in greatest demand: water.

A recent proposal to counter the declining level of water in the Dead Sea by constructing a canal to carry water from the Red Sea has raised concern among several environmental organizations about the potential environmental impacts of such a scheme. Despite benefits for electricity generation, employment creation and tourism, the possible impacts on ecosystems need to be carefully studied, including at the wider regional level.

Despite its high importance, in this Desk Study, it was not possible to address in greater depth the discussion on the Dead Sea. However, owing to the high importance of the Dead Sea regionally and globally, in another context, more detailed environmental studies are necessary.

Laws, institutions and land use

9.1 Introduction

The legal situation in the Occupied Palestinian Territories is unique and rather complex, as successive Ottoman, British, Egyptian, Jordanian and Israeli administrations have deeply influenced current legal instruments and associated structures and practices.

After the 1967 war, Israeli military assumed control of and occupied the West Bank and the Gaza Strip, which until then were under Jordanian and Egyptian control. By Military Order No. 2 of the same year, Israel vested all military and government authority in Gaza and the West Bank in the Israeli military, initially through Regional Commanders, later Area Commanders and currently Civil Administration bodies. The Civil Administration is a section of the Israeli military that is responsible for affairs in the West Bank and Gaza.

Furthermore, Order No. 2 declared the applicable laws to be those existing in the Occupied Palestinian Territories as of June 1967 so long as these were not contradictory to or in conflict with Israeli proclamations and military orders, and subject to amendments as a result of the Israeli military being established. In practice, through the use of military orders, Israel gained complete jurisdiction over all matters including land disputes, taxes, water and other natural resources, licences, permits, prohibitions, restrictions, fees, charges and taxes. Israeli environmental legislation only applies to the Occupied Palestinian Territories if a corresponding military order is issued.

Subject to military enactments of 1967, the Israeli residents inside the Occupied Palestinian Territories are subject to the legislation applicable in those territories, in addition to specific Israeli legislation, which applies to them on a personal rather than on a territorial basis. In short, two Israeli legal systems (including laws related to environment) are applied in parallel within the Occupied Palestinian Territories. In addition, Palestinian laws are applicable to certain geographic areas under the terms of the Oslo II Accord.

Under the terms of the Oslo I and Oslo II Accords the two parties agreed, among others, on specified geographical areas for which administrative authority was transferred to the Palestinian Authority. On the basis of these agreements, a Palestinian ministry responsible for environmental issues, now the Environmental Quality Authority, was established. The Palestinian Authority inherited a mix of legislation from previous systems, which, in terms of environmental protection, was weak, piecemeal and sector-based. In practice, there are fundamental contradictions and overlaps between inherited laws, new environmental laws promulgated by the Palestinian Authority, and Israeli military law.

There is an urgent need to undertake a detailed and critical review, including identifying gaps, of all existing laws related to environmental management in the Occupied Palestinian Territories, and to make recommendations for a viable system of environmental legislation,



Minister Abu Safieh and Pekka Haavisto at the Palestinian Environmental Quality Authority offices in Gaza

including not only new laws but also amendments and cancellations, where appropriate, of existing instruments.

To the extent possible, and in the interests of reducing risks to the environment and human health, mutual understanding and cooperation between the parties is required for minimizing legal and institutional conflicts in environmental matters.

9.2 Plans, policies and strategies on environment

■ Palestinian Development Plan 1999–2003

Despite the difficulties posed by the ongoing conflict, the Palestinian Authority incorporated environmental considerations, as spelt out in the Oslo I and Oslo II Accords, into its first five-year Palestinian Development Plan (PDP) covering the period 1999–2003. This puts the optimal use of natural resources at the top of the public sector's environmental priorities. The PDP also identifies the need for a review of legal and institutional systems and foresees finalizing the organizational structures of the various ministries and other public bodies. It also underscores the importance of scientific research, transfer of technology, and protection of the environment against pollution.

From a sectoral viewpoint, infrastructure development and natural resource management are given the highest priority under the PDP, while water, wastewater, environment, solid waste and energy have been identified as priority subsectors, along with transportation. Overall, the PDP demonstrates a clear policy commitment by the Palestinian Authority to improve environmental protection and resource management.

■ National environmental strategy:

The Palestinian Authority has developed a ten-year environmental strategy document to be updated every three to five years, for 2000–2010. This identifies and analyses the causes of current environmental problems, defines targets and proposes prioritized measures required for meeting these targets. The document acknowledges the crucial role to be played by other authorities including ministries and municipalities, under the supervision and monitoring of the Environmental Quality Authority.

The nine priority “environmental themes” set out in the strategy include: depletion of water resources, deterioration of water quality, depletion of natural resources, land degradation, air and noise pollution, shoreline and marine pollution, depletion of biodiversity, landscape degradation, and threats to cultural heritage. The prioritization accorded to these themes in Gaza and the West Bank is shown in the table below. (See Table 9.1)

Most of the environmental themes in the strategy are transboundary in nature. Consequently, the Palestinian Authority stresses the importance of regional arrangements with neighbouring countries, as indicated in the Oslo II Accord.

■ National Environmental Action Plan

The Palestinian Authority adopted a National Environmental Action Plan (NEAP) in August 2000 as an instrument to translate the general themes and priorities set out in the national environmental strategy into concrete and prioritized actions, plans and projects for the three-year period 2000–2002, with subsequent annual updates. The ranking of the 111 actions and projects contained in the NEAP was based on a set of criteria and recommendations that emerged from a consultative, participatory process involving stakeholders in the Occupied Palestinian Territories. The NEAP proposed actions and projects under

Table 9.1 Prioritization of environmental themes

Priority	Gaza	West Bank
High	Depletion of water resources Deterioration of water quality Shoreline and marine pollution	Depletion of water resources Deterioration of water quality Land degradation
Medium	Depletion of natural resources Land degradation Deterioration of nature and biodiversity	Depletion of natural resources Air and noise pollution Deterioration of nature and biodiversity
Low	Air and noise pollution Landscape and aesthetic distortion Threats to cultural heritage	Landscape and aesthetic distortion Threats to cultural heritage

headings which include, among others, wastewater management, water resources management, solid waste management, agricultural and irrigation management, industrial pollution control, nature and biodiversity, land-use planning, environmental standards and regulations, and monitoring.

The NEAP includes 24 policy guidelines focussing on environmental health, public health, and the role of women, NGOs, the private sector and universities in the development of the environmental sector.

In practice, implementation of the NEAP has been on hold partly since the start of the second intifada in September 2000 due to the constraints from the Israeli military, including closures, curfews and lack of access to construction materials.

9.3 Summary of environment-related laws

■ Palestinian environmental law

Reflecting general principles established in the Palestinian Basic Law, the Palestinian Environmental Law (referred to below as “the Law”) establishes the general legal framework for environmental protection in the Occupied Palestinian Territories. It is, in essence, a framework law adopted by the Palestinian Legislative Council on 6 June 1999 and approved by His Excellency Yasser Arafat, President of the Palestinian Authority, on 28 December 1999. The Law is divided into five parts, with ten chapters and a total of 82 articles, concerning a wide range of environmental protection and management issues.

The Law’s objectives (article 2) are: the protection of the environment by preventing all types of pollution; promotion of public health and welfare; preservation of biodiversity and improvement of those areas which are environmentally degraded. It also promotes public awareness and encourages sustainable resource development for the benefit of present and future generations on the basis of intergenerational equity.

Among the specific issues covered under the Law are protection of the environment (land, air, water, marine environment) and of the natural historical and archaeological area, environmental planning and enforcement tools (including impact assessment, licensing, inspection and administrative procedures, and penalties). The Law also incorporates the ‘polluter pays’ principle and sets out government/public sector duties, including the basis for intersectoral coordination.

■ Sectoral environment laws

The Palestinian Authority is currently reviewing the environmental legislation, including inherited legislation, to determine current and likely future relevance. To date, the following new laws relevant to environmental matters have been adopted: Palestinian Local Government Law No. 1 of 1997, Industrial Estates and Free Industrial Zones Law No. 10 of 1998, Natural Resources Law No. 1 of 1999, Palestinian Water Law No. 3 of 2002, and Protection of Animal Wealth Law No. 8 of 1998.

Several other draft laws and implementing regulations are also under preparation, including: Draft Palestinian Lands Law; Draft Agricultural Law; Draft Regulation on Stone Quarrying; Draft Regulation on Solid Waste; and Draft Regulation on Waste Water Treatment.

9.4 Institutional framework for environmental protection

The Oslo I and Oslo II Accords provide for creation of institutional structures by the Palestinian Authority, such as the Palestinian Legislative Council (PLC) as well as civil departments and ministries for many sectors, including the environment portfolio. Until May 1995, all environmental responsibilities in the Occupied Palestinian Territories, and especially in the West Bank, were held by the Israeli Civil Administration. These responsibilities were administered through the Environmental Health Department under the Israeli Ministry of Health and limited mainly to inspections. Following the establishment in 1993 of the Israeli Ministry of Environment, the Department of the Environmental Officer was established in the Civil Administration, which carries out projects in the fields of solid waste and liquid waste treatment, pest control, and more. Municipalities were the main environmental service providers and this continues to be the case under the Palestinian Authority.

■ Environmental Quality Authority (and previous bodies)

In October 1994, following the Oslo I Accord, an Environmental Planning Directorate (EPD) was established in the Ministry of Planning and International Cooperation (MOPIC) to deal with environmental protection matters in terms of planning, management and implementation.

During the negotiation of the Oslo II Accord, it was agreed to establish a number of ministries and authorities. As a result, in December 1996, a Palestinian Environmental Authority (PEA) was established and the EPD mandate and responsibilities were transferred to it. Although an organizational structure was developed for the PEA, it was neither approved nor made operational. However, all activities started within the EPD continued, alongside additional tasks.

In December 1998, a Minister of State for Environmental Affairs was appointed by His Excellency Yasser Arafat, President of the Palestinian Authority, through Presidential Decree No. 2. An entire new Cabinet was appointed at that time to head various ministries, authorities and other institutions. However, the cabinet appointments were not followed by specific written mandates and tasks and the development of each ministry's functions and responsibilities was left to individual ministers. This led to a high degree of overlap within and between institutions, especially with regard to inter-sectoral environmental issues, and the subsequent development of memoranda of cooperation and agreement to reduce such overlap. Following Presidential Decree No. 2 designating a new Cabinet, a Palestinian Ministry of Environmental Affairs was established.

As a result of administrative reforms, Presidential Decree No. 6 in June 2002 established the Environmental Quality Authority as the successor body to the Ministry of Environmental Affairs.

The Environmental Quality Authority has its own budget and is responsible to the Cabinet of Ministers. All the functions, responsibilities and authorities of the former ministry were transferred to the Environmental Quality Authority including all property and employees.

Although there continues to be no overall written mandate for the Environmental Quality Authority, its primary responsibilities are clearly set out in the Palestinian Environmental Strategy and the Palestinian Environmental Law, as discussed above.

Two levels of coordination and cooperation are required for cross-cutting environmental issues: (a) coordination among Palestinian environment-related governmental institutions, municipalities, NGOs and the private sector (and other groups); and (b) coordination between Palestinians and those donors supporting environmental activities in the Occupied Palestinian Territories.

In response to these needs, the Sector Working Group on the Environment was established under the coordination of the Environmental Quality Authority and with representation of all ministries dealing with issues linked to the environment, authorities and donors. The group meets periodically to discuss mutual roles and activities. A subgroup has been set up to deal with wastewater issues. The Sector Working Group has identified a number of challenges that will have to be addressed for the group to function effectively. These relate especially to the need for the roles and responsibilities of the various bodies to be clearly defined.

The frequent institutional changes over recent years have undoubtedly disrupted the actual implementation of environmental measures. However, the ongoing conflict has also had a major impact on the ability of the Environmental Quality Authority (and its predecessor ministry) to perform its functions, for example, because of the communication and mobility restrictions imposed during the conflict. This is especially the case since Gaza and the West Bank are separated geographically.

■ Sectoral ministries and other bodies with mandates related to the environment

In addition to the Environmental Quality Authority, many other ministries and authorities, as well as one international organization, have environment-related tasks. Among those specifically identified in the environmental strategy are:

- Ministry of Planning and International Co-operation and the Higher Planning Council, which are responsible for land use and planning, and hence development of emergency natural resources protection plans and regional development plans;
- Ministry of Local Government, which deals with solid waste management and is therefore involved in the operation and financing of solid waste collection and disposal. Municipalities and village councils focus on collection, transport and disposal of municipal wastes. The United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA), on the other hand, is responsible for these services in the refugee camps;
- Ministry of Health, which, via its Department of Environmental Health, is involved in the control and management of medical waste. It is also involved in management of water and food quality, wastewater and solid waste, pest control, etc;
- Ministry of Industry, which is concerned with hazardous waste and industrial pollution control and management, environmental standards, natural resources and industrial safety and zoning;

- Ministry of Agriculture, which is responsible for environmental management in the use of agro-chemicals and protection of nature and biodiversity;
- Ministry of Tourism and Antiquities, which focuses on protection and management of the cultural heritage;
- Ministry of the Interior, which is involved in environmental law enforcement;
- Ministry of Transport, which is concerned with environmental aspects of traffic and infrastructure.

Though not mentioned in the environmental strategy, the Ministry of Education also has a specific role through environmental education and awareness building. In addition there are several authorities with environment-related mandates and functions. These include the Palestinian Water Authority, and the Palestinian Energy Authority.

There are also numerous environment-related NGOs in the Occupied Palestinian Territories, many of which have played an important role in contributing information and experience to the preparation and review of laws and decision-making processes. Capacity-building for NGOs will assist in making these functions still more effective in future, particularly with regard to supporting and facilitating the work of public bodies.

The economic development of the Occupied Palestinian Territories largely depends on donor funding. At present, coordination among donors with regard to environmental matters is undertaken primarily through the Environment Sector Working Group (and subsectoral groups). It seems, however, that donor coordination still needs to be emphasized and strengthened to ensure that limited resources are wisely spent.

9.5 Legal and institutional framework on land use

Since 1967, Israeli military orders have been used to requisition land in the West Bank and Gaza for settlement construction. (See page 114)

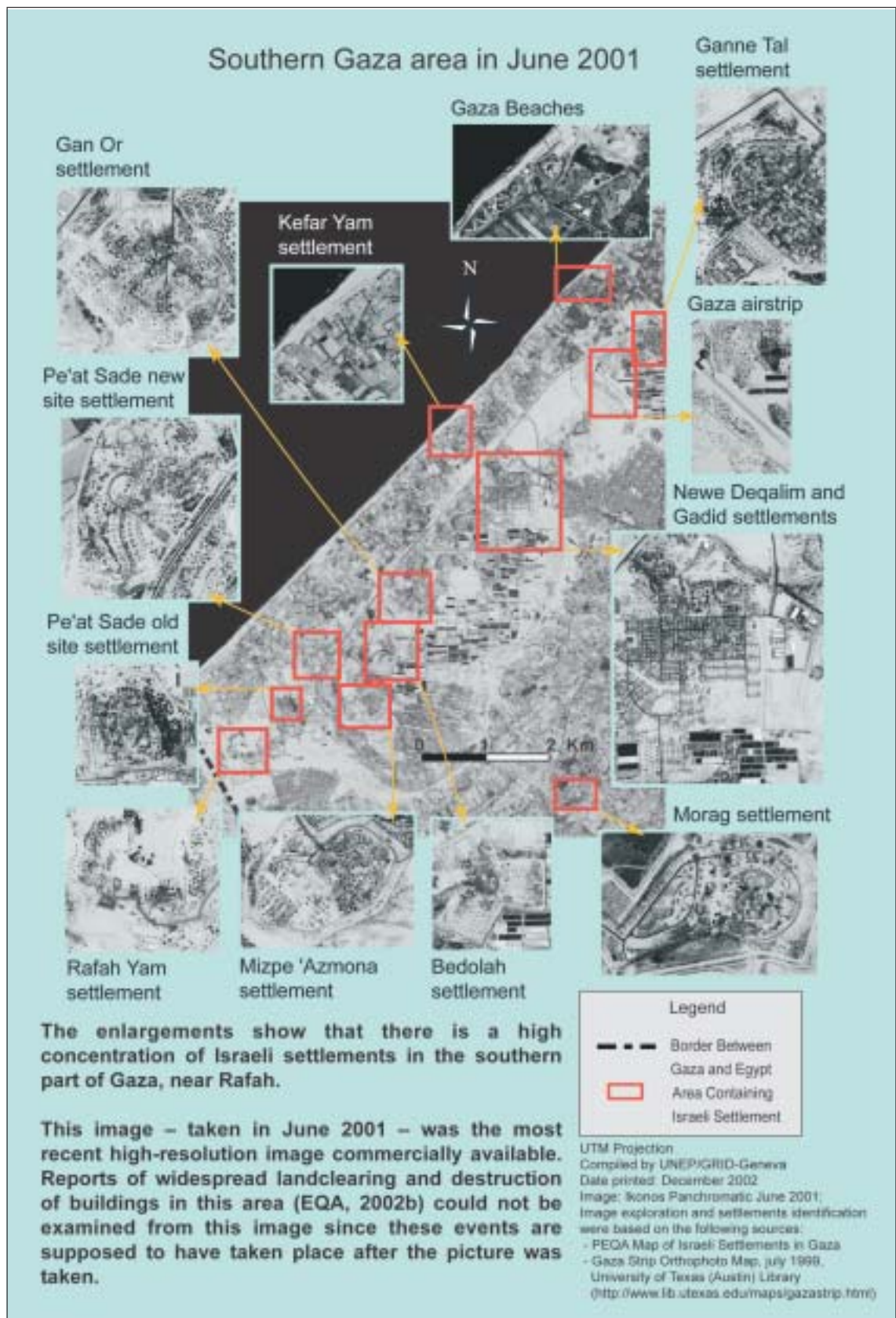
Since 1994, military orders have also been used for the purpose of building bypass roads intended to meet four key needs defined by the Israeli Ministry of Defence (Lein, Y. & Weizman, E. 2002):

- To permit Israelis to travel without passing through Palestinian population centres;
- To permit Israelis to travel by the shortest route across the "Green Line", which is the pre-1967 border between Israel and the West Bank;
- To provide direct contacts between Israeli settlements;
- To ensure that Palestinian traffic would not pass through the settlements.

After the outbreak of the intifada in September 2000, a new wave of land requisitions through military orders began for the construction of additional bypass roads, which Israel considered necessary for avoiding or minimizing security risks to Israelis.

In addition to the application of military orders, since 1967, some 40 % of West Bank territory has been declared by Israel as land owned by the State, part of which was previously publicly owned. Additional land has been requisitioned for "public need" under the provision of a former Jordanian law, amended by Israel in 1969 and 1981.

► Israeli settlements in Southern Gaza



A decision by Israel's Ministerial Committee for Settlements in 1982 opened up the possibility of establishing settlements by private initiative. (See page 116)

■ Land-use planning

The planning system in the Occupied Palestinian Territories operates along two lines, one for the Israeli settlements and one for the Palestinians.

In legal terms, the planning system in the West Bank operates on the basis of the Jordanian legislation applied in the area at the time of occupation in 1967. The Jordanian planning law was amended by Israel by means of a military order (no. 418, 1971) and several subsequent amendments. Under the Oslo II Accord, authority for planning in areas A and B of the occupied territories was transferred to the Palestinian authorities, in which the majority of Palestinians live. The authority for planning in area C (60 % of the West Bank) remained under Israeli control.

One of the principal changes Israel made in the Jordanian law was the transfer of all authority formerly conferred upon the Jordanian Minister of the Interior, to the commander of the Israeli military.

The only regional outline plans for the West Bank that existed before the transfer of authority to the Palestinian authorities in 1995 were two regional plans prepared in the 1940s under the British Mandate.

In the early 1990s, the Central Planning Bureau of the Israeli administration prepared special partial outline plans for approximately 400 villages in the West Bank. Aerial photographs were taken of each village and a schematic line was added around the settled area to indicate where development could take place. Applications filed by Palestinian residents to the Israeli administration in area C for building on private land outside these areas, or outside the areas designated for construction in the British outline plan, were generally rejected.

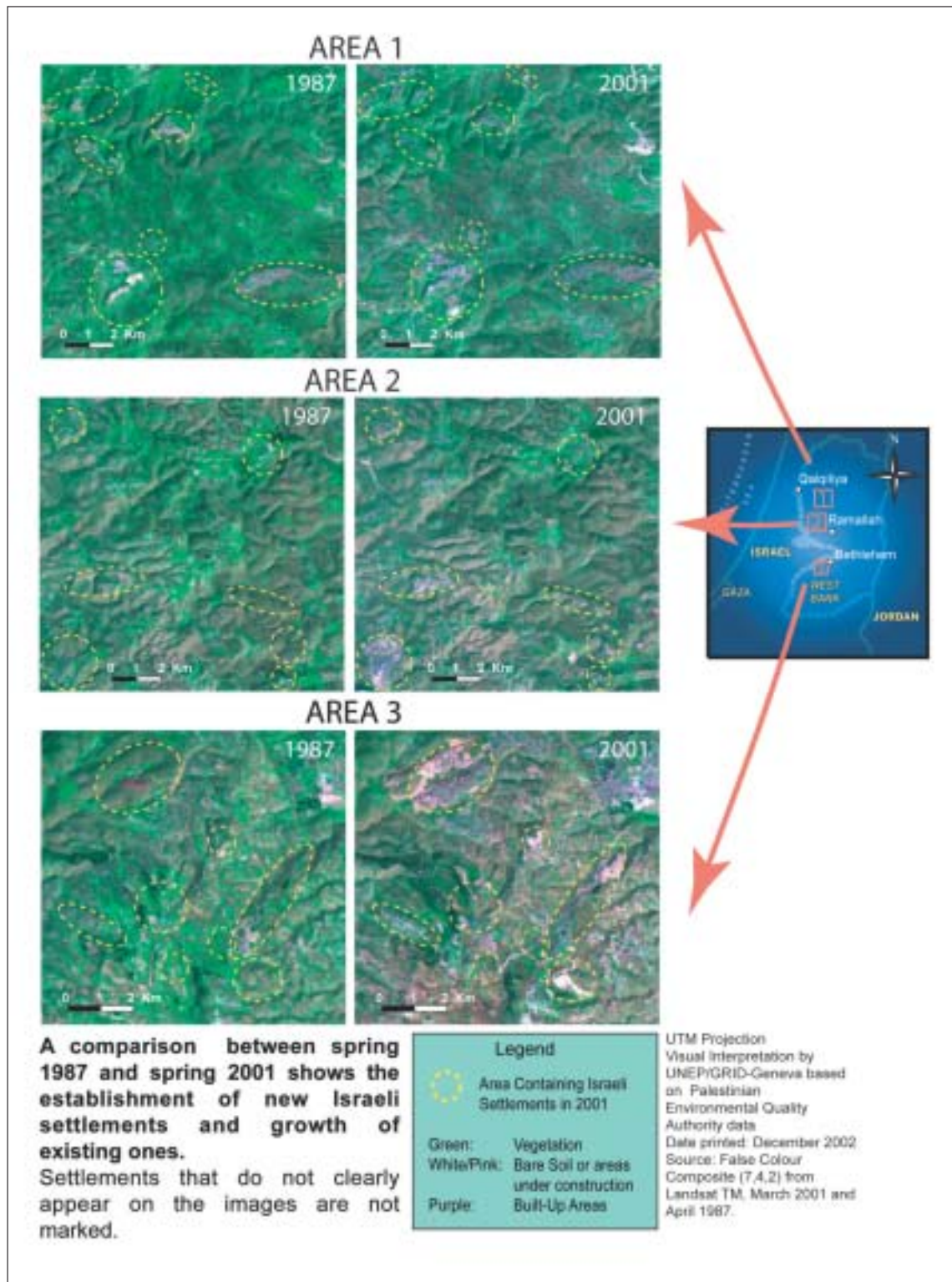
The outline plans for the Israeli settlements are approved by the Israeli Sub-Committee for Settlement operating under the auspices of the Civil Administration's Supreme Planning Council. The commander of the armed forces of the region was empowered to issue orders appointing "special planning committees" for defined areas, possessing the powers of local and regional planning committees. The Israeli local authorities in the West Bank were defined as special planning committees, empowered to prepare and submit local plans to the Supreme Planning Council, and to grant building permits to residents. Israel states that the above-mentioned plans are implemented within the Palestinian Authority urban areas by Palestinian Planning Committees, and in rural areas, where larger Palestinian settlements in area C have been given the authority to act as a local planning committee. Various environmental concerns are addressed in the planning committee for areas C.

During the latter part of the 1990s, the Occupied Palestinian Territories enjoyed a certain degree of self-government and relative peace, which favoured coherent land-use planning and development, especially in Gaza. Since 60% of the West Bank is comprised of areas C under Israeli control, this makes coherent land-use planning difficult for the Palestinians. (See page 117)

■ Environmental impacts of the prevailing land-use planning system

Integrated land-use planning is one of the pillars on which socially, economically and environmentally sustainable development is founded. At present, land-use planning in the

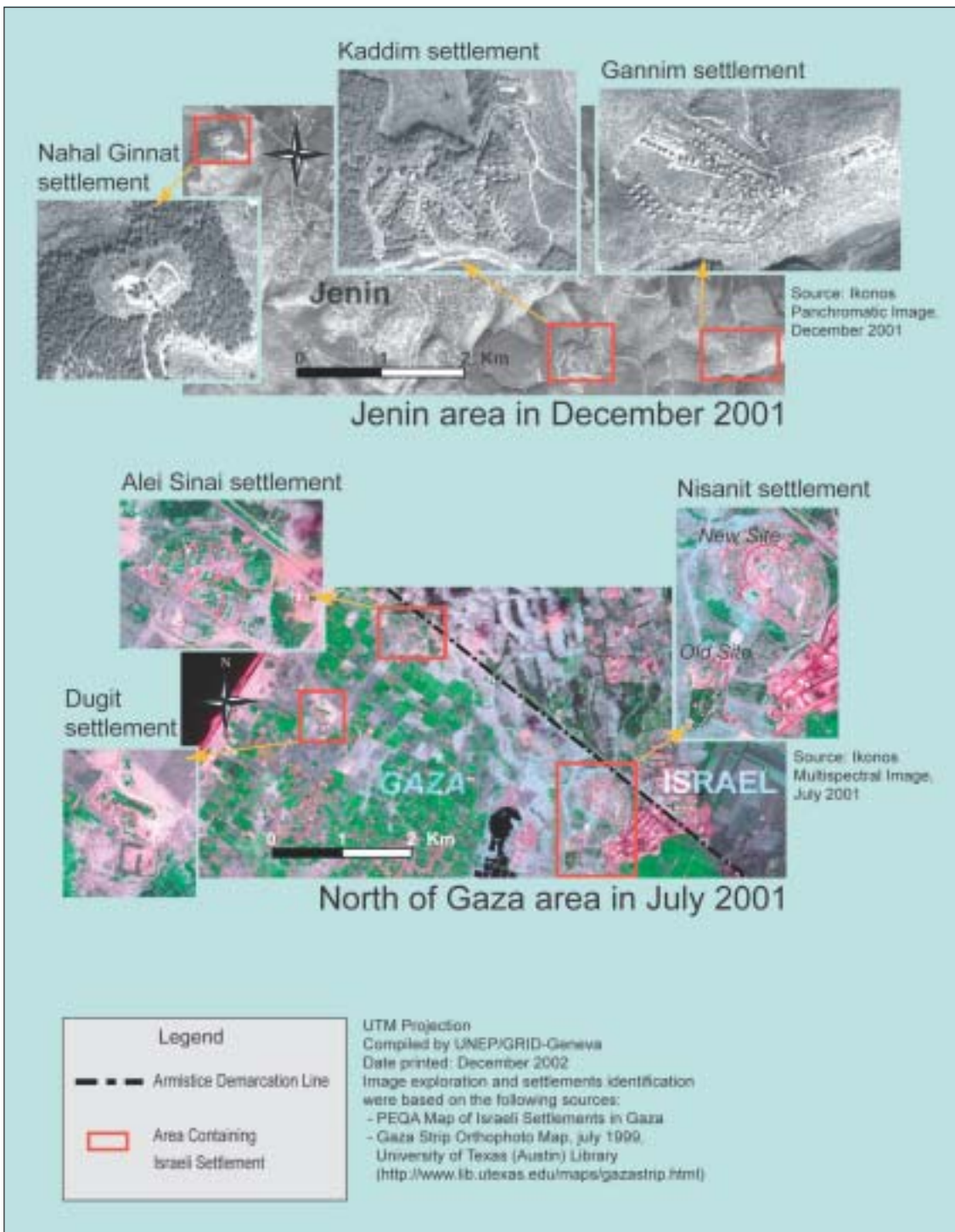
► Israeli settlement growth between 1987 and 2001



Occupied Palestinian Territories is driven by Israeli security considerations, with environmental concerns playing a minor role, in spite of the importance of environmental conditions for long-term human health and well-being for Israeli and Palestinian citizens alike. (See page 119)

Among the adverse environmental impacts of current territorial arrangements and lack of integrated land-use planning are:

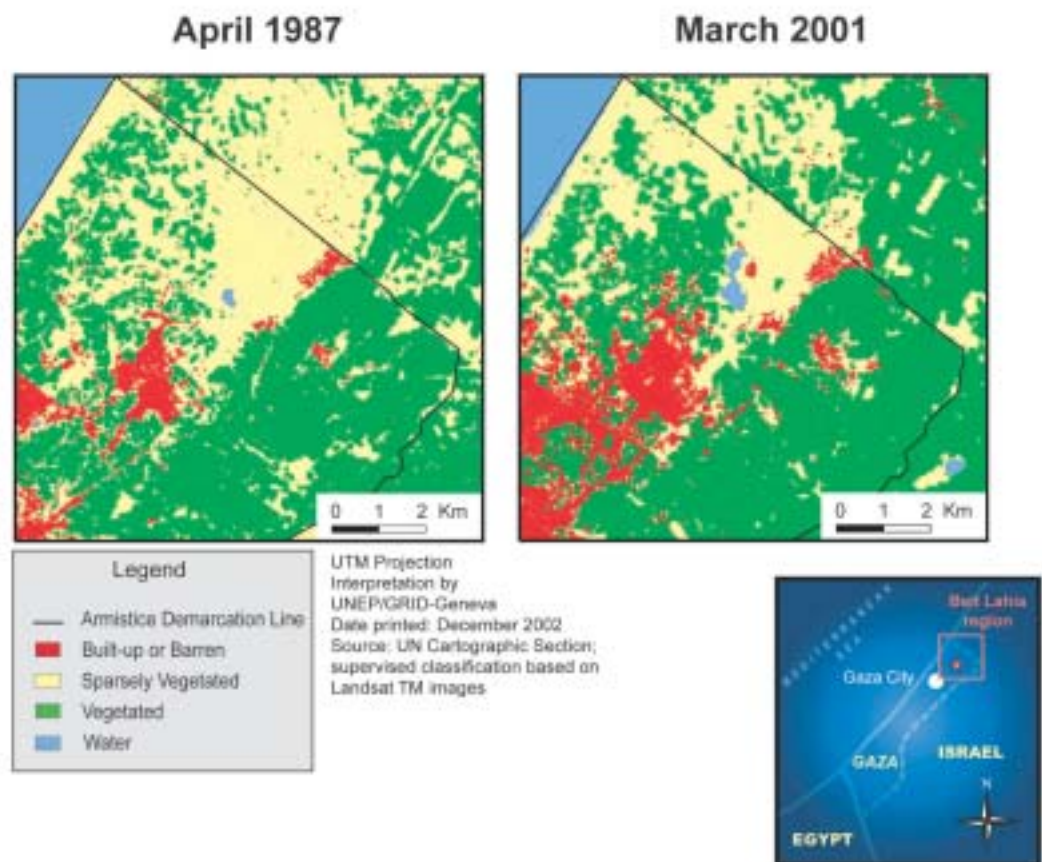
► Israeli settlements in Jenin and Northern Gaza



- Fragmentation of planning powers and responsibilities;
- Physical and ecological fragmentation and degradation of natural and semi-natural ecosystems, habitats and landscapes;
- Further deterioration of existing environmental service infrastructure such as water and sewerage systems;

- Absence of adequate waste collection, treatment and disposal across large areas of the Occupied Palestinian Territories, including both Palestinian and Israeli-controlled areas;
- Unsustainable exploitation of natural resources, especially water, forests and rangelands and associated biodiversity;
- Degradation of the region's rich cultural heritage;
- Degradation of vegetation cover, biodiversity and landscape due to establishment of Israeli settlements and bypass roads.

► Land cover change in Northern Gaza



Land cover change

Red areas depict densely built-up areas and barren land, such as rock, which have greatly increased between April 1987 and March 2001. Visual textural analysis of high-resolution images suggests that most of the red areas in the 2001 image are indeed built-up areas, including both Palestinian towns and the Israeli settlement of Nisanit.

The comparison has been made between pictures taken in the same period in the calendar year to minimize differences in vegetation arising from seasonal climatic variations. However, there may nevertheless be some such variations owing for instance to rainfall patterns.

LAWS, INSTITUTIONS AND LAND USE

International cooperation

10.1 Introduction

Perhaps nowhere else in the world does international cooperation play such an important role in conflict resolution as in the Middle East. International cooperation also carries enormous potential benefits for environmental protection, particularly in a region such as the Mediterranean, where common problems and shared resources are subject to intense human pressures. The donor community has played, and will continue to play, a pivotal role in the quest for peace and environmental security.

10.2 Multilateral environmental agreements (MEAs)

Pending further progress of the peace process and final status negotiations, the Palestinian Authority has not been able to become a signatory to the multilateral environmental agreements (MEAs). However, in view of its observer status in the United Nations General Assembly, the Palestinian Authority has participated in MEA conferences and meetings. In the current situation, travel to participate in meetings abroad is subject to numerous administrative obstacles, not to mention outright curfews and closures.

Furthermore, in accordance with the Oslo II Accord, the Palestinian Authority has agreed to adhere to the accepted principles and standards spelt out in international treaties, including MEAs, with respect to transboundary and cross-border issues.

The Palestinian Authority continues to participate in regional arrangements on transboundary environmental issues such as water, and has been able to secure funds to implement specific national components of regional or subregional projects from the Global Environment Facility (GEF). The Palestinian Authority continues to benefit from bilateral donor support for measures within the Occupied Palestinian Territories that contribute to meeting international environmental priorities. The Palestinian Authority also continues to cooperate closely with the United Nations, and its organs and agencies, for the implementation of various environment-related activities.

10.3 Mediterranean Action Plan (MAP)

The UNEP Mediterranean Action Plan aims to meet the challenges of environmental degradation in the sea, coastal areas and inland, and to link sustainable resource management with development in the Mediterranean region. Under the MAP, a set of legal instruments has been developed, including the Barcelona Convention (the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean) and its six Protocols, which address specific environmental themes. The Barcelona Convention originally entered into force in 1976 and two of its original Protocols never entered into force. The 1995 amendment to the Convention, as well as some of the amendments to the protocols, have not yet entered into force.

The Palestinian Authority regularly participates in the MAP activities, in particular the activities of the Mediterranean Commission on Sustainable Development (MCSDD) and the MED POL programme, which is the environmental assessment of the Mediterranean Action Plan. As a result, Palestinian representatives have actively participated in all MCSDD meetings and in all technical and policy meetings organized in the framework of MED POL. Cooperation includes the recent agreement with the Palestinian Authority for the preparation of an assessment of the state of marine pollution in its territories. The assessment

was successfully prepared and is now being used for the formulation of a national pollution-monitoring programme to be implemented as part of the MED POL programme.

10.4 Euro-Mediterranean Partnership

The Barcelona Declaration, adopted at the Euro-Mediterranean Conference in November 1995, established a new framework for cooperation between the EU and 12 other Mediterranean partners, to guarantee peace, stability and prosperity in the region. The Declaration establishes progressively a free-trade area between the EU and its members and the other partners. The role of sustainable development and its environmental dimension were fully integrated (EC, 1995).

The European Commission was entrusted with coordinating the preparation of a Short and Medium-Term Priority Environmental Action Plan (SMAP), which was adopted in Helsinki, Finland, in 1997. Five priority areas of action were identified: integrated water management, waste management, hot spots, integrated coastal zone management and combating desertification (EC, 1999).

A financial instrument for EU implementation of the Barcelona process was defined – the MEDA programme. Between 1995 and 1999, MEDA accounted for 3,435 million of the 4,422 million euros of budgetary resources allocated for financial cooperation between the EU and its Mediterranean partners. For the period 2000-2006, MEDA is endowed with 5,350 million euros.

The Palestinian Authority participates in the Barcelona process as a full partner. In addition to MEDA funding, a special financial instrument was established to cater for the special circumstances in the West Bank and Gaza, namely the support programme for the Middle East peace process. Over the period 1995-1999, support to Palestinians in the form of grants amounted to 88 million euros per year (EC, 2000). During this period, small-scale projects in municipalities were funded in water supply, sewerage and road rehabilitation, and a local rural development programme launched. In addition, support was provided to UNRWA, for food aid, humanitarian aid (through the ECHO programme), NGO co-financing, decentralized cooperation, human rights and democracy, and training for the Palestinian Authority security forces. Between 2000 and 2001, commitments amounting to 368.9 million euros were made from the EU budget in favour of the Palestinians, of which 332.6 million euros, or 90%, were disbursed.

A Euro-Mediterranean Interim Association Agreement on trade and cooperation between the European Community and the Palestinian Liberation Organization for the benefit of the Palestinian Authority was signed in July 1997, which progressively establishes a free-trade area between the parties.

This is one of the few fora in which both Palestinians and Israelis participate.

10.5 League of Arab States

The League of Arab States is a regional organization set up to strengthen ties between Arab states, coordinate policies and promote common interests. Membership has now reached 22, and includes Palestinian membership.

The League of Arab States includes several specialized organizations and councils of relevance to the environment, in which the Palestinian Authority participates, such as the Council of Arab Ministers Responsible for Environment (CAMRE), the Arab League Educational, Cultural and Scientific Organization (ALECSO), the Arab Center for Studies of

Arid Lands and Desertification (ACSAD) and the Arab Organization for Agricultural Development (AOAD).

ALECSO was established in 1970 and has as its primary responsibility the promotion and coordination of educational, cultural and scientific activities at the regional level. Some activities of relevance to the environment are carried out. For example, in 1974, ALECSO initiated a programme for the protection of the environment of the Red Sea and Gulf of Aden. Its direct involvement continued until the declaration of the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA) in September 1995 and its active support continues to this day.

The Palestinians also participate actively in functions of other Arab League organizations including ALECSO, the Arab Center for Studies of Arid Lands and Desertification (ACSAD) and the Arab Organization for Agricultural Development (AOAD).

The Palestinian Authority has been an active member of CAMRE, participating in its the Ministerial Sessions, and other functions such the preparatory process for the World Summit on Sustainable Development (WSSD), the Global International Waters Assessment (GIWA), the UNIDO's Cleaner Production Programme and UNEP's Awareness and Preparedness for Emergencies at a Local Level (APELL). In 2003, the Palestinian Authority has so far participated in the following regional activities organized jointly with CAMRE and the hosts: a workshop on integrated environmental assessment (Bahrain); a workshop on integrating environmental concepts into illiteracy eradication programmes (Qatar); the Steering Committee for Industrial Pollution (League of Arab States); and the regional briefings for industry on ISO14001 (Jordan).

10.6 Donor support

During the period 1994-1998, the donor community disbursed a total of US\$ 2,506 million to the Palestinian Authority, mostly in the form of grants, which is equivalent to approximately US\$173 per capita per year. The top six contributors in descending order were the USA, Japan, the EU, Germany, Norway and Saudi Arabia (MOPIC, 1998).

In 1999, actual donor disbursements were US\$ 523.9 million; in 2000, they declined to US\$ 369.3 million, although pledges rose during this period. (UNSCO, 2001). The share of funds going to water and sanitation declined, although this remained the largest recipient sector, with an overall increase in support for technical assistance.

In 2001, donor disbursements reached a record annual US\$ 900 million, although, in view of the growing socio-economic crisis, much of this was spent on providing humanitarian relief, for example for food aid and cash relief, employment generation and emergency health programmes (UNSCO, 2002). Over this period, the Arab League through the Islamic Development Bank became the largest contributor, followed by the EU, and then the USA, each paying 42, 26 and 12 percent of total disbursements.

In response to the growing concern at the deepening humanitarian crisis, a Humanitarian Plan of Action was prepared in autumn 2002 by a United Nations mission comprised of ten United Nations agencies and the World Bank, in follow-up to a report of the Special Humanitarian Envoy of the United Nations Secretary-General. The Action Plan was included in the 2003 United Nations Consolidated Inter-Agency Appeals for Humanitarian Assistance, in which US\$ 296 million were sought for the Occupied Palestinian Territories (UN, 2002). Elements of this plan have significant linkages with environmental topics. Activities on health include solid waste disposal to protect water supplies, procurement of

insecticides to fight West Nile Fever, and more. The Plan requires approximately US\$ 3.8 million for activities on water and sanitation include.

In successive phases in 2002, the World Bank approved credits and grants aimed at providing basic social services in the West Bank and Gaza. In December 2002, these were extended and expanded to include municipal services.

The fact that the Palestinian Authority is not a signatory to MEAs limits the extent to which funding may be obtained through the GEF. However, in some cases, Palestinians have been able to benefit from GEF funding when neighbouring countries submit a joint regional project.

During the intifada, difficulty has been experienced in implementing donor-financed projects, both emergency relief as well as longer-term investments in capacity-building. Closures have prevented workers from reaching their place of work, but food aid distribution has also been hampered. In addition, there has been direct destruction of infrastructure by Israeli military actions. Most environment projects are on hold, including those where donors have already committed funding.

During the Desk Study, the following provided information on relevant environment activities that they are funding: the European Commission, Canada, Denmark, Finland, Germany, the Netherlands, Spain, Sweden, Switzerland and the United States of America.¹

10.7 Donor coordination

Following the September 1993 accord between Israel and the PLO, a donors' conference took place in Washington, D.C., USA, to mobilize international support for the Occupied Palestinian Territories. Subsequently, the Ad Hoc Liaison Committee (AHLC) was established as the principal policy coordination body for development efforts in the West Bank and Gaza. AHLC members include Canada, the European Community, Japan, Norway, the Russian Federation, Saudi Arabia and the United States. The Palestine Liberation Organization and Israel are fully associated members of the AHLC, as are Egypt, Jordan, Tunisia, and the United Nations. In addition, a World Bank Consultative Group was established as a forum for all donors to discuss specific programmes and to pledge funds.

In November 1994, the AHLC created a locally-based counterpart institution, the Joint Liaison Committee (JLC), to improve the coordination of development efforts on the ground and to facilitate the transformation of pledges into disbursements. The Joint Liaison Committee was composed of the Chair of the Local Aid Coordination Committee (Norway) and the two co-chairs (the United Nations Special Coordinator in the Occupied Territories and the Resident Representative of the World Bank) and three ministerial representatives of the Palestinian Authority. The JLC was formed to overcome problems that might arise in donor-recipient relations.

At the same time, a Local Aid Coordination Committee (LACC) was also established as an additional mechanism to increase the efficiency of development efforts at the local level, bringing together 25-30 donor countries on a monthly basis.

In an effort to improve information sharing and coordination at the operational level and to direct donor assistance towards the needs and priorities identified by the Palestinian Authority, the LACC has established twelve Sector Working Groups (SWGs). Each of these

¹ In this chapter, reference is made to information provided by donors during the preparation of the Desk Study. However, UNEP would welcome all additional information to complete this section.

is composed of all donors interested in that particular sector, with one donor representative acting as Shepherd of the group, a representative of relevant PA ministries as Gavel Holder and the World Bank, United Nations Special Coordinator's Office (UNSCO) as Secretariat. UNSCO, in turn, delegated most secretariat functions to specialized United Nations organizations with a presence on the ground, namely, ILO, UNDP, UNICEF, UNRWA and WHO.

The SWGs cover the following sectors: agriculture, education, employment creation, environment, health, infrastructure and housing, institution building, police, private sector, public finance, tourism, and transport and telecommunication.

The Netherlands is Shepherd for the Environment Sector Working Group, the Gavel Holder is the Environment Planning Department of the Ministry of Planning and International Cooperation, and the Secretariat is provided by UNRWA. Many of the projects identified through this forum are on hold owing to the intensification of the ongoing conflict and difficulties in mobility.

Over and above difficulties existing before September 2000, the donor coordination structures established following the Oslo Accords have found the challenges posed by the intifada and deepening crisis to be demanding. Efforts have been made to revitalize the sector working groups and to improve information flows. The United Nations Humanitarian Plan of Action proposes ways of improving coordination at the policy and operational levels.

In addition to the bi-lateral coordination mechanisms, the parallel multilateral peace process established a Multilateral Working Group on the Environment (EWG), one of the five Working Groups established to address areas of common regional concern, with a membership of over forty. The EWG carries out projects in environmental management, maritime pollution, desertification, water quality, and sewage and solid waste management.

10.8 Conclusions

The conclusions of the Desk Study are that efforts to coordinate donor funding and information flow in the environment sector should be continued, that there is a need to urgently resolve obstacles to implementation of projects already approved, that the transition from studies to actual implementation should be supported, and that efforts should be made to ensure that new projects are both sustainable and economically self-sustaining.

Further, in face of the growing emergency humanitarian needs, it is important that environment projects are not neglected, but rather integrated into emergency response measures. Further environmental degradation will aggravate the humanitarian situation. It will be technically more difficult and more costly to resolve more acute environmental problems. For example, cooperation to prevent freshwater pollution and protect shared water resources will avoid near irreversible damage. Also, degrading of the water supply from wells and springs will reduce the amount of available drinking water available to villages not connected to the water supply, and will increase dependency on tanked water. Longer-term sustainable solutions to these problems will become more costly to implement.

Recommendations

Among other factors, the occupation, policies of closure and curfew and incursions of the Israeli military have had significant negative environmental impacts. Many of the findings in this UNEP Desk Study are alarming, and need to be addressed immediately.

In the current phase of the conflict, the absence of even minimal cooperation is worsening the situation on a daily basis, with impacts not only on the environment but also on human health.

For these reasons, the Israelis and Palestinians, as well as the international community, should do their utmost to put an end to the conflict. All efforts at seeking a peaceful solution should include parallel attempts to re-open channels to address environmental protection, which could be facilitated by an independent third party, when needed.

The alarming conflict-related environmental problems are adding to existing pressures on the environment, which include population pressures coupled with scarcity of land, weak environmental infrastructure, inadequate resources for environmental management, and global environmental trends such as desertification and climate change.

Transboundary and international cooperation

As a result of the occupation and the escalation of the Israel-Palestinian conflict since September 2000 (second intifada), only minimal cooperation between the Israeli and Palestinian authorities is taking place. However, a document signed by the water authorities of both parties aims to keep water and wastewater issues out of the conflict, but even this has proved to be difficult. In particular, almost all projects relating to wastewater have been on hold since autumn 2000, although the Israelis have reported positive news on the meeting of the Joint Water Committee in December 2002.

Given the alarming findings of the Desk Study, cooperation between the parties on acute environmental issues should be immediately revitalized. There is need for an institutional framework to negotiate these issues, especially during times of conflict. The specific recommendations are listed below.

1. Keep the environment out of the conflict.

At the beginning of the second intifada, an agreement between Israeli and Palestinian water authorities was made to keep water and wastewater issues out of the conflict. This agreement should be supported and respected by all parties, and should be extended to all environmental issues, including solid waste management, hazardous wastes and protection of biodiversity. The international community should give its full support to keeping the environment out of the conflict. Israel's role as a valuable partner in any regional and international cooperation should be recognized.

2. Reactivate the Joint Environmental Experts Committee established by the Oslo agreements.

This committee should work as an Israeli-Palestinian expert committee for acute environmental problems. Both Israeli and Palestinian environmental administrations should have their representatives on the committee. It should identify environmental hot spots that affect both sides, and recommend and plan realistic remedial actions with a clear schedule. In the beginning, an independent third party could facilitate these meetings, if needed.

3. **Build on regional solutions.**

From the economical and logistical perspectives, many environmental solutions relating to the freshwater supply, wastewater, solid waste and hazardous waste management should be built on the regional, cross-border cooperation. For example, the water company that serves both Israel and the Occupied Palestinian Territories continues to function despite the conflict. This kind of technical cooperation should be encouraged to minimize costs and find efficient solutions for environmental management.

4. **Revitalize the cross-border cooperation between environmental authorities, experts, scientists and NGOs.**

Regular and open exchange of information would enable environmental experts, scientists, authorities and NGOs to seek timely and cost-effective solutions to environmental problems and to make reasonable plans for regional environmental management. A better exchange of information is acutely needed.

5. **Facilitate the Palestinian Authority's participation in international environmental cooperation.**

In the ongoing Palestinian institution-building process, it is very important that the Palestinian Authority can fully benefit as soon as possible from international environmental cooperation in the Middle East region, in the Mediterranean and in a global context. Secretariats of multilateral environmental agreements (MEAs) should facilitate, as appropriate, the participation of the Palestinian Authority in relevant meetings and processes.

6. **Make environment a priority.**

In the Occupied Palestinian Territories and in the whole region, many environmental threats meet. These include water scarcity, pollution of aquifers, rapid population growth, burden on the environment from refugees, overgrazing, loss of forests and vegetation cover, land degradation, desertification and the effects of global climate change. Environmental issues and projects have to be among the highest priorities for the Palestinian Authority, but also for the international community and donors.

7. **Coordinate environmental laws and regulations regionally.**

To avoid a situation where industries move to the other side of the border to avoid more stringent environmental standards, environmental laws and regulations should be coordinated, and also regionally harmonized. Therefore environmental laws and standards in the region should be harmonized to avoid the risk of conflicting practices and to maximize regional and cross-border effects of environment protection. Internationally accepted standards as agreed under the Oslo II Accord should be used. Both Israel and the Palestinian Authority should take part in this regional coordination.

8. **The international community and donors should support sustainable development and environmental cooperation.**

When the international community and donors are financing and supporting projects in the Occupied Palestinian Territories, all projects should meet demanding environmental criteria. Important elements of the projects should be the analysis of cross-

border environmental impacts and promotion of cross-border environmental cooperation. Israel should take all steps to facilitate the passage without restriction and delay of imported materials for construction, repair and maintenance related to the implementation of these projects. There have been delays in the approval of locations for construction of donor-funded environmental infrastructure. Efforts should be made by Israelis and Palestinians to speed up the process of approval, for example by making the negotiation process more efficient when there is a need to modify plans.

9. Active role for the Global Environment Facility (GEF).

The Global Environment Facility (GEF) should seek ways to continue supporting the Palestinian Authority in its efforts to improve its preparedness to implement international environmental agreements.

10. Develop environmental cooperation as a confidence-building tool.

During the conflict, a minimum level of environmental cooperation is essential to safeguard natural resources and to prevent health risks and long-term degradation of the environment. Environmental cooperation should also be used as a confidence-building tool between Israelis and Palestinians, to facilitate other steps in the peace process.

National Environment Action Plan (NEAP)

The Palestinian Authority needs a scientific and clearly prioritized plan to work with the most acute environmental problems. This work plan can be developed from the existing National Environment Action Plan (NEAP).

11. Review and update the National Environment Action Plan (NEAP).

The NEAP should be based on key international concepts such as the polluter pays principle and precaution. The updated National Environment Action Plan should identify priority actions to be implemented as soon as conditions permit.

12. Include all stakeholders in the revised NEAP.

All relevant sectors in environmental planning should be involved when updating the National Environment Action Plan (e.g. water, agriculture, urban planning).

13. Develop sectoral environment policies based on the NEAP.

Sectoral environment policies and laws should be developed on the basis of the updated National Environment Action Plan. The sectoral policies and standards could be harmonized with advanced international standards. Establish bylaws and guidelines for environmental themes under the framework environmental law.

14. Develop capacity-building for the NEAP.

The international community should assist the Palestinian Authority with capacity-building for National Environment Action Plan implementation, drawing on relevant experience in other countries. Promote research as a decision support system and integrate the results of the research into the development of the environmental sector.

15. Promote environmental education.

Environmental education should be promoted, targeting students at the primary and secondary school levels through curricula, and also by including appropriate modules in university courses. The general public should be sensitized using various media and other channels. It is essential that all Palestinians are fully aware of the value of the environment and the need to protect it, as well as the risks of damage.

Environmental Quality Authority (EQA)

The Palestinian Environmental Quality Authority (EQA) has the main responsibility for environmental administration in the Occupied Palestinian Territories. It still lacks a clear mandate, and financial and human resources to fulfil its tasks. An additional problem for EQA, as for all other bodies of the Palestinian administration, is that the work is conducted in two geographically separate entities, the West Bank and Gaza.

16. Strengthen the mandate of EQA.

The mandate and functions of the Environmental Quality Authority should be strengthened and its coordination role on environmental issues clarified.

17. Build capacity for intersectoral cooperation.

Specific training programmes should be provided on intersectoral coordination and cooperation on environmental matters for Environmental Quality Authority officials and officials of other key bodies.

18. Improve the controlling capacity of EQA.

EQA should have proper equipment and resources to observe and measure the quality of the environment. For this a properly equipped environmental laboratory with trained personnel for sampling and laboratory work is needed.

19. Use environmental impact assessments (EIA).

Environmental impact assessment (EIA) procedures should be strengthened by building in an effective review and dispute settlement procedure. EIA training and awareness-raising are also needed.

20. Strengthen the enforcement of environmental laws.

The enforcement of environmental laws and standards should be strengthened, including through the further application of penalties. The role of the courts, the police and private law professionals in enforcement should be clarified. The role of economic incentives as an enforcement mechanism should be increased. Major awareness-raising and capacity-building efforts should be carried out, directed at Palestinian Authority officials and stakeholders, concerning all aspects of the Environmental Law, to support its effective implementation and enforcement.

Land-use planning

Land-use planning is one of the most difficult issues in the Occupied Palestinian Territories. The Oslo agreements divide the territory into areas A, B and C, where Israeli and Palestinian authorities have different mandates and responsibilities. Once the Palestinian Authority received full powers and responsibilities over land-use planning in areas A and B,

according to the Oslo Accords, Israel has not been involved in land-use planning processes in those areas. In the current conflict situation, the Israeli military has re-occupied various parts of the areas A and B at different times, and therefore the Palestinian Authority has had difficulty in carrying out its responsibilities on land-use planning.

It is also evident that many environmental improvements – building of new wastewater treatment plants, upgrading the quality of landfills or relocating them, etc. – are pending, and may not be resolved before there is an end to the conflict.

As a consequence of the occupation, the security demands make land-use planning a very complex process and an additional burden on the environment by having existing settlements and the land areas divided into different sectors. This leads to a situation where double-infrastructure often exists in an area where land is already scarce (e.g. security roads to settlements).

21. Improve cross-border cooperation in land-use planning.

Land-use planning can be developed as a cooperation tool between the parties. Proper land-use planning could help the parties to make effective plans for environmental infrastructure and to avoid unnecessary double structures.

22. Take environmental considerations into account in land-use planning.

In the Occupied Palestinian Territories, land-use planning should take into account environmental considerations. For example, plans on where to locate new wastewater treatment plants and solid waste landfills should take into account the proximity of human settlements, and new housing should not be located too close to existing wastewater treatment plants and solid waste dump sites.

Non-governmental organizations (NGOs)

One of the negative aspects of the current conflict is that very few non-governmental organizations in the Occupied Palestinian Territories and in Israel have cross-border cooperation. The role of the civil society and NGOs is vital and therefore cooperation between NGOs should be encouraged. Also, inside the Occupied Palestinian Territories, the NGOs should be given more room to influence policy-making.

23. Encourage NGO cooperation between Palestinians and Israelis.

All stakeholders should support cooperation between NGOs in the Occupied Palestinian Territories and Israel. The international community and donors should help the Palestinian NGO society play an important role regionally and internationally.

24. Support the role of NGOs inside the Occupied Palestinian Territory.

Discussing environmental issues, presenting different opinions and challenging the authorities are normal functions that NGOs carry out in democratic societies. The Palestinian National Environmental Action Plan also recognizes the important role of the NGOs. A strengthening of the capacities and the role of NGOs, and preserving of their independence, should be encouraged. An important aspect related to NGO activities is access to all information, and this should include full transparency on donor-funded environmental projects.

Private sector

The private sector has become a crucial player in environmental policies, due to commitments and environmental standards adopted voluntarily by the business community. The private sector should be made an ally in the much-needed environmental changes in the Occupied Palestinian Territories.

25. Open an environmental dialogue with the private sector.

The private sector should be fully engaged in environmental policy-making in the Occupied Palestinian Territories. This would enable it to continue working proactively on environmental management and to further facilitate the work of the Environmental Quality Authority.

26. Introduce voluntary environmental standards in the private sector.

Environmental quality standards, such as ISO 14001, should be introduced in the private sector.

Freshwater management

Due to the water scarcity in the region, freshwater is the most crucial aspect of environmental management in the Occupied Palestinian Territories. Water is also one of the important issues addressed in the Oslo Accords. Even since the escalation of the conflict, attempts have been made to follow the lines of the Oslo Accords with regard to the establishment of new wells and management of quantities pumped.

According to the information available to UNEP, both the quantity of water that may be extracted on a sustainable basis and the quality of the groundwater should be addressed. The overall quantity of water that may be pumped on a sustainable basis has to be critically reviewed based on the newest data available. The quality of water is rapidly deteriorating, and proper protection measures have to be implemented as soon as possible.

Finally, desalination of sea water seems to be a long-term solution to increase the amount of water for households and industry. However, the resulting higher costs of water may present social challenges in the Occupied Palestinian Territories.

27. Strengthen the capacity of the Palestinian Water Authority (PWA).

The capacities of PWA staff should be strengthened, in particular in the fields of aquifer modelling and analyses.

28. Activate the National Water Council.

In the Occupied Palestinian Territories, the National Water Council, comprising representatives with membership of different ministries and stakeholders, should meet on a periodic basis to manage all freshwater and wastewater issues in a comprehensive way.

29. Approve and implement a National Water Plan.

A National Water Plan should be a tool for the Palestinian Authority to improve the management of water resources and plan water issues.

30. Carry out regular updates of the National Water Plan.

The National Water Plan should be updated regularly.

31. Continue the technical Palestinian-Israeli water cooperation.

Technical cooperation on the water sector should continue. The cooperation is needed to determine sustainable water use plans and to solve the urgent problems of water infrastructure. The cooperation should also focus on wastewater issues.

32. Create transparency with regard to shared aquifers.

It is important to create transparency in the management of aquifers shared by Israelis and Palestinians by improving the exchange of hydrological monitoring data. The exchange of information should cover methodologies applied for the analyses of the shared aquifers and the results of such analyses.

33. Review the water extraction practice and plans.

The water extraction practice and plans need to be carefully reviewed against existing knowledge about the water resources. Water extraction rates must be based on sustainable principles that do not overexploit the resources.

34. Improve water monitoring.

The regular water monitoring should focus both on quantity and quality. Regular metering of pumping amounts and water levels would enable the respective authorities to regulate the use of water. Much more systematic monitoring is needed to maintain necessary data on water quality. There is also a need for improved monitoring of wells in Gaza (metering of pumping amounts, quality and water levels).

35. Develop local springs (West Bank).

There is a need for continued support for the development of local springs, especially in the West Bank, paying due attention to the protection of ecosystems.

36. Identify the pollution risks for freshwater.

The protection of freshwater should be improved by identifying pollution hot spots, devising short-term remedies at the hot spots, enforcing bans on obsolete pesticide use, improving integrated pest management, ensuring that polluting activities do not affect streams, water channels, springs and wells, and preventing pollution from fuel storage, including at petrol stations.

37. Tell people how to protect freshwater sources.

Awareness campaigns should be organized on the impacts of improper disposal of domestic and hazardous waste, and on day-to-day hygiene measures in relation to household water storage and use.

38. Save water.

Efforts should be made to save water, including by optimizing its use. There is a need to develop and implement demand-side management aimed at limiting and optimizing water use. The demand-side water management should address industrial, agricultural

and household use of water and should include such tools as registration and licensing of wells, permitting the use of water, pricing and awareness-raising.

39. **Replace freshwater in irrigation.**

Increasing the use of treated wastewater in irrigation will save scarce freshwater resources.

40. **Promote regional exchange on agricultural technologies.**

The exchange of information and experience between Israelis and Palestinians should be promoted on crop varieties, irrigation techniques and efficient use of water in agriculture.

41. **Stop the leakages.**

There should be immediate action to repair and rehabilitate leaking and damaged water supply systems. Water is currently misused, and leaking networks can also cause dangerous cross-contamination with wastewaters and wastes, leading to negative hygienic and health effects.

42. **Implement desalination projects (Gaza).**

It is obvious that, even with water-saving measures, new sources of freshwater will be needed in the future. Therefore desalination projects to obtain freshwater from the sea should be promoted, drawing on renewable sources of energy where possible. Existing plans should be completed. Funding of projects should include long-term maintenance and operational costs.

43. **Continue water modelling of the Coastal Aquifer (Gaza).**

Continued work, including local capacity-building, is needed on the modelling of the Gaza aquifer as an instrument for improved management decisions.

44. **Increase knowledge of the mountain aquifers (West Bank).**

The sound management of water resources calls for improved knowledge and management of the mountain aquifers. Modelling should include recharge calculations from rainfall, soil characteristics, and the potential effects of transport of pollutants. It is essential to resolve any uncertainties concerning the amount of water that may be extracted on a sustainable basis from the mountain aquifers, in particular the Eastern Aquifer. Reliable measurements should be carried out of the actual outflows from the Eastern Aquifer via the Dead Sea shore springs.

45. **Revive hydrological monitoring.**

The hydrological monitoring that has effectively stopped since September 2000 should be resumed.

Wastewater management

There are only a few wastewater treatment facilities in the Occupied Palestinian Territories, and due to the conflict and/or inadequate management most of them are not functioning properly. This is an alarming issue since the untreated wastewater is polluting the aquifers

and the seashore in Gaza. As the freshwater and sewage networks are in poor condition, there is also cross-contamination from wastewater to freshwater, causing negative health effects.

In addition to the wastewater from the Palestinian towns and villages, the Israeli settlements in the West Bank and Gaza are adding to the problem of untreated wastewater.

46. Prioritize wastewater issues.

Wastewater issues should be given high priority in the development of the region. Current trends and threats from untreated wastewaters undermine the livelihood development and jeopardize the quality of the water.

47. Include wastewater issues in Israeli-Palestinian water cooperation.

Wastewater issues should be included in existing technical cooperation between the parties. Without prejudice to the outcome of the Final Status Negotiations on settlements, in the interim, each party should have responsibility for the management and disposal of the wastewater it generates. However, where appropriate, joint solutions could be considered.

48. Strengthen wastewater management.

The institutional framework on wastewater management should be strengthened. The role of the Environmental Quality Authority (EQA) in controlling the wastewater outlets should be clarified. Similarly, the municipal authorities should be given clear tasks to implement sound wastewater practices.

49. Improve wastewater legislation.

Legislation on the handling of wastewater needs to be strengthened, in order to implement the goals and policies presented in the National Water Plan. Accompanying measures should include the introduction of relevant standards, permits and fees for purification, and should reflected advanced international standards.

50. Improve law enforcement.

Enforcement tools are needed to enable the authorities to control and implement policies. The roles of enforcement bodies should be identified with regard to policing and court procedure in enforcement and control.

51. Implement the polluter pays principle.

Policies and systems should be instituted to recover the investment and operation costs of wastewater treatment.

52. Repair the cesspits.

Existing cesspits should be repaired or rehabilitated to minimize the uncontrolled flow of wastewater, including with concrete lining to protect groundwater.

53. Use cesspits only as a temporary solution.

The use of cesspits can be used only as a temporary solution in areas where the wastewater infrastructure will not allow for more comprehensive improvements.

However, the cesspits should be emptied in carefully selected areas, or optimally, in wastewater treatment facilities, and should have concrete lining.

54. Improve wastewater management in the refugee camps.

Improved wastewater management is needed in the refugee camps in the West Bank.

55. Include the wastewater treatment plants in land-use planning.

The construction of wastewater networks and wastewater treatment plants must be given the highest priority. Possibilities of establishing joint wastewater treatment plants and infrastructure should be explored. Only in the event that this is not feasible should separate structures be planned and constructed. Land-use planning should support the mid-term planning and site selection for the treatment facilities.

56. Expand the wastewater system to the whole population.

In the long term, the wastewater system should be expanded to cater for the whole population, with adequate treatment and effective reuse of collected wastewater. Wastewater treatment plants should be established in accordance with advanced international standards. Donor countries should be encouraged to allocate funds for long-term operation and maintenance.

57. Establish wastewater treatment plants.

Establishment of wastewater treatment plants has to be the long-term policy in all areas of the Occupied Palestinian Territories.

58. Treat industrial wastewater.

Industries must be required to implement restrictions and controls, including pre-treatment of wastewater before it is discharged to municipal collection systems, to reduce the level of pollutants entering the environment.

59. Separate the hazardous substances and waste from wastewater.

On an urgent basis, studies must be conducted on industrial sites that are potentially generating highly hazardous wastewater effluent. Immediate action should be taken to minimize environmental and health risks.

60. Monitor and control direct pollution to the Mediterranean.

The 18 effluent pipes discharging wastewater of varying quality and quantity into coastal waters and onto Gaza beaches must be closed. A plan to reduce the number of effluent pipes, as well as to upgrade the effluent to acceptable standards for reuse or discharge to natural watercourses must be initiated. The current discharge into the sea has negative impacts on human health and also threatens seaside recreational and tourism development in Gaza.

61. Settlements should treat all their own wastewater.

Israeli should do the utmost to minimize the environmental impacts of the settlements. Israel must ensure that all settlements are equipped with wastewater treatment plants and that domestic and industrial effluents meet applicable standards.

62. Increase reuse of treated wastewater.

The reuse of treated wastewater should be promoted on a widespread basis. Reuse of wastewater should be borne in mind when any new wastewater treatment plants are planned and constructed.

63. Establish standards for reuse.

Standards should be established and implemented for the various reuses of treated wastewater, such as irrigated agriculture and aquifer recharge.

64. Treat immediately the Beit Lahia (Gaza) wastewater lake.

The Beit Lahia wastewater treatment plant and its sewage lake is one of the major environmental "hot spots" where urgent remedial action is required. The problem is also a political one where the parties have shown little willingness to make compromises in the interests of environmental protection and to minimize potential risks to human health. A mobile wastewater treatment plant should be installed as soon as possible to treat the effluent from the existing overloaded treatment plant ensuring that it meets standards for irrigation reuse, aquifer recharge, and/or disposal at sea. The issue of the sewage lake and measures to eliminate it should also be urgently addressed by the JWC.

65. Establish standards for treated wastewater effluent and sludge

The wastewater effluent discharged to wadis, streams and the Mediterranean Sea in Gaza must be of advanced international standards.

Solid waste

There were several critical findings with regard to solid waste management in the Occupied Palestinian Territories. On the one hand, the solid waste management sector has suffered from the Israeli occupation in many ways. For example, curfews and roadblocks have hindered transport to the municipal disposal sites, resulting in the establishment of temporary disposal sites.

On the other hand, most of the permanent disposal sites are not sanitary landfills, and groundwater is threatened by pollution from the landfills. Existing landfill management is not optimal. At all the landfills UNEP visited, the environmentally dangerous practice the open burning of waste was taking place. For example, if any PVC is contained in the solid waste, hazardous dioxins will be released. There is no separation of hazardous and non-hazardous waste, except for medical waste in selected circumstances.

The proposed mitigation measures are divided into short-term (3 years), medium-term (10 years) and long-term (20 years) actions.

One critical assumption for implementation of all action and follow-up is an easing of restrictions on motorized transport within the region (curfews, roadblocks). The easing of import restrictions concerning spare parts and necessary new and replacement equipment is also required. Without these measures, any upgrading and improvement of the situation will be very difficult.

■ Short-term recommendations

66. Strengthen the role of EQA in the waste sector.

Activities of the Environmental Quality Authority in municipal solid waste and hazardous waste coordination, planning, licensing and monitoring must be revitalized as soon as possible, within the context of a comprehensive overhaul of environmental laws, regulations and standards.

67. Improve donor coordination in the waste sector.

There is a need for strengthening donor coordination related to municipal solid waste and hazardous waste management in the Occupied Palestinian Territories. Projects should focus also on treatment, and should take into account the costs of operation and maintenance.

68. Re-establish Israeli-Palestinian waste cooperation.

Cooperation and coordination in waste management must be revitalised between the Israeli and Palestinian environmental authorities. One means of achieving this would be to revitalize the former Joint Environmental Experts Committee (JEEC) and to develop a set of updated objectives and tasks. Initial key topics would be acceptable disposal sites and practices throughout the Occupied Palestinian Territories, recycling schemes, transfer of regional experience, and hazardous waste disposal and treatment.

69. Separate hazardous and non-hazardous waste.

Separate collection and disposal schemes for key hazardous waste types should be established, based on initial, simple disposal or storage (see additional recommendations below).

70. Establish regional solid waste councils.

The existing, fragmented institutional structure does not support professional and rational municipal solid waste services. The ongoing efforts to establish regional solid waste councils must continue, particularly for the regions with many small villages and extensive rural areas. Assuming that progress is made on resolving the conflict, it could be a short-term goal to have all substantive parts of solid waste services in the Occupied Palestinian Territories organised through a combination of large municipalities or regional councils. Donor-supported schemes for institutional strengthening and training must be an initial activity within this component.

71. Introduce solid waste fees.

When the collection and disposal system is functioning more adequately, municipal solid waste fees should be introduced for all citizens (starting at an agreed minimum level). Disposal fees payable must be introduced at all remaining disposal sites to facilitate improved operation.

72. Improve collection of wastes.

Improved collection schemes should be established or re-established immediately. The recent damage assessment by the Donor Support Group provides an initial

overview of replacement needs resulting from direct damage or extraordinary wear and tear. However, upgrading of the collection system must be based on a professional overview assessment, once closures, curfews and other restrictions are lifted. It is not rational merely to replace systems that could be significantly improved. Thus, a complete survey should be carried out as soon as possible. This must include the specifications, age and condition of equipment and information on performance, maintenance schemes, workshop facilities, etc. Based on this, it will be possible to establish an overall priority list for upgrading of the collection system throughout the Occupied Palestinian Territories. Once closures and curfews are lifted, the pre-September 2000 levels would be a starting point.

73. Keep the Occupied Palestinian Territories clean.

In a non-conflict situation, initial clean-up campaigns should be launched throughout the Occupied Palestinian Territories, possibly using the substantial unemployed workforce. In parallel, an overall, environmental awareness and education campaign should be launched via schools and the media.

74. Stop the open burning of waste.

An initial recommendation for the disposal system is to stop immediately the open burning of municipal solid waste in the Occupied Palestinian Territories, both at temporary and permanent sites as well as at open lots in the collection areas. This is probably the most important health and environmental hazard from solid waste management. Furthermore, operational equipment should be made available at all remaining sites. If the operational experience from the use of a specialized solid waste compactor in Nablus is positive, such compactors should be introduced elsewhere, at least at the other large sites. These compactors can achieve a density in the landfill that may be 25-50 % higher than with conventional vehicles, and this may be crucial given the availability and costs of land within the Occupied Palestinian Territories.

75. Remove the debris from damage due to the conflict.

The most visible and problematic debris should be removed as soon as possible. Specialized cutting and sorting equipment (designed for environmental demolition) should be procured and distributed to the most relevant regions. Local contractors may utilize this equipment, preferably after practical training. This will transform mixed debris from a problem to a resource, reducing the need for natural stone and gravel from quarries.

76. Recycle metal, glass and other materials.

Collection and recycling of car wrecks should also begin as soon as possible, assuming that domestic processing capacity in Nablus can be used. The same applies to recycling of glass, based on the facilities in Hebron (Al Khalil). Smaller pilot schemes for other waste components may be introduced if found to be viable.

77. Introduce composting.

The existing pilot schemes for composting in Gaza should be re-established, supported by one or several pilot projects in the West Bank. As soon as positive results are achieved, the planning and gradual introduction of more widespread low-cost composting schemes should begin.

78. Close and cover all temporary and emergency disposal.

If located in environmentally sensitive areas, the accumulated solid waste should be removed or the site capped with a liner. However, it must be noted that removal of large disposal sites may also cause extra environmental impacts and substantial additional costs.

79. Specific recommendations for solid waste management in Gaza.

- Access to the three existing disposal sites must be opened as soon as possible, enabling the use of the normal collection fleet.
- The containers throughout Gaza should be replaced if the systems are functioning once more.
- Available municipal workshops should be upgraded and spare parts provided. In view of the short distances involved, necessary maintenance in Gaza could be carried out in three or four municipal/council workshops.
- A relevant revised institutional arrangement might include three regional councils and the Gaza city municipality.
- The waste from northern Gaza should be brought to the Gaza city site.
- The measures and operations at the disposal sites must be reviewed and improved, and training provided if necessary, for instance the use of daily soil coverage of disposal sites.
- Further site development must maintain an agreed minimum distance to the Israeli border. New sites should be coordinated to minimize environmental impact.
- Available equipment must be utilized to the maximum according to modern practices.
- If not already in place, operational plans must be prepared and introduced.
- Bulldozers should be supplemented by compactors, with a minimum of one compactor for each site.
- Leachate control should be improved

80. Specific recommendations for solid waste management in the West Bank.

- An immediate assessment should be conducted to map the sites that pose a great threat to human health and to the environment.
- The current waste disposal site in Ramallah/Al Bireh should be closed. Closure restrictions should be eased to allow use of the previous disposal site. However, the site and the access road would need to be slightly relocated to a more isolated adjacent location. Operational practices should be improved, for instance, the use of daily cover.
- The access should be re-established to the disposal site used prior to September 2000 in Jenin. The operational practices at this site should be improved.

- An immediate assessment should be conducted to identify which of the previous disposal sites can be used if/when curfew and closure restrictions are lifted, in a transitional phase until a planned network of new disposal sites is established.
- A future disposal site plan should be developed for the West Bank as soon as practically possible to identify an optimized network of sites, coordinated to minimize environmental impact. Previous proposals for three to five sites for the West Bank should be taken into consideration, and attention paid to vital aquifer recharge areas.
- Construction work should begin at the Jenin site as soon as access for the contractors has been provided. This site may cover Jenin, Tulkarm and Tublas districts.
- The site in the Jordan valley could be used for the Nablus district or a new site identified, possibly a regional site for Nablus, Qalqiliya and part of Salfit districts.
- A single site should be used for Ramallah, Jericho (Ariha) and part of Salfit districts. With an appropriately adjusted location, the Al Bireh site may be at least an interim solution for this region.
- If continued to be used as up to now, the Abu Dis site should be upgraded.
- A new site should be developed for the Bethlehem (Beit Lahm) district.
- A new site should be developed for Hebron (Al Khalil) district (or one common site for Bethlehem (Beit Lahm) and Hebron (Al Khalil)).
- Other sites could be developed if found to be feasible (e.g. north-western West Bank, Jericho (Ariha)).
- Israel should ensure that settlements are equipped with appropriate treatment and disposal facilities, which meet internationally accepted standards for municipal and industrial solid waste.

■ Medium-term recommendations

81. Introduce privatization gradually.

Privatization should be introduced gradually, starting with tendering for collection and some of the disposal operations.

82. Make improvements throughout the Occupied Palestinian Territories.

Within the medium term, all the local institutional improvements started in the short term should be finalized throughout the Occupied Palestinian Territories. All rationalized municipal solid waste entities (large municipalities and regional councils) should be established and be in operation.

83. Upgrade the collection system to cover most of the population.

The collection system should be completely upgraded according to the overall recommendations, to cover nearly 100 % of the Gaza population and approximately 80-90 % of the population of the West Bank.

84. Remove debris.

All remaining debris in urban areas from the conflict should be removed and utilized/recycled within the medium term. All visible car wrecks should be removed, covered, and/or recycled as feasible and appropriate.

85. Introduce gas utilization and treatment of leachate at landfills.

The disposal sites should be further developed, for instance adding landfill gas utilization when applicable and increasing the treatment level of leachate.

86. Provide incentives for recycling.

Recycling should be developed through incentives and voluntary schemes, with a view to increasing recycling to 10 %. Processing should be based on domestic processing, cooperation with the Israeli recycling industry and export where economically feasible.

87. Introduce full-scale composting plants.

Assuming that experience from the initial composting schemes is positive, full-scale composting plants based on low-cost and low-tech solutions should gradually be implemented in the medium (and long) term, starting with the most suitable areas where land is scarce and/or soil is particularly needed. These plants should be at an appropriate distance from populations.

88. Separate collection system for hazardous waste.

Separate collection and disposal schemes for most hazardous waste types and quantities should be established, based on local disposal, export etc.

89. Introduce collection and disposal fees.

The fee collection system should be developed, and all municipal solid waste entities should be organized along the same lines, for instance through adding waste fees to water or electricity bills. The portion of costs being recovered from the households should be increased to a higher, agreed level (for instance 50 %). The disposal fees at the sites should cover 100 % of the actual disposal costs of the received waste.

90. Reduce the number of disposal sites in Gaza.

In Gaza, the central and southern disposal sites are fairly close to each other. The possibility of having only one or two sites in Gaza should be assessed on the assumption that restrictions are more or less removed. Due to scarcity of land, composting should be particularly encouraged.

91. Limit the number of disposal sites in the West Bank.

A revised disposal site system for the West Bank should be identified, established and put into operation, resulting in five to seven operational sites. A transfer and haulage system should be implemented based on non-compacting systems.

92. Envisage cross-border cooperation in waste collection and treatment.

Cross-border cooperation between the Palestinian and Israeli towns and villages could be introduced. This could make waste collection and the use of disposal sites more effective.

■ Long-term recommendations

93. Use state of the art technology in all solid waste treatment.

All treatment systems should be further developed, and new treatment options assessed when conditions are found feasible. All facilities should be at an appropriate distance from populations. Advanced international standards should be followed and funding for long-term operation and maintenance should be included in the cost of projects.

94. Establish state-of-the-art sanitary landfills.

In the longer term, all remaining landfills must be brought up to high international standards, and the number should be reduced to a few large sites. Ultimately, one central landfill, with at least two large transfer stations, could serve all of Gaza. The whole West Bank could be served by three major sites: north, central and south. If continued to be used as up to now, the Abu Dis site should be upgraded.

95. Increase the level of recycling.

Recycling will be an important part of the system, and mandatory schemes will be gradually introduced, having a recycling rate of 20-25 % as a starting point.

96. Apply the polluter pays principle.

Fees should ultimately cover 100 % of the costs of solid waste management, avoiding any subsidies from the authorities and fully applying the polluter pays principle.

Hazardous waste

Currently, hazardous wastes are not separated from other wastes, nor stored or disposed of safely. At most of the solid waste disposal sites, there is a practice of open burning, which releases toxic substances, such as dioxins. Also liquid hazardous wastes enter the soil, thus polluting the groundwater. These existing practices may result in solid waste disposal sites being closed in the near future, with major clean-up operations of polluted soil then being needed. To minimize or avoid these very expensive risks, immediate action should be taken to separate the hazardous wastes and handle them properly.

■ Short-term recommendations

97. Classify and separate hazardous waste.

As a first phase, it is essential to separate hazardous waste from other waste at source, according to physical and chemical characteristics relevant to their disposal and storage. This requires the establishment or adoption of a classification system for hazardous wastes. A classification system should be adopted. The approach outlined in the Pollutant Release and Transfer Register (PRTR) programme developed by the

United Nations Institute for Training and Research could be used. Field surveys need to be conducted to establish a database on the quantity, quality and generators of hazardous wastes within the Occupied Palestinian Territories.

98. Introduce regulations and other policy tools.

Hazardous waste management regulations need to be finalized, including regulatory measures for the environmentally sound management of hazardous wastes that make the generator responsible for all hazardous waste up to final elimination. Regulations should encourage industry to treat, recycle and reuse waste at the source of generation. The prohibition on import, sale and use of internationally banned pesticides should be enforced.

99. Minimize the amount of hazardous waste.

Policies to minimize (or eliminate) hazardous waste should be pursued. Hazardous waste minimization and recycling objectives should be integrated into procedures for environmental impact assessment.

100. Adopt a regional approach to the treatment of hazardous waste.

In general, the regional treatment of hazardous waste generated in the Occupied Palestinian Territories should be promoted. The low volume of hazardous waste generated in the Occupied Palestinian Territories does not justify, economically or operationally, the construction of a separate treatment facility. Further the small size of the area in question, the scattered distribution of the population, the fragile ecosystem and the sensitivity of the watershed areas also argue against such a solution. These wastes must be handled on a regional basis. As agreed in the Oslo II Accord, the facility at Ramat Hovav in Israel should be used. It is currently equipped to handle all types of hazardous waste generated in the Occupied Palestinian Territories, with the exception of highly halogenated waste and some types of special waste. Additional regional solutions could be explored in partnership with Egypt, including construction and operation of a joint incinerator.

101. Develop local solutions for selected types of hazardous waste.

In a few specific cases (e.g. old tyres and medical waste), there are solutions for certain types of environmentally sound hazardous waste treatment that could be established in the Occupied Palestinian Territories, and which do not require a regional solution (see recommendations 113 and 114 below). With regard to medical waste, the incinerators in the West Bank should be improved.

102. Establish a cleaner production centre.

A cleaner production centre should be set up to provide training and capacity-building for Palestinians along the lines of those already set up by UNEP and UNIDO.

103. Introduce economic incentives.

Appropriate incentive measures should be developed, including those drawing on the polluter pays principle. Economic incentives should be introduced to encourage the use of recycled material, providing that these materials are environmentally sound.

104. Use the Basel Convention notification process.

In spite of the fact that the Occupied Palestinian Territories are not a party to the Basel Convention, the relevant notification procedures should be adopted, and regional agreements promoted to regulate the transboundary movement of hazardous wastes. The disposal of hazardous wastes should be tracked, from shipment procedure, certificates of acceptance and receipt, to the issuing of permits for hazardous waste transportation and disposal.

105. Increase knowledge.

Knowledge and information on the economics of prevention and management of hazardous wastes should be promoted, together with information on waste generators, on environmentally sound technologies for waste reduction, and recycling.

106. Launch public awareness campaigns.

Public awareness and information programmes should be developed on hazardous waste generation, classification, and management. Information should be publicly available on the quantities, nature, handling procedures, disposal, treatment and any other activities related to the environmentally sound management of such waste.

107. Develop and implement a collection plan.

A plan should be developed for collection of hazardous wastes, safe temporary storage and proper treatment.

108. Take precautions with regard to asbestos.

Many buildings in the Occupied Palestinian Territories are covered with asbestos cement sheeting. The demolition of such buildings can result in the spread of asbestos dust in the air. In areas where people are living in close proximity to such demolished buildings, for example in Jenin where military operations have resulted in such damage, there could be harmful health effects to persons living nearby. Based on precaution, UNEP recommends analysing soil and air samples at these sites. The demolition or removal of asbestos sheeting should be undertaken in accordance with accepted precautionary measures.

109. Sample and clean up illegally dumped hazardous waste.

Several open sites contain barrels of hazardous waste that are currently not stored in secure conditions. Short-term priorities include sampling these barrels, analysing their contents, arranging transport to a secure storage site, and starting the transfer procedure of the waste to an appropriate disposal site.

110. Establish a collection system for used oil.

A collection system for used oil should be set up immediately, and a treatment facility constructed. Necessary equipment could be financed by the revenue from eco-taxes paid by the car owners when they change oil. The proposed treatment will yield a cheap secondary fuel that could be used in energy-intensive technologies needed in other hot spots.

111. Ensure that settlements manage their hazardous waste.

Israel should inventory the exact quantities and types of solid and liquid hazardous waste that are generated in the settlements, and take appropriate steps to ensure their safe collection, treatment and disposal, in accordance with Israel's own legislation.

112. Measure the activity of radioactive materials.

Funds should be made available for the Environmental Quality Authority to obtain portable equipment for radioactivity measurement to allow detection. All radioactive waste should be collected and stored safely. In general it is important that the capacity should exist to handle radioactive substances. If currently not available, assistance should be provided to the Palestinian Authority to procure safe storage facilities. Claims have been made concerning radioactive material used for military purposes. As a general rule, UNEP recommends that all such claims should be investigated seriously and measurements carried out, provided adequate information is available on locations where such material has been used. Relevant United Nations agencies should be consulted on the issue of radioactivity.

■ Medium- and long-term recommendations**113. Set up a pilot project for medical waste management.**

As noted in recommendation 101, in a few specific cases, there are solutions for certain types of environmentally sound hazardous waste treatment that could be established in the Occupied Palestinian Territories, and which do not require a regional solution. For instance, a pilot project should be set up comprising:

- Full inventory of medical waste generated in medical centres, clinics and laboratories;
- Testing of the separation and packing process in two or three representative medical centres;
- Interim storage at a temperature below 7° C;
- Transport of waste using specially designated refrigerated vehicles;
- A small-scale unit for the sterilization and solidification of medical waste (recent technologies include thermolysis, microwave treatment and steam sterilization – the best should be chosen for local conditions). Once damage from the conflict has been repaired, the installation next to the Gaza landfill could be used for this;
- Landfilling of treated waste in a pilot area, for example the Gaza landfill.

114. Set up a pilot project for the recycling of tyres.

A pilot project should be set up for the recycling of tyres, including the establishment of collection infrastructure (transportation and storage), a small -scale unit for the crushing of tyres, and a test site facility for recycling crushed tyres as raw material for road construction with bitumen. There is no available treatment facility in the West Bank or Gaza, but at least two technologies could be explored.

(a) Recycling asphalt

The tyres are crushed and the crushed granulated rubber particles obtained are mixed with asphalt. The process includes a feeder system, a reactor, a gas treatment system and storage tanks, and the tyre granulating equipment, which must be available locally to ensure supply. Asphalt is the binder for paving materials used in road construction. The performance of road surfaces depends not only on the quality of this binder, but also on the road's foundation and on the aggregates added to the paving mixture. A production unit of 50,000 metric tons per year requires about 5 million British Thermal Units/hour and 15 workers. Safety measures for workers are the same as those that apply in traditional asphalt manufacturing plants. A plant in an urban area producing 75,000 metric tons per year would cost between US\$ 1.2 and US\$ 1.5 million

(b) Thermal treatment of used tyres in cement kilns

Tyres can be used as an auxiliary fuel in cement manufacturing. The high temperature in the cement kiln eliminates the possibility of air pollution from the processing of the tyres. In addition, the metallic elements in the tyres are incorporated as a necessary ingredient in the cement itself and no secondary waste is created.

115. Organize a workshop on capacity-building.

A workshop should be held to identify the potential for existing and new hazardous waste industries in the private sector in the Occupied Palestinian Territories, the incentives necessary to render their operation more attractive, and ways to improve hazardous waste treatment technologies.

116. Pay attention to tanneries.

Tannery effluent, currently released untreated into wastewater collection systems or directly into the environment, contains chromium and other hazardous substances requiring specially tailored treatment. The small size of tanneries in the Occupied Palestinian Territories presents a challenge for recouping investments in costly treatment facilities. As an interim measure, mobile treatment units could serve to concentrate the liquid effluent under pressure at low temperatures. The resulting sludge could be stabilized through solidification, and then buried in locations that are safe from the hydrological point of view. This technique could also be applied for the treatment of liquid effluent from olive oil production. Appropriate collection, transport and storage infrastructure, together with monitoring, would be required.

117. Re-use oil.

Used oil is currently re-refined into lubricating oil. The residues from the process are often released into the municipal solid and wastewater stream, with damaging impacts on the environment. Awareness must be raised on the problems caused by this casual disposal. Ideally, residues should be burnt in a cement kiln. When this is not possible, residues should be placed in a landfill in a sealed container. Used oil is currently also used as a fuel, which carries risks that heavy metals contained in the oil will be emitted into the environment. Thus, used oil is best used as a fuel in cement kilns where heavy metals are absorbed into the cement matrix. Implementing the re-use of oil in cooperation with existing Israeli facilities, such as the ones in Ariel and near Hebron, should be examined.

118. Process used batteries.

Used wet batteries are generated wherever car maintenance is done. These batteries contain acids and lead, both of which are hazardous. The small-scale recycling of wet batteries is typically highly polluting and should be avoided. An appropriate alternative is the draining of the acid, with subsequent neutralization, and melting of the metal casing in a non-ferrous foundry.

119. Take care of sewage sludge and septage.

Sludge volumes can be minimized through the separation of sewers and storm drainage systems. Sludge can be disposed of on land, but only when very frequent testing indicates low metal content, and when the standards for such testing are regularly checked. As these safety conditions are very stringent, in practice, this implies that direct disposal on land is not often an option. Other treatment methods include drying, liming, composting, or co-composting with yard waste or organics, followed by disposal on land, which is designed to return the organic matter in sludge to the land. As above, however, contaminants in sludge can make this practice inadvisable for farmland. If sludge is disposed of in landfills, it is important to carry out prior drying in order to avoid generating large volumes of leachate.

Conservation and biodiversity

Biodiversity is under threat from a variety of pressures, which are further worsened by the ongoing conflict. During times of conflict, the political focus and resources are shifted away from sustainable management of natural resources and nature protection to other issues. The conflict presents difficulties for those on both sides who need to work together and to exchange information to achieve goals of nature protection.

120. Continue cooperation on management of protected areas and desertification.

The lack or non-existence of cooperation is hampering the protection of valuable biodiversity as well as sustainable management of natural resources. Official cooperation on these issues has been halted since September 2000 and even technical cooperation has been very limited.

121. Strengthen the regional cooperation to combat desertification.

Regional efforts to combat desertification would benefit from the participation of Israel in the UNCCD Sub-Regional Action Programme for West Asia. Jordan, Lebanon and the Syrian Arab Republic have recently endorsed the updated programme. The Palestinian Authority is also engaged in its development.

122. Enhance the protection of migratory species.

Efforts should be made to engage the Palestinians and Israelis in relevant regional agreements such as the African-Eurasian Migratory Water Bird Agreement.

123. Strengthen the cooperation to protect the Dead Sea.

Collaborative approaches between Israel, Jordan and the Palestinian Authority are needed to halt the degradation of the world's unique geomorphological feature. The international community should assist the parties to carefully assess the possibilities of including the Dead Sea in a World Heritage Site.

124. Increase nature protection.

The pressures of population growth and economic development are endangering the environmental health of the region. Existing protected areas are in many cases too small to maintain their ecological integrity and long-term viability.

125. Ensure proper management of the existing protected areas.

Authorities on both sides should respect the goals and management rules set for the areas protected. In particular, efforts to rehabilitate the Wadi Gaza should be intensified.

126. Restart capacity-building activities on conservation management.

The system planning project for the protected areas has been suspended since 2000 and many of the much-needed in situ training activities have been stopped.

127. Prepare an educational book of Palestinian flora and fauna.

With support from the international community, the Palestinian Authority and/or NGOs should prepare a comprehensive easy-to-read catalogue of the Palestinian flora and fauna, in Arabic and English. This tool should be used for capacity-building of the local authorities and as educational material in schools and universities.

128. Reconsider the ecological impacts of the separation wall.

If the proposed separation wall is completed, this will further fragment the ecosystems and will disconnect natural ecological corridors. This is likely to have a negative impact on biodiversity. The demolition of buildings to enable construction of the wall could also have negative environmental impacts. An environmental impact assessment could show additional negative impacts. Further, the proposed wall may have other negative impacts on local communities, for instance separating people from their wells and agricultural lands. From the environmental point of view, the construction of the separation wall should be reconsidered.

129. Enforce the prohibition on hunting.

While the conflict has hampered the enforcement of the ban in the West Bank and in some parts of Gaza, the illegal hunting of migratory birds along the Gaza coastline should be stopped at once.

130. Stop deforestation.

Rapid loss of planted and natural forests in the region is increasing the risks of soil degradation and loss of biodiversity. More than 25 % of the officially designated forest areas are thought to have been lost between 1971 and 1999. Natural forests should be protected and afforestation promoted.

131. Diminish pollution of wetlands.

Untreated wastewater discharged to vulnerable wetlands may result in changes in ecosystem functions and loss of species. Eutrophication caused by nutrient-rich effluents creates high biological oxygen demand.

132. Improve solid waste management.

Uncontrolled solid waste disposal sites handling toxic substances, pesticide residues and heavy metals pose additional risks to biodiversity.

133. Stop uncontrolled clearance of farmland.

The practice of clearing farmland for security purposes needs to be weighed against the agrobiodiversity loss, other environmental costs, and losses of cultural importance, such as olive groves, not to mention the detrimental environmental impacts of increased poverty.

134. Improve the protection of rangelands.

Overgrazing and improper management of rangeland has contributed to the loss of vegetation and erosion. There is a need for improved protection and rangeland management.

135. Improve coastal zone management.

While regional and Mediterranean cooperation should help, the Palestinians must resolve the fundamental environmental threats on the coastal zone in Gaza. The results and recommendations of the "Gaza Coastal and Marine Environmental Action Plan" should be taken into account.

136. Stop overfishing.

Ways and means must be sought to provide Palestinian with greater access to fishing grounds, both to prevent damage to local fish populations, and also to ensure that Palestinians traditionally reliant on fish do not, driven by necessity, resort to overexploiting other natural resources as well.

Annex A

Decision GCSS.VII/7 of the Seventh Special Session of the Governing Council/Global Ministerial Environment Forum

Environmental situation in the Occupied Palestinian Territories

The Governing Council,

Recalling its decisions 20/2 of 5 February 1999 and 21/16 of 9 February 2001 on the environmental situation in the Occupied Palestinian Territories,

Taking note of the report presented by the Executive Director,¹

Conscious of the need to respond to the decisions of the Governing Council comprehensively,

Gravely concerned over the continuing deterioration and destruction of the environment in the Occupied Palestinian Territories,

Encouraged by the recent invitation extended to the Executive Director by the two concerned parties to visit the region,

1. **Requests** the Executive Director to visit the area as soon as possible with a view to establishing a framework and modalities of the study requested by the Governing Council in decisions 20/2 and 21/16;
2. **Requests** the Executive Director to designate a team of the United Nations Environment Programme experts to prepare a desk study outlining the state of environment in the Occupied Palestinian Territories and to identify major areas of environmental damage requiring urgent attention;
3. **Also requests** the Executive Director to undertake field studies, as deemed necessary, with the objective of proposing remedial measures to improve the environmental situation in the Occupied Palestinian Territories and by implementing existing agreements for improving the environment in the area;
4. **Urges** the Executive Director to take all necessary steps, on an urgent basis, to:
 - (a) Coordinate the activities of the United Nations Environment Programme in the area, including the implementation of this decision;
 - (b) Follow up the findings and recommendations of the United Nations Environment Programme study and assist the Palestinian Ministry of Environmental Affairs in its efforts to address the urgent environmental needs in the Occupied Palestinian Territories;
5. **Invites** all the parties concerned to cooperate with the Executive Director in the implementation of this decision;
6. **Requests** the Executive Director to report on the implementation of this decision to the Governing Council at its twenty-second regular session.

6th meeting, 15 February 2002

¹ UNEP/GCSS.VII/4/Add.3.

Annex B

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B

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Annex C

List of institutions and sites visited

Institutions visited in the Occupied Palestinian Territories:

Al-Bireh Municipality
Al-Quds University
Applied Research Institute of Jerusalem (ARIJ)
Bethlehem University
Birzeit University, Institute of Water Studies
Environmental Quality Authority
Friends of the Earth Palestine
Hebron Municipality
Heinrich Böll Foundation, Ramallah
Land Research Center- Jerusalem
LAW-The Palestinian Society for the Protection of Human Rights and the Environment
Palestinian Hydrology Group
Ramallah municipality
The Joint Environmental Mediation Services - Jerusalem (JEMS)
The Palestine Red Crescent Society (PRCS)
The Palestinian Academic Society for the Study of International Affairs (PASSIA)
The Palestinian Environmental Non-Governmental Organizations Network (PENGON)
The Palestinian Water Authority (PWA)
Water & Soil Environmental Research Unit (WSERU)
Wildlife Palestine Society (WLPS)
World Bank Office, Ramallah

Institutions visited in Israel:

Friends of the Earth - Middle East (FoEME)
Ministry of Environment of Israel
Ministry of Foreign Affairs of Israel
National Commission for UNESCO of Israel
Nature and National Parks Protection Authority of Israel
Union for Environmental Defense of Israel
Israel/Palestine Center for Research and Information (IPCRI)
Society for the Protection of Nature in Israel (SPNI)
The Hebrew University of Jerusalem
The International Center for the Study of Bird Migration

Other institutions visited:

AFES - PRESS, Peace Research and European Security Studies

OCHA, UN Office for the Coordination of Humanitarian Affairs

UNFPA, the United Nations Population Fund

UNRWA, the United Nations Relief and Works Agency for Palestine Refugees in the Near East

USAID - Middle East; the United States Agency for International Development

UNDP / PAPP, the United Nations Development Programme / Programme of Assistance to the Palestinian People

Towns and Sites visited in the Occupied Palestinian Territories and Israel:

Al Bireh

Al Arrub Agricultural Station

Beit Anoun

Beit Lahia WasteWater Treatment Plant

Bethlehem

Birzeit

Durah

Emek Hefer region

Gaza City

Halhul

Henron

Hebron (Al Khalil)

Jenin

Jerusalem (Al Quds)

Kibbutz Hafetz Hayim

Ramallah

Saeir

Shyoukh

Tel Aviv - Yafo

Wadi Al Samen

Wadi Gaza

Wadi Hasska

Wadi Al Quff

Sansan National Reserve

Annex D

Israeli-Palestinian Joint Water Committee

Joint declaration for keeping the water infrastructure out of the cycle of violence

The Israeli and Palestinian sides view the water and waste water sphere as a most important matter and strongly oppose any damage to water and wastewater infrastructure.

The two sides are taking all possible measures to supply water and treat wastewater in the West Bank and Gaza Strip, even in the difficult circumstances of the recent months.

The two sides wish to bring to public attention that the Palestinian and Israeli water and wastewater infrastructure is mostly intertwined and serves both populations. Any damage to such systems will harm both Palestinians and Israelis.

A special effort is being made by the two sides to ensure the water supply to the Palestinian and Israeli cities, towns and villages in the West Bank and Gaza Strip. In order for this effort to succeed, we need the cooperation and support of all the population, both Israeli and Palestinian. We call on the general public not to damage in any way the water infrastructure, including pipelines, pumping stations, drilling equipment, electricity systems and any other related infrastructure.

The two sides also call on those involved in the current crisis not to harm in any way the professional teams that conduct regular maintenance or repair damage and malfunctions to the water and wastewater infrastructure.

Both sides wish to take this opportunity to reiterate their commitment to continued cooperation in the water and wastewater spheres.

Done at the Erez Crossing, This 31 January 2001.

Noah Kinarty
Head of the Israeli side to the JWC

Nabil El-Sherif
Head of the Palestinian side of the JWC

Annex E

Excerpts from the Palestinian National Water Plan

The following excerpts are taken from the Palestinian National Water Plan of 2000, and refer to Palestinian projected water demand.

“It can be seen that overall demand for water in the Occupied Palestinian Territories is projected to more than double, from 348 Mcm/yr in 2000 to 846 Mcm/yr in 2020. It should be noted that the year 2000 figure is an unrestricted demand and that the present situation is constrained by the available supply of only 269 Mcm/yr. The major growth will be in Municipal and Industrial demand by almost four fold from 133 Mcm/yr to 472 Mcm/yr, whereas agricultural demand is projected to grow from 215 Mcm/yr to 374 Mcm/yr.” (p. C.1-2)

“Considering the growing population and very scarce water resources in the region, economic utilization of water is one of the most important key policies in formulating the development strategy in Palestine. In accordance with PWA policy principles that water is an economic good, pricing and market forces will have to be taken into account together with other considerations. The projected demand developed by this strategy would result in Municipal and Industrial demand almost quadrupling from 133 million Mcm/yr today to 472 Mcm/yr in 2020 and agricultural demand almost doubling from 215 Mcm/yr to 374 Mcm/yr in the same period.” (p. 4)

“The projected demand in the Gaza Strip will almost double in the same period from 146 Mcm/yr in 2000 to 262 Mcm/yr in 2020. The growth will be totally in the Municipal and Industrial demand from 55 Mcm/yr to 182 Mcm/yr with Agricultural demand projected to decrease from 91 Mcm/yr to 80 Mcm/yr due to the lack of land for further agriculture and improved agricultural practices.” (p. C.1-2)

“Demand in the West Bank is projected to increase by almost three fold from 202 Mcm/yr to 584 Mcm/yr with Municipal and Industrial growing by almost four fold from 78 Mcm/yr to 290 Mcm/yr and Agriculture more than doubling from 124 Mcm/yr to 294 Mcm/yr to satisfy not only the increasing demand in the West Bank but also the unsatisfied demand in the Gaza Strip due to lack of land there.” (p. C.1-3)

“Groundwater will continue to be the major source of resource development in the West Bank over the next 20 years for both Municipal and Industrial and Agricultural demands.

Surface water however will have to make an increasingly significant contribution from 2010 onwards to satisfy the growing agricultural demand. Wastewater re-use and brackish water will also have to be utilized in the latter part of the planning period to satisfy overall demand.” (p. B.2-5)

“By 2010, the introduction of surface water, wastewater re-use and the incorporation of brackish sources are planned to reduce the dependence on the freshwater aquifer for agriculture. However this would not be sufficient still at this date, in order to eliminate the continued temporary dependence on a great quantity of fresh water until this is required for domestic supply” (p.C.2-8)

"Resource Development in the Gaza Strip, 2000 to 2020

	2000 Water Development (million m ³ per year)	2010 Water Development (million m ³ per year)	2020 Water Development (million m ³ per year)
Coastal Aquifer *	55	100	148
Wastewater re-use	0	34	63
Brackish groundwater	51	32	0
Mekorot	5	10	10
Desalination	0	47	57
Storm water recharge	3	5	7
Total	114	228	285

All figures in MCM/yr

* Note that this table assumes no transfer of resources from the West Bank to Gaza. If surplus water resources are available in the West Bank after negotiations, then transfer of water can be considered in order to reduce the quantity of desalinated water required

* Includes natural recharge and return flow from municipal, industrial and agricultural systems." (p. B.2-6)

"Resource Development in the West Bank, 2000 to 2020

	2000 Water Development (million m ³ per year)	2010 Water Development (million m ³ per year)	2020 Water Development (million m ³ per year)
Mountain Aquifer *	133	311	388
Surface Water	0	50	112
Wastewater re-use	0	2	39
Brackish groundwater	0	15	45
Mekorot	22	16	0
Total	155	394	584

All figures in MCM/yr

* Note that this table assumes no transfer of resources from the West Bank to Gaza. If surplus water resources are available in the West Bank after negotiations, then transfer of water can be considered in order to reduce the quantity of desalinated water required

* Includes natural recharge and return water from municipal, industrial and agricultural systems" (p. B.2-8)

Annex F

F

List of acronyms, abbreviations and units

ACSAD	Arab Center for Studies of Arid Lands and Desertification
AHLC	Ad Hoc Liaison Committee
ALECSO	Arab League Educational, Cultural and Scientific Organization
AOAD	Arab Organization for Agricultural Development
APELL	UNEP's Awareness and Preparedness for Emergencies at a Local Level
ARIJ	Applied Research Institute – Jerusalem
BOD	Biochemical oxygen demand
CAMP	Coastal Aquifer Management Programme
CAMRE	Council of Arab Ministers Responsible for Environment
CBD	Convention on Biological Diversity
CCD	Convention to Combat Desertification
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Convention on Migratory Species
DU	Depleted uranium
DURP	Department of Urban and Rural Planning
EIA	Environmental Impact Assessment
EPD	Environment Planning Directorate
EOA	Environmental Quality Authority (formerly Ministry of Environmental Affairs)
EU	European Union
EWG	Multilateral Working Group on the Environment
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIWA	Global International Waters Assessment
HDPE	High-density polyethylene
IAEA	International Atomic Energy Agency
IUCN	The World Conservation Union.
JEEC	Joint Environmental Experts Committee
JLC	Joint Liaison Committee
JWC	Joint Water Committee
LACC	Local Aid Coordination Committee
MAP	Mediterranean Action Plan
MCM	Million cubic metres
MCSD	Mediterranean Commission on Sustainable Development

F

MEA	Multilateral Environmental Agreement
MEEnA	Ministry of Environmental Affairs
MLG	Ministry of Local Government Affairs
MOPIC	Ministry of Planning and International Cooperation
NBSAP	National Biodiversity Strategy and Action Plan
NEAP	National Environment Action Plan
NGO	Non-Governmental Organisation
PCB	Polychlorinated biphenyls
PCT	Polychlorinated terphenyls
PDP	Palestinian Development Plan
PEA	Palestinian Environmental Authority
PECDAR	Palestinian Economic Council for Development and Reconstruction
PLC	Palestinian Legislative Council
PNA	Palestinian Authority
PVC	Polyvinylchloride
PWA	Palestinian Water Authority
SMAP	Short and Medium-Term Priority Environmental Action Plan
SRAP	Sub-Regional Action Programme under the CCD
SWGs	Sector Working Groups
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
UNRWA	United Nations Relief and Works Agency for Palestine Refugees in the Near East
UNSCO	Office of the United Nations Special Coordinator
USAID	United States Agency for International Development
USD	United States Dollars
WHO	World Health Organisation
WSSD	World Summit on Sustainable Development
WWTP	Waste Water Treatment Plant

ANNEX G

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G

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Annex H

Technical information on satellite image analysis

1. LAND COVER

Description

The MOD12Q1 Land Cover Product (MODIS/Terra Land Cover 96 Day L3 Global 1 km ISIN Grid) supplies an IGBP land cover classification map of the globe along with an assessment of the quality or confidence that is placed in that classification.

Documentation

<http://geography.bu.edu/landcover/userguidelc/intro.html>

Data download

<http://duckwater.bu.edu/lc/mod12q1.html>

The most current data product available is nominal data day 2000289, version 3. The data set name to search for at the EDC DAAC is "MODIS/TERRA LAND COVER TYPE 96-DAY L3 GLOBAL 1KM ISIN GRID V003".

Map legend

The IGBP classification has been chosen, with the following themes:

Water	0
Evergreen needleleaf forest	1
Evergreen broadleaf forest	2
Deciduous needleleaf forest	3
Deciduous broadleaf forest	4
Mixed forests	5
Closed shrubland	6
Open shrublands	7
Woody savannas	8
Savannas	9
Grasslands	10
Croplands	11
Barren or sparsely vegetated	12
Urban and built-up	13

For the area under consideration, only a subset of these is represented:

Urban and Built-up

Croplands

Grasslands

Shrublands (open and closed)

Woody savannas

Savannas

Barren or sparsely vegetated

Water

Representativity

The map represents the land cover state in 2000. Every subsequent year, a similar MOD12Q1 Land Cover Product is prepared following the same methodology, thus enabling diachronic comparisons.

2. LAND COVER CHANGES IN THE NORTH OF GAZA

Description

Diachronic analysis of two Landsat TM images to show the evolution of land cover in the northern part of Gaza between 1987 and 2001.

Methodology

As the whole area is almost flat, there was no need for a topographic correction prior to the cartography of land cover. The same thematic classes have been used as in the analysis for Bethlehem, but they have been defined through a supervised classification:

- Several spectral subclasses were defined on the basis of six TM band signatures, for each of the thematic classes, except water (vectors from visual interpretation).
- Training sites were chosen also with the help of high resolution Ikonos imagery.
- Classification was done by maximum likelihood algorithm using ERDAS Imagine.

Several trials were performed, so as to minimize omission and commission errors.

3. DECLINE IN LEVEL OF THE DEAD SEA

Description

Diachronic analysis of three Landsat TM images to show the drop in the Dead Sea level between 1973 and 2000.

Methodology

For each date, a water mask was defined by thresholding the NIR channels of the Landsat images (MSS4 for 1975, TM4 for 1987 and 2000). These masks were overlaid, yielding the following three classes: Water present in 1973 and 2000; Water in 2000 only; and Water in 1973 only.