

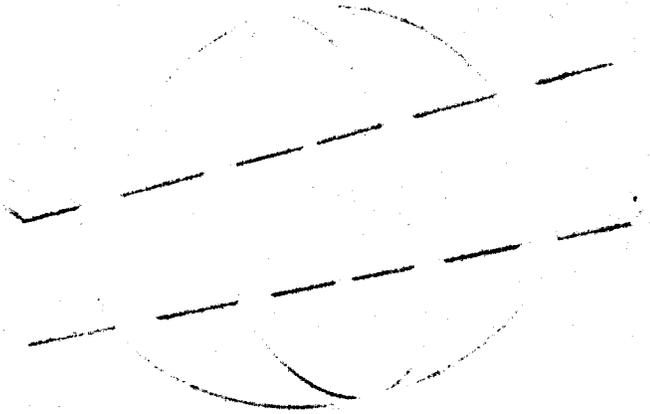


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## **Cooperative Border Security for Jordan: Assessment and Options**

*Colonel Mazen Qojas*  
Jordan Army



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*Cooperative Border Security  
for Jordan: Assessment and Options*

*Col. Mazen Qojas  
Jordan Army*

Cooperative Monitoring Center Occasional Paper/8

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***Cooperative Border Security for Jordan:  
Assessment and Options***

**Abstract**

This document is an analysis of options for unilateral and cooperative action to improve the security of Jordan's borders. Sections describe the current political, economic, and social interactions along Jordan's borders. Next, the document discusses border security strategy for cooperation among neighboring countries and the adoption of confidence-building measures. A practical cooperative monitoring system would consist of hardware for early warning, command and control, communications, and transportation. Technical solutions can expand opportunities for the detection and identification of intruders. Sensors (such as seismic, break-wire, pressure-sensing, etc.) can warn border security forces of intrusion and contribute to the identification of the intrusion and help formulate the response. This document describes conceptual options for cooperation, offering three scenarios that relate to three hypothetical levels (low, medium, and high) of cooperation. Potential cooperative efforts under a low cooperation scenario could include information exchanges on military equipment and schedules to prevent misunderstandings and the establishment of protocols for handling emergency situations or unusual circumstances. Measures under a medium cooperation scenario could include establishing joint monitoring groups for better communications, with hot lines and scheduled meetings. The high cooperation scenario describes coordinated responses, joint border patrols, and sharing border intrusion information. Finally, the document lists recommendations for organizational, technical, and operational initiatives that could be applicable to the current situation.

## **Acknowledgment**

The author would like to acknowledge the contributions by Col. (res.) Gideon Netzer (Israel Defense Forces), Michael Vannoni (Sandia National Laboratories Cooperative Monitoring Center), and Diane Leek (Tech Reps, Inc.) in the development and presentation of the concepts in this report.

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## **Project Background**

The search for peace in the Middle East depends on many factors. One of the most important is border security. The problem of disputed and unrecognized borders in the region is slowly being resolved. Once borders are recognized, nations must achieve ongoing security. Nations face common problems with illegal immigration, smuggling, terrorism, and political infiltration. The growth of confidence between neighboring countries needed for an enduring peace is adversely affected by these illicit border intrusions. In absence of cooperation, scarce resources must be devoted to military security forces in an attempt to counter these problems.

This study is the product of the joint efforts of a Jordanian researcher and an Israeli researcher. The authors collaborated in this project because of a common interest in achieving an enduring peace in the Middle East. We believe that peace in the Middle East is inevitable. This is the first time such Israeli-Jordanian collaboration has taken place at the Cooperative Monitoring Center. The goals of this project were to 1) research options for cooperation in border security and 2) define a strategy to achieve it. Technical options exist that can significantly improve security conditions along borders, and there has been no study to date to assess how these potentially valuable tools can be used in the Middle East.

Nations around the world are beginning to think in terms of cooperative security. Unilateral or purely military actions are no longer effective. Even in the Middle East, countries are beginning to recognize that all can benefit from cooperation. The 1994 peace treaty between the Hashemite Kingdom of Jordan and the State of Israel is an important agreement to manage various security concerns shared by the two countries. This fact led us to focus on the future, and to present a general model to implement security along borders with an emphasis on cooperative security. Various ideas about the nature of threats and conditions along borders in the Middle East, particularly Israel and Jordan, served as the backdrop for this project.

The first document (*A Generic Model for Cooperative Border Security*, Gideon Netzer, SAND 98-0505/7) deals with the development and presentation of a generic model for border security. The second document (*Cooperative Border Security for Jordan: Assessment and Options*, Mazen Qojas, SAND 98-0505/8) applies the principles of generic border security to Jordan.

Mazen Qojas, Colonel, Jordan Army  
Gideon Netzer, Colonel (res.), Israel Defense Forces

## **Acronyms**

CBMs	confidence-building measures
cp	candlepower
GPS	Global Positioning System
HF	High Frequency
HH	hand-held
HM	His Majesty
HRH	His Royal Highness
JAF	Jordan Armed Forces
JMG	Joint Monitoring Group
NATO	North Atlantic Treaty Organization
PTT	Push-to-Talk
TAPline	Trans-Arabian Pipeline
UHF	ultra-high frequency
VHF	very high frequency

## ***Cooperative Border Security for Jordan: Assessment and Options***

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### **Executive Summary**

Jordan plays a pivotal political and geographic role in the Middle East. Geographically, Jordan acts as a land bridge for passage both east to west and north to south. This position places Jordan among larger and stronger states than itself, both demographically and in terms of their military power. Regional strategic and military doctrine needs to change from the philosophy of resolving a conflict on the basis of military strategies or offensive doctrines into a philosophy of preventing conflicts through cooperative regional security strategies.

This document is an analysis of options for unilateral and cooperative action to improve the security of Jordan's borders. The first section describes the current political, economic, and social interactions along Jordan's borders. The border security strategy used in this discussion is based on cooperation with neighboring countries and the adoption of mutual confidence-building measures (CBMs) among the existing political systems. The project research focused on identifying the best techniques for controlling activities of concern (armed infiltration, smuggling, and other illegal intrusions). Based on the applicable technologies and methodologies, the author defines a practical, cooperative, border security system consisting of hardware for early warning, command and control, communications, and transportation.

The 1994 Peace Agreement between Jordan and Israel has added some stability to the Arab-Israeli conflict. However, other disputes in the region may cause conflicts that may have direct and indirect effects on Jordan such as the movement of refugees, disrupted trade and travel, and illegal transit by terrorists and smugglers through Jordan. The political, economic, social, and security impacts of these threats can negatively affect relations among neighboring countries and adversely affect internal stability, economic well being, and social structure. Illegal border crossings may increase unemployment and crime.

This paper also examines strategic goals of the Jordan Armed Forces (JAF) modernization efforts. Currently, the relatively large number of military units now assigned to border security has created a heavy administrative, personnel, and financial burden on Jordan. The security mission of the JAF includes the need to prevent infiltration, smuggling, or cross-border terrorism; to control the movement of civilians in border areas to prevent misunderstandings; to facilitate tourism by providing adequate security; and to provide early warning of military operations against Jordan. Modernization efforts will include improved border monitoring capabilities, new communications methods, and optimization of security force command and control.

The document describes applicable technology and methodology for the detection, identification, and response to various threats. For detection, a variety of sensors may be used, such as seismic, break-wire, magnetic, and pressure-sensing sensors. Identification of intruders typically relies on vision, either by direct observer or a camera system. Combining unattended

sensors with cameras could reduce manpower requirements by sending images to a monitoring center for human evaluation. A cooperative system has the potential to improve effectiveness while reducing the cost and administrative burden for the participating countries.

Political circumstances in the future are difficult to predict but potential options for cooperative security can be grouped in three general categories: low, medium, and high. The document describes conceptual options for cooperation, offering three scenarios that relate to three hypothetical levels (low, medium, and high) cooperation. Potential cooperative efforts under a low cooperation scenario could include information exchanges on military equipment and schedules to prevent misunderstandings and the establishment of protocols for handling emergency situations or unusual circumstances. Additional measures under a medium cooperation scenario could include establishing joint monitoring groups for better communications, with hot lines and scheduled meetings. The high cooperation scenario describes coordinated responses, joint border patrols, and sharing border intrusion information.

Finally, the document lists recommendations for organizational, technical, and operational options that could be applicable to the current situation. Organizational options include creating a committee, either bilateral or multilateral, for border security; creating a military liaison system to increase bilateral communication and coordination; forming joint study groups or consultative groups for the receipt, evaluation, and circulation of information relating to border security. Technical recommendations include the conduct of field experiments with various components of cooperative monitoring systems (such as sensors, communication equipment, etc.) to determine effectiveness under local conditions. While each country would maintain its own regulations, countries could increase cooperation at official border crossing points, negotiate protocols for proper handling of border incidents and intruders, and exchange and coordinate plans for patrols, training, and operations.

# ***Cooperative Border Security for Jordan: Assessment and Options***

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## **Introduction**

This document is an analysis of options for unilateral and cooperative action to improve the security of Jordan's borders. The objectives of the project include the following:

1. Describe the current political, economic, and social interactions along Jordan's borders.
2. Devise a border security strategy that allows the integration of all national elements, based on cooperation with neighboring countries and the adoption of mutual confidence building measures (CBMs) among the existing political systems.
3. Promote a clear vision of cooperation among the neighboring countries to deter and punish illegal intrusions while reducing overall resources devoted to security and establishing an information center for the benefit of all parties.
4. Conduct research to identify the best techniques for controlling activities of concern (armed infiltration, smuggling, and other illegal intrusions), and to define a practical cooperative border security system consisting of hardware for early warning, command and control, communications, and transportation.
5. Propose coordination measures among neighbors regarding border security.

Historically, Jordan has sought regional and international cooperation. This goal has been expressed in various addresses by His Majesty (HM) King Hussein bin Talal (Figure 1).

*By virtue of its central geographic position in our region, Jordan is naturally attuned to a strengthening of cooperation at the regional and international levels. The concept is deeply embedded in our consciousness. Since the dawn of history, our country has straddled trade routes linking the desert with the coastal regions. It is surrounded by countries with varied economies (depending on the nature of their resources) and with different sociopolitical systems. Consequently, Jordan has come to stand for stability sustained by an interactive relationship with its neighbors and sensitive to any imbalance in regional or international relations.*

HM King Hussein bin Talal,  
Address to the Jordan Development Conference  
Amman, November 8, 1986

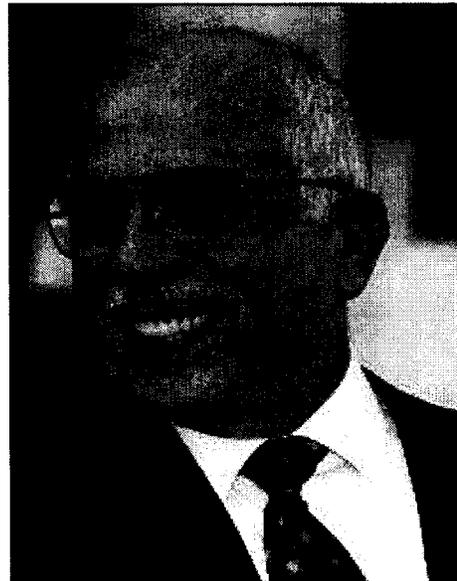


Figure 1. HM King Hussein bin Talal

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## 1.0 Formation of Jordan's Borders

Jordan plays a pivotal political and geographic role in the Middle East. Geographically, Jordan acts as a land bridge for passage both east to west and north to south. This position places Jordan among larger and stronger states than itself, both demographically and in terms of their military power. (See Figure 2.) Its central geopolitical location, both in the eye of the Israeli-Arab conflict and in the center of the Fertile Crescent, makes Jordan a classic partition state. This reality has, at times, posed threats to the kingdom and its stability.

### 1.1 Political History

Although the history of the land comprising Jordan dates back to 2000 BC, the political process leading to the formation of the modern Kingdom of Jordan and its borders began at the end of World War I. The League of Nations awarded the former territory of the Ottoman Empire now comprising Israel, Jordan, the West Bank, Gaza, and Jerusalem to the United Kingdom as the *Mandate for Palestine and Transjordan*. In 1922, the British divided the Mandate by establishing the semiautonomous *Emirate of Transjordan*, ruled by the Hashemite Prince Abdullah, while continuing the administration of Palestine under a British High Commissioner.<sup>1</sup> Despite recognition by Britain of the independence of the Emirate of Transjordan on May 25, 1923, the first Anglo-Jordanian treaty, concluded on February 20, 1928, did not meet Jordanian demands for a fully sovereign and independent state.<sup>2</sup> On March 22, 1946, Britain signed an agreement recognizing the independence of Transjordan under the name of the *Hashemite Kingdom of Jordan*, effective June 17, 1946. The Jordanian Legislative Council met on May 25, 1946, and voted unanimously to declare Jordanian territories a fully independent state with a representative, hereditary, monarchic government.

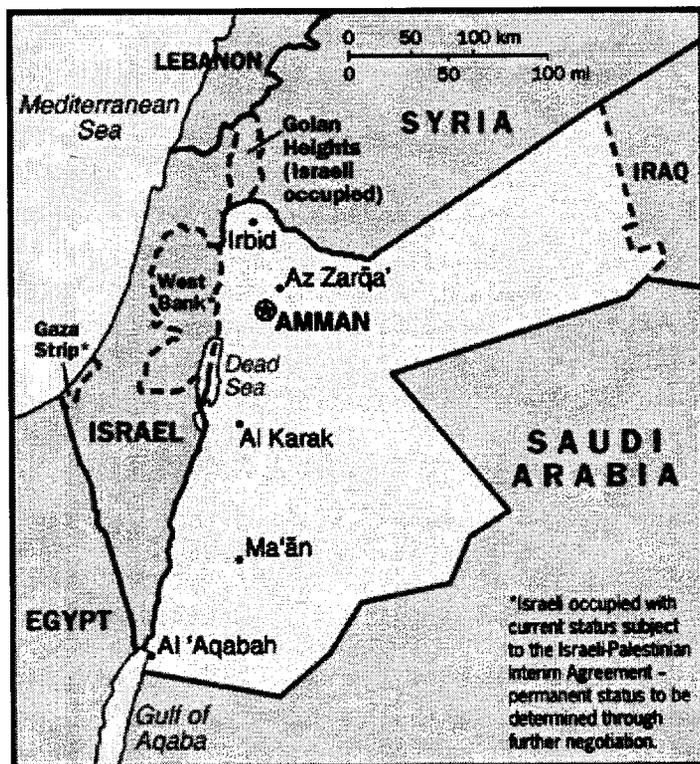


Figure 2. Map of Modern Jordan

The King is the head of state and approves laws; directs the government to promulgate and enforce bylaws and regulations; exercises judicial

<sup>1</sup> <http://mena-peacenet.nist.gov/Dosfan/Jordan/History.htm>

<sup>2</sup> <http://www.icconnect.com/jordan/nc/ncintro.html#history>

authority by Royal Decree; orders parliamentary elections; and inaugurates the lower house under the constitution. As the Supreme Commander of the Armed Forces, the King has the power to declare war, conclude peace, and sign treaties and agreements.

Jordan has been ruled by four monarchs with the title of *His Majesty the King of the Hashemite Kingdom of Jordan*: HM King Abdullah bin Al Hussein (1921-1951), HM King Talal bin Abdullah (1951-1952), HM King Hussein bin Talal (1952-1999), and HM King Abdullah bin Hussein, 1999-present). In 1946, the Legislative Council pronounced the King Abdullah I as the constitutional monarch at the head of the Jordanian State. In January 1952, King Talal I and Parliament passed a new constitution declaring that the system of government in Jordan was a hereditary parliamentary monarchy and that the people of Jordan were the source of all powers. On August 11, 1952, King Hussein was proclaimed King and reigned until January 1999. King Abdullah II was proclaimed monarch on February 7, 1999 after King Hussein's death.

King Hussein presided over the transformation of Jordan from a tribal and nomadic society still under British colonial influence to a fully modern state with an extensive internal infrastructure and literacy and education levels that are among the highest in the developing world. King Hussein was committed to popular consultation and participation in government as well as respect for human rights throughout the Arab world. In 1954, the constitution was amended to strengthen the democratic base. The amended constitution ensured that the government was answerable to parliament. Jordan also has an excellent record in human rights.

Over his 47-year reign, King Hussein guided Jordan through several regional crises. The June 1967 War left Israel in occupation of the West Bank of Jordan and East Jerusalem, including the Old City. King Hussein was subsequently instrumental in drafting UN Security Council Resolution 242, which called for an Israeli withdrawal from all lands captured in the June 1967 War in exchange for peace. This resolution served as the basis for the current peace negotiations. King Hussein was always committed to peace through diplomatic resolution of conflicts rather than the use of armed force. During the Gulf crisis of 1990-1991, King Hussein repeatedly attempted to mediate a peaceful solution to the conflict.

## **1.2 Description of Jordan's Borders**

Except for small sections of the borders with Israel and Syria, Jordan's international boundaries do not follow well-defined natural features of the terrain. The country's boundaries were established by various international agreements, and none are currently in dispute.

By the time political boundaries were drawn defining Transjordan after World War I, most of the nomadic tribes in that region had long-established areas lying within the confines of the new state. To accommodate the few cases where tribal peoples traditionally had moved back and forth across the country's borders, agreements with neighboring countries provided for a continuation of migratory practices, subject to certain regulations.

### **1.2.1 Jordan – Saudi Arabia Boundary**

The border between Jordan and Saudi Arabia was partly defined by a series of agreements between Britain and the government of what eventually became Saudi Arabia. The border was still partly undefined when Jordan became independent in 1946.

On August 10, 1965, Jordan and Saudi Arabia concluded a bilateral agreement that realigned and delimited the boundary.<sup>3</sup> The realignment resulted in an exchange of territory. Jordan's coastline on the Gulf of Aqaba was lengthened by about 18 kilometers and 6,000 square kilometers of territory in the interior were ceded to Jordan. In turn, 7,000 square kilometers of Jordanian-administered territory were ceded to Saudi Arabia. The new boundary came into effect on November 7, 1965. (See map in Figure 3.)

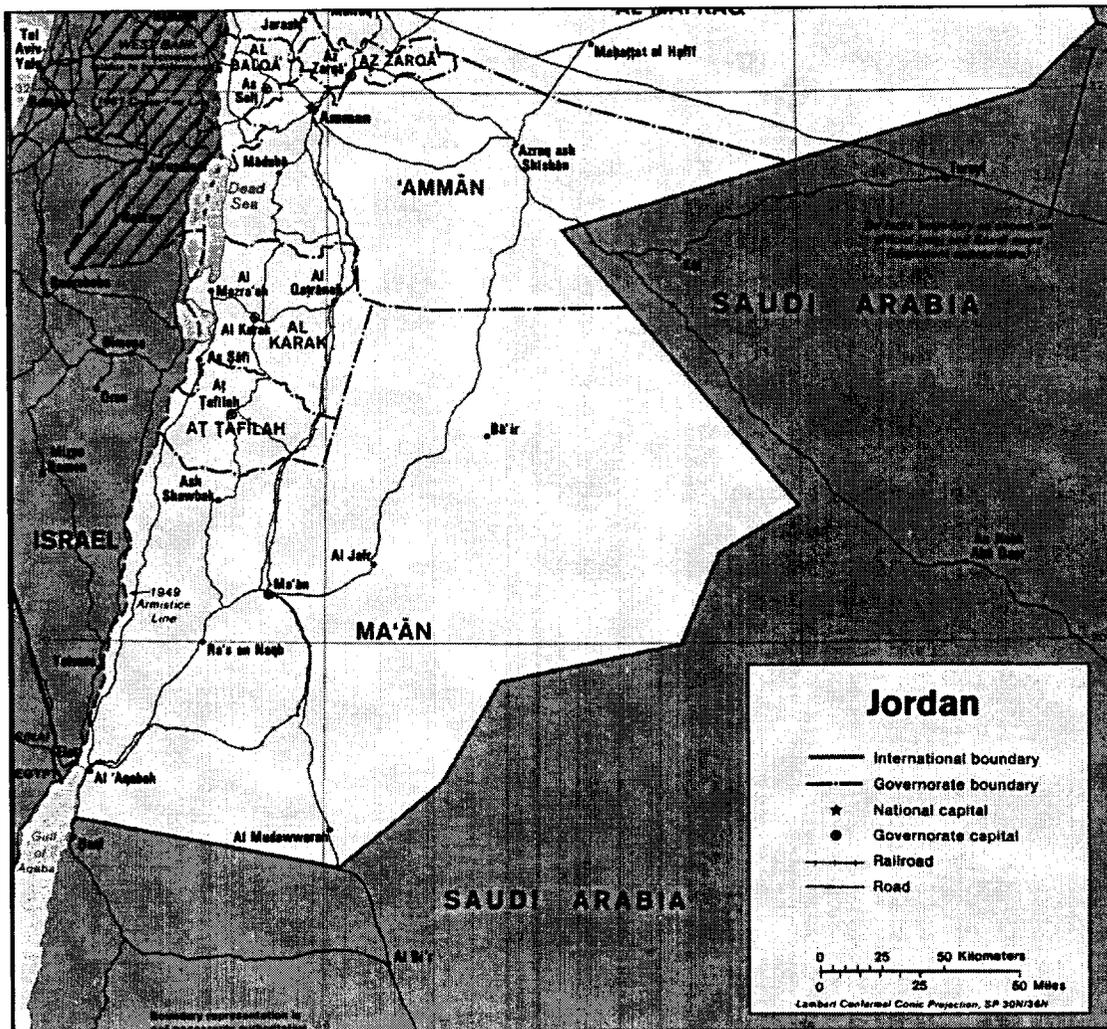


Figure 3. Jordan-Saudi Arabia Border

The new boundary enabled Jordan to expand its port facilities and established a zone in which the two parties agreed to share petroleum revenues equally if oil were discovered. The agreement also protected the pasturage and watering rights of nomadic tribes inside the exchanged territories. The boundary measures 740 km from the point where Jordan, Saudi Arabia, and Iraq meet at Jabal Anazah to a point on the Gulf of Aqaba, approximately 18 km due south of the Jordanian port of Aqaba.

<sup>3</sup> International Boundary Study No. 60, Jordan-Saudi Arabia Boundary, December 30, 1965, U.S. Department of State, Bureau of Intelligence and Research, issued by The Geographer, Office of Research in Economics and Science.

The boundary passes through a desert or near-desert area of limited economic potential. The frontier is virtually rainless and almost devoid of population. Scattered wells and access to the Gulf of Aqaba (for Jordan) are the primary points of strategic value. The currently closed Trans-Arabian Pipeline (TAPLine) is the most important economic feature crossing the boundary.

The frontier region is a tilted plateau with the highest elevations in the west and lower elevations in the east. The interior district is composed of sand areas interspersed with eroded lava flows that are dissected by dry streambeds. A few peaks attain elevations of 900 meters, approximately 300 meters above the average elevation of the plateau. The general alignment of the drainage pattern is toward the south and the east, reflecting the slope of the plateau. Soil, except in the wadi bottoms, is very thin or nonexistent. Close to the shores of the Gulf of Aqaba, the border traverses the escarpment marking the edge of the Dead Sea/Jordan/Aqaba fault valley. The escarpment, in places, looms 1,400 meters above the level of the adjacent sea. However, many dry watercourses dissect the escarpment into a series of broken blocks. A narrow coastal plain fringes the shores of the Gulf with relatively easy access to the interior furnished by the numerous wadi beds.

### 1.2.2 Jordan – Iraq Boundary

The Iraq-Jordan boundary is 185 km long with no boundary markers or demarcation on the ground.<sup>4</sup> The boundary is essentially artificial and associated with the division of spheres of interest between Britain and France following the defeat of Ottoman Turkey in World War I. (See map in Figure 4.)

The eastern boundary of Jordan was not established until 1932 when the rulers of Iraq and Jordan exchanged letters agreeing to draw a boundary line. In 1984, the southern section was modified to allow Iraq to gain territory for a military airfield and to extend Jordan's territory near Saudi Arabia.<sup>5</sup> The dashed line in Figure 4 shows the modified border.

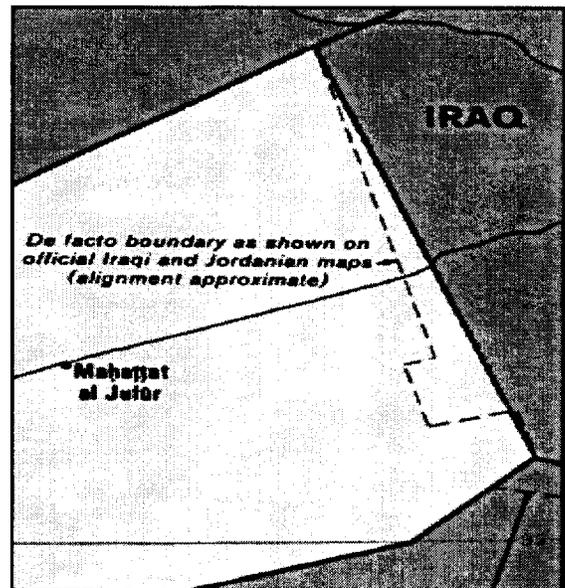


Figure 4. Jordan-Iraq Border

<sup>4</sup> International Boundary Study No. 98, Iraq-Jordan Boundary, April 15, 1970, U.S. Department of State, Bureau of Intelligence and Research, issued by The Geographer.

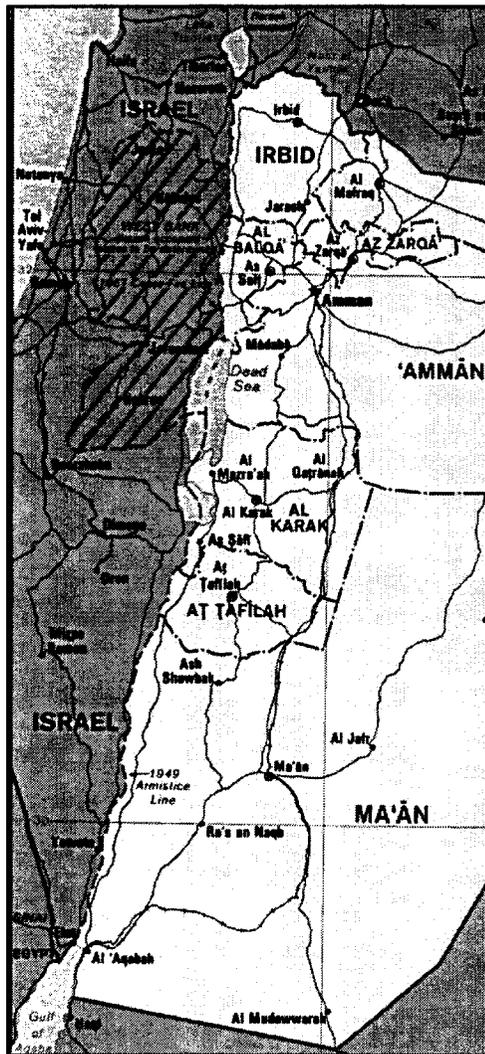
<sup>5</sup> Biger, Gideon, *The Encyclopedia of International Boundaries*, in collaboration with The International Boundaries Research Unit, University of Durham, England; published by Facts on File.



### 1.2.4 Jordan – Israel Boundary

Jordan's boundaries with Syria, Iraq, and Saudi Arabia do not have the special significance that the border with Israel does. Until 1994, the recognized border with Israel was based on the armistice line agreed to in April 1949 by Israel and what was then Transjordan, following negotiations facilitated by the United Nations (see map in Figure 6). In general, the border represented the battle positions held by Transjordanian and Israeli forces when a cease-fire went into effect and had no relation to economic or administrative factors. Until the Israeli occupation of the West Bank during the June 1967 War, the demarcation line divided the city of Jerusalem, with Jordan holding the Old City and most of the holy places.

The government of the Hashemite Kingdom of Jordan and the government of the State of Israel signed a peace treaty on October 26, 1994. The treaty was based on principles contained in UN Security Council resolutions 242 and 338 and formalized the 480-km-long boundary between them. Both parties recognize the international boundary, as well as each other's territory, territorial waters, and airspace, as inviolable.



The new official boundary is delimited with reference to the boundary under the British mandate (see Appendix A for a description including the official map). The land boundary defined in the treaty consists of three sectors:

#### 1. The Jordan and Yarmuk Rivers

The boundary line follows the middle of the course of flow of the Jordan and Yarmuk Rivers. The boundary follows natural changes in the course of the river unless otherwise agreed. Artificial changes in the course of the rivers do not affect the location of the boundary unless otherwise agreed. If a sudden major change occurs due to natural causes, the Joint Boundary Commission decides on necessary measures, including physical restoration of the former course. (Map, Appendix A, pp.67-68)

#### 2. The Dead Sea and Salt Pans

The boundary line crosses the Dead Sea and salt pans according to the line defined by the Joint Boundary Commission. (Map, Appendix A, pp.69-70)

#### 3. The Wadi Araba/Emek Ha'arava

Pillars that are jointly located, erected, measured, documented, and maintained by the Joint Boundary Commission mark the boundary. The boundary line follows a straight line between the pillars. (Map, Appendix A, pp.71-72)

Figure 6. The 1949 Armistice Line Between Israel and Jordan

## 2.0 Jordan's Actions to Maintain the Security of Its Borders

### 2.1 The Hashemite Vision

Like most states, the majority of Jordan's day-to-day foreign policy centers on the business of protecting the country's immediate interests and promoting the short-term welfare of its citizens. However, the Hashemite leadership also pursued another track designed to promote the long-term rejuvenation of the Arab world. Jordan's vision is evident in the speeches, remarks, and statements of King Hussein. (Figure 7.) Essential to the Jordanian vision is the importance of being open-minded to the outside world and remaining aware of the constraints imposed by the current international order.<sup>7</sup> The vision calls for an Arab world that

- guarantees democracy, human rights, and political participation;
- uses social justice in dealing with the wide gap between the haves and have-nots;
- recognizes that Arab security is indivisible;
- bases relations between Arab countries on cooperation and respect, not dominance; and
- resolves territorial disputes between Arab states through diplomacy.

The promotion of these long-term objectives has sometimes conflicted with Jordan's pursuit of its immediate interests. As a small state with limited resources and a growing population, Jordan must safeguard its interests by maintaining good relations with neighboring countries as well as global powers. In the long term, Jordan seeks to change the status quo in the Arab world, and has at times encountered resistance and suspicion from the dominant states. Jordan must thus balance the two tracks of its foreign policy, safeguarding the immediate interests of its citizens while promoting the rebirth of the Arab world and the well-being of the region.

Peace is a strategic objective for Jordan. Jordan has concluded a peace treaty with Israel, and this decision resulted in Jordan's rights being fully recognized by Israel. In practical terms, the peace treaty reasserts Jordan's role in the region. Under the leadership of King Hussein, the Hashemite Kingdom of Jordan always pursued a policy of consistently supporting all instruments for the achievement of peace and stability among all parties of the region, irrespective of religious differences or ethnic origins.

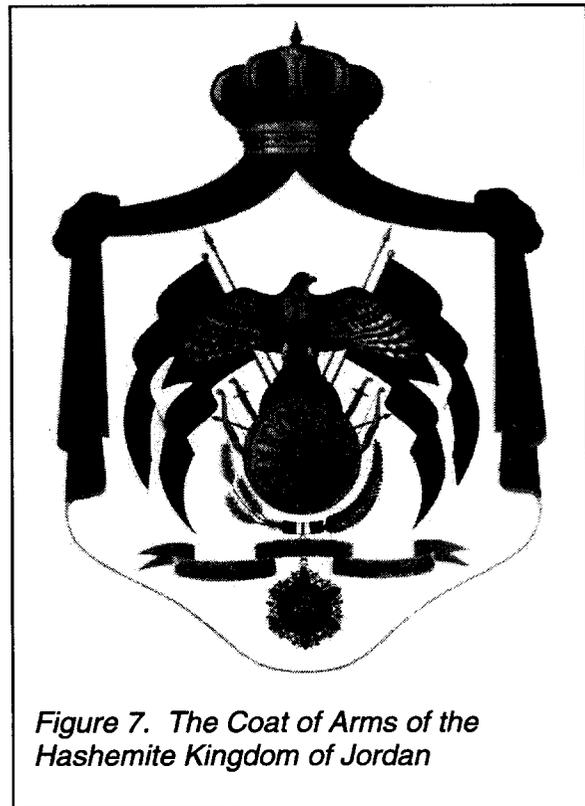


Figure 7. The Coat of Arms of the Hashemite Kingdom of Jordan

<sup>7</sup> *Jordan Diary 1997*, International Press Office, The Royal Hashemite Court, Amman, Jordan (courtesy of the Embassy of Jordan, Washington, DC).

## **2.2 Regional Security Concerns**

The threats to Middle East regional security are not limited to the Arab-Israeli conflict and might extend to conflicts between other countries in the Middle East.<sup>8</sup> There is the possibility that Arab-Arab political differences might cause conflict over border disputes. Potential conflicts exist between Iran and Iraq, Iran and the Gulf States, and Syria and Turkey. Potential conflicts near the Middle East include Turkey and Greece, Turkish Cypriots and Greece, India and Pakistan, and continued civil war in Afghanistan. All of these conflicts have direct and indirect effects on Jordan such as the movement of refugees, disrupted trade and travel, and illegal transit by terrorists and smugglers through Jordan.

Regional strategic and military doctrine needs to change from the philosophy of resolving a conflict on the basis of military strategies or offensive doctrines into a philosophy of preventing conflicts through cooperative regional security strategies. Purely military strategies are no longer able to prevent conflicts.

As a small state with limited resources, the primary concern of Jordanian policy makers must be to safeguard the country's immediate national interests. Jordan has long suffered from a severe imbalance between resources and population. Before the peace treaty with Israel, Jordan was forced to shoulder the defense burdens of a front-line state and the resultant military expenditures. Jordan's small economic base has also been strained by large waves of Palestinian refugees seeking refuge during the Arab-Israeli wars of 1948 and 1967, as well as Jordanians and other nationalities displaced from the Persian Gulf region during the 1990 Gulf Crisis.<sup>9</sup>

The imbalance of military and economic power in the Middle East and the absence of a comprehensive peace settlement have created an unstable atmosphere and encouraged an arms race. Such circumstances increase the risk of armed confrontation and violence. Jordan therefore feels continually insecure because these conditions directly affect its national interests and security. Jordan must maintain high readiness in its security forces in order to counter potential future threats.

## **2.3 Jordan's Security Concerns**

Unlike Europe, where ancient borders mark linguistic and ethnic differences, most of Jordan's borders have similar populations on each side. Only Israel as a Jewish state is different. (Section 1.2 described the evolution of Jordan's borders.) Jordan's strategic position and long international borders place a heavy burden on its armed forces, particularly with the present unstable environment in some neighboring states.

Jordan no longer faces a significant threat by conventional military forces. The signing of the 1994 treaty with Israel removed this concern (see Appendix A). Jordanian military doctrine is defensive, and the Army of Jordan has never conducted any aggressive action against

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<sup>8</sup> *The Jordanian Vision on Security Concerns in the Middle East Region*, MG Mahmoud Al-Omari, presentation at the Cooperative Monitoring Center, Albuquerque, NM, USA, November 18, 1998.

<sup>9</sup> *Jordan Diary 1997, Jordan's Resource Gap*, International Press Office, The Royal Hashemite Court, Amman, Jordan.

its neighbors. The Jordan Army is an active participant in UN Peacekeeping Operations. Over 15,000 Jordanian soldiers have participated in UN missions around the world.

Uncontrolled illegal crossings of Jordan's borders are the primary threat today, and sovereignty depends on effective control of Jordan's borders. Currently, army units and public security personnel patrol the borders. The mission of these forces is to maintain security and stability by preventing all forms of illegal crossings. The incorporation of surveillance technology in these forces' capabilities would enhance their effectiveness. In addition, a strategy of cooperative border security with Jordan's neighbors would also enhance the effectiveness of Jordan's forces. This strategy of cooperation will require the collection and exchange of information about security topics of mutual concern.

The primary types of illegal border crossings that affect Jordan are described in the following paragraphs.

### **2.3.1 Terrorism**

Jordan condemns all acts of terrorism and believes that it is the responsibility of all peace-loving countries to work together on a long-term solution to solve this problem. Jordan will not permit any country or group to use its territory as a stepping stone for terrorist actions that are directed against any neighboring country. Jordan also believes that social education and freedom of expression and democracy are the best medicine to counter extremism and violent political acts. Jordan has succeeded in absorbing various opposition groups into its parliamentary system. If opposition forces can vent their anger verbally, while at the same time respecting the law, they will not engage in terrorist acts.

### **2.3.2 Smuggling**

Smuggling is a common problem in the region and Jordan. The smuggling of narcotics and weapons, either for the local market or en route to other countries, is a continuing threat to sovereignty. Smugglers are becoming more violent and are often in collusion with international criminals. In 1997, five members of the Jordan Armed Forces and security forces were killed in clashes with smugglers. A new concern is the smuggling of weapons technology and nuclear material from the Former Soviet Union and China.

Jordan has increased its military presence along its eastern and northern borders. This strategy has reduced incidents but smugglers are still attempting to cross. More and better protective efforts are needed for border security.

### **2.3.3 Infiltration**

Infiltration is a considerable threat to many countries in the region. Infiltrators may enter a state for economic reasons (i.e., seeking employment unavailable at home) or to promote political terrorism in Jordan or against neighboring countries. In 1998, 302 infiltration attempts, involving 1,896 persons, mostly Iraqi, were foiled. The border with Israel is the most secure. Rather than the smuggling of contraband, the concern here is that a terrorist might try to enter Israel.

### **2.3.4 Refugees**

Several massive waves of immigration have exerted enormous pressure on several countries in the region. Jordan received three major influxes of refugees in 1948, 1967, and 1990-91. Over a million refugees still live in Jordan, creating major social and economic problems in a country with a population of 4.3 million.

## **2.4 Security Conditions Along Jordan's Borders**

Defending Jordan's borders is one of the main tasks of the Jordan Armed Forces. Sixteen army battalions with a total of 12,000 personnel are deployed for border security duty. The relatively large number of units assigned to border security duty places a heavy administrative and financial burden on Jordan. To decrease the number of troops and financial costs, it is necessary to acquire monitoring equipment, high mobility vehicles, and a modern system of command and control, and to establish new road networks in the border areas.

### **2.4.1 Jordan – Israel**

As a consequence of signing the peace treaty between Israel and Jordan, Israel no longer poses a threat to Jordan. The supreme national interest of Jordan is the preservation of security and stability along this border. Jordan's main concern is infiltration by Palestinian sympathizers into the West Bank. Since the 1994 peace treaty, security has been increased as necessary. Strict controls are enforced in border areas. For example, Jordanians who picnic along the Jordan River are searched at checkpoints for guns and drugs. Some roads are closed at night.

Unlike Jordan's other neighbors, the Israelis have implemented strong controls over this border. There are two official crossing points with two new ones planned soon (one in the north and one between Eilat and Aqaba). The rate of infiltration is low. Any incident along the Jordan-Israel border would be a serious matter and must be prevented at all costs.

Jordan and Israel have implemented a system for coordination in border security. Twelve liaison officers are posted in each country. Potential security incidents are communicated from the border security units to the military headquarters through the liaison officers to the other side.

### **2.4.2 Jordan – Arab Neighbors**

Border security problems with Arab neighbors stem from several causes. Smugglers try to avoid customs duties on animals, gold, luxury goods, and tobacco. Illegal immigrants attempt to enter Jordan in search of jobs and a better life. Terrorists use Jordan as a route to other countries.

In a news conference on April 21, 1998, Jordan's acting Prime Minister Abdullah Ensour urged neighboring countries to refrain from allowing armed groups to infiltrate Jordan.<sup>10</sup> He said the Kingdom wanted to maintain good ties with all Arab neighbors. In response to a question about what measures Jordan would take to prevent the infiltration of "armed groups from Syria,"

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<sup>10</sup> Ayyoub, Tareq, "Jordan urges neighbors to stop infiltration attempts," *Jordan Times*, Tuesday, April 21, 1998.

Dr. Ensour said, “These missions will not disturb us and we hope that they do not exist.” He refrained from naming any country. “All attempts that were aimed at hurting the country have failed. One of the pillars of our foreign policy is not to interfere in other countries’ internal affairs in any form, and we expect others to reciprocate,” he said.

#### 2.4.2.1 Jordan – Saudi Arabia

There are three official crossing points between Jordan and Saudi Arabia. Saudi Arabia has built a patrol road parallel to the border on its side. In addition, Saudi Arabia has built observation posts for its National Guard security forces approximately every 2 km. Jordan, with fewer resources, conducts patrols but has far fewer observation posts. The army patrols the eastern and western parts of the border; the Desert Police patrols the center. An informal agreement between Saudi Arabia and Jordan permits security forces to cross into the other country up to a distance of 7 to 10 km. Security force commanders in both countries have active coordination and communication.

The following list describes border concerns:

- The majority of smuggling moves from Jordan into Saudi Arabia. In most cases, the illicit material originated in a third country and was transported across Jordan. The most significant area for smuggling is along the eastern part of the border.
- Nomadic Bedouin tribes are permitted to cross the border in either direction to graze and water their animals subject to oversight by security forces in each country. Bedouins also sometimes smuggle commercial goods from Saudi Arabia in the area south of Al-Aqaba.

#### 2.4.2.2 Jordan – Iraq

There is one official crossing point between Jordan and Iraq. The army patrols the border and has built a ditch and berm along the entire border with Iraq to discourage illegal crossings. Local Jordanian and Iraqi military commanders hold monthly meetings. There is no direct communication to prevent illegal crossings. Most of the illegal crossings are from Iraq into Jordan.

The largest concern is uncontrolled illegal immigration. Regional crises can have an adverse effect on Jordan. For example, during the crisis between the UN and Iraq in February 1998, Minister of State for Information Affairs Samir Mutawi stated that Jordan would not allow Iraqi refugees to enter its territory if the U.S. launched an attack on Iraq. Dr. Mutawi said Jordan’s decision to prevent refugees from entering the country was taken “to avoid any repetition of what happened in 1991,” when Jordan received more than 1.5 million people from different nationalities who fled from Kuwait and Iraq.<sup>11</sup>

The following describes border concerns:

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<sup>11</sup> Ayyoub, Tareq, “Jordan will not allow refugees from Iraq into its territories,” *Jordan Times*, Wednesday, February 4, 1998.

- The international economic sanctions imposed on Iraq since 1990 have caused severe internal dislocations resulting in illegal immigration. Many Iraqis seek to cross into Jordan and other neighboring countries for employment and other needs. Legal crossings are permitted, but Iraq imposes exit taxes that many Iraqis seeking to leave cannot afford to pay. Some Iraqis are not permitted to leave the country for political or security reasons.
- Political infiltration to Jordan and other countries occurs.
- Significant price differences between Jordan and Iraq for items such as livestock and weapons have led to smuggling of these items.

#### 2.4.2.3 Jordan – Syria

There are two legal crossing points, both in the western part of the border between Jordan and Syria. Local Jordanian and Syrian military commanders hold monthly meetings. There is no direct communication to prevent illegal crossings. Most of the illegal crossings are from Syria into Jordan. Jordan has recently constructed a ditch and berm in eastern and western parts of the border to deter illegal crossings.

The following describes border concerns:

- Iraqis, having illegally crossed into Jordan, often cross into Syria from Jordanian territory.
- Palestinian groups located in Lebanon and Syria infiltrate Jordan for political purposes and to smuggle arms.
- Drugs produced in Turkey, Lebanon, and Syria are smuggled across Jordan to Saudi Arabia, Egypt, and Israel.

### **2.5 Political, Economic, Social, and Security Impacts of Border Trespassing on Jordan and Neighboring Countries**

Every illegal border crossing has political, economic, social, and security implications. These events negatively affect the relations among the neighboring countries and contribute to disputes over borders. For example, in December 1997, Iraq executed four Jordanians for smuggling auto parts. King Hussein and Parliament strongly condemned the action and relations with Iraq were damaged.<sup>12</sup> A comprehensive strategy incorporating the best technical and non-technical means is needed to control a national border. Neighboring countries could engage in security cooperation and coordinated application of force to control their borders. Unilateral efforts may not be as effective.

Good relations among countries may be undermined when a neighboring country encourages or accepts illegal border crossings to another country to achieve political, social, or security aims. The neighboring country would be forced to devote resources to maintain security at a level that could weaken its economy. Even if cases of intrusion were not frequent, they may still cause social and security concerns. Conversely, if resources devoted to border security were

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<sup>12</sup> "Parliament condemns execution of four Jordanians as 'total disregard for human rights'," *Jordan Times*, December 13, 1997.

used in an atmosphere of mutual trust, they could build an infrastructure that will reinforce security.

### **2.5.1 Political Impacts**

Illegal border crossings may increase tension and create political problems, as follows:

- (1) Arms smuggling might be used to support armed opposition inside Jordan. Activities by such groups could constitute a serious threat to the regime.
- (2) Espionage groups may be established that are counter to Jordan's interests.
- (3) Illegal crossings may be politically motivated. Political groups with links to foreign countries might undermine Jordan's foreign policy by disrupting stability.
- (4) Criminal activities such as narcotics smuggling might create dissatisfaction among the opposition Islamic political parties, who could lose confidence in the government's ability to protect Jordanian cultural values.
- (5) Illegal border crossings, when combined with military tensions, might create a situation that could escalate into armed conflict among the neighboring countries.

### **2.5.2 Economic Impacts**

Illegal border crossings could have the following impact on Jordan's economy:

- (1) Illegal trade by smuggling could hurt the national economy because of unpaid taxes.
- (2) Local products may be unable to compete with smuggled products, which depresses the legal economy. For example, domestic agricultural products may be displaced by products from the Palestinian Authority areas. This is significant because of Jordan's economic reliance on agriculture.
- (3) Considerable amounts of Jordan's hard currency reserves may be transferred abroad because of illegal trade. Investment in the local economy could be hurt, preventing Jordanian businesses from achieving economies of scale and investing in new technology to improve quality.
- (4) Large numbers of refugees could harm the economy because of demands on Jordan's infrastructure and system of social services.
- (5) Illegal trading could damage trade agreements with neighboring countries.
- (6) The operation and maintenance of large border security forces would be a burden on the national budget and economy.

### **2.5.3 Social Impacts**

Illegal border crossings may negatively affect Jordan's culture in the following ways:

- (1) Smuggled drugs can severely hurt Jordanian society. Resources would need to be devoted to the medical treatment of addicts. The huge profits from the drug trade might give criminal organizations the ability to challenge the government.
- (2) Criminal groups could create an environment of lawlessness and disrespect for legitimate authority that might hurt Jordan's civil society and increase crime. Smuggled weapons may contribute to violence, including the potential for conflict between Jordan's Bedouin tribes.
- (3) Smuggling and criminal actions from Jordan into neighboring countries could turn public opinion in those countries against Jordan and hurt diplomatic relations.
- (4) Uncontrolled illegal immigration could increase the rate of unemployment among the native population of Jordan.
- (5) A high proportion of illegal immigrants in the population and intermarriage between Jordanians and immigrants may cause ethnic tensions.
- (6) Prohibited publications and movies could adversely affect people's behavior.
- (7) The communities along the borders that benefit from smuggling might turn against the government because of its anti-smuggling policy.
- (8) An extensive presence of Jordan's security personnel could lead to the perception of a police state and weaken the relationship between the security forces and the people.

### **2.5.4 Security Impacts**

Illegal border crossings may create an environment of instability and negatively impact security as follows:

- (1) The presence of illegal arms in Jordan could complicate the mission of Jordan's security forces.
- (2) Illegal border crossings could increase the forgery of documents, passports, and currencies.
- (3) Organized crime might spread inside the country and could become linked to foreign groups.
- (4) If violent crime were to become common, extra effort would be needed to protect tourists. (Jordan's economy has a high dependence on tourism.) Bad publicity (such as was caused by terrorist activities against tourists in Egypt in recent years) would have an adverse impact on Jordan's economy.

- (5) Neighboring countries could change their foreign policies toward Jordan if terrorist or criminal factions were shown to have entered illegally from Jordan.
- (6) Illegal border crossings could redirect the mission of the Armed Forces and complicate training and increase the burden on the defense budget.

### **3.0 Plans to Improve Jordan's Border Security**

#### **3.1 Disadvantages of Jordan's Present Border Security System**

In the past, the famous Bedouin soldiers of the Desert Police patrolled Jordan's borders on camels. Their mission was to control the migration of nomads between Jordan and Saudi Arabia, Iraq, and Syria. Unfortunately, in recent years the number of illegal crossings has increased. The types of intrusions have expanded from Bedouin tribesmen to organized gangs of smugglers, refugees and illegal immigrants, and terrorists and political subversives. Violence against security forces has increased. This new environment has led to the Jordan Army taking responsibility for large sections of the border.

The relatively large number of military units now assigned to border security has created a heavy administrative, personnel, and financial burden on Jordan. Equipment for border security missions is withdrawn from regular army units and has an adverse effect on the overall readiness of these units. Border duty also causes unplanned wear and damage to the equipment.

Regular military equipment from army units is not optimal for the border security mission. There is no integrated communication system for widely dispersed units along the border. Armored vehicles are too slow and trucks break down frequently while patrolling in rugged terrain. In some cases, smugglers have better vehicles, equipment, and operational skills than the security forces. Military surveillance equipment such as the U.S.-made (LAURIS) thermal imaging system is very useful but there is a shortage of such equipment.

#### **3.2 Strategic Goals of Jordan Armed Forces (JAF) Modernization**

The peace treaty with Israel and the lack of a significant conventional military threat have resulted in a plan to restructure Jordan's army. Jordan plans to improve the capability of border security forces as part of the modernization program. Securing Jordan's 1767-km-long border requires mobile, light-infantry brigades operating under a common headquarters. This force should employ modern surveillance equipment and high-performance vehicles suitable for patrolling. All-weather patrol roads and infiltration obstacles should be constructed parallel to the northern and western borders. The forces will have the following security mission:

1. Prevent infiltration, smuggling, or cross-border terrorism.
2. Control the movement of farmers, hunters, and fishermen in border areas.
3. Facilitate internal and external tourism by providing adequate security.
4. Provide early warning of military operations against Jordan.

The process of modernizing Jordan's armed forces and improving control of its borders will occur regardless of any future agreements for cooperation with its neighbors. This section focuses on Jordan's unilateral plans for improvement. Section 4 examines options for cooperation with Jordan's neighbors and ways in which such cooperation can complement Jordan's existing and planned border security capabilities.

The objectives of the modernization project are listed below:

1. Improve border monitoring capabilities
  - a. Detect intruders at greater distances than currently possible
  - b. Monitor 24 hours a day, in daylight and night conditions
  - c. Remove gaps in the current coverage of the border zones
  - d. Improve ability to identify persons and vehicles crossing the border
2. Modernize communications
  - a. Establish secure communication between units
  - b. Improve speed and reliability of communications
  - c. Improve ease of use
3. Optimize the security force command and control
  - a. Shorten reaction time
  - b. Improve ability to detain or repel intruders

The following factors should guide the selection of monitoring equipment for border security:

1. Geographical nature of border area.
2. Cost of equipment.
3. Simplicity of equipment and ease of use.
4. Availability of experience and resources for maintenance of equipment in the JAF.
5. Degree to which new equipment and systems can complement those already in use.

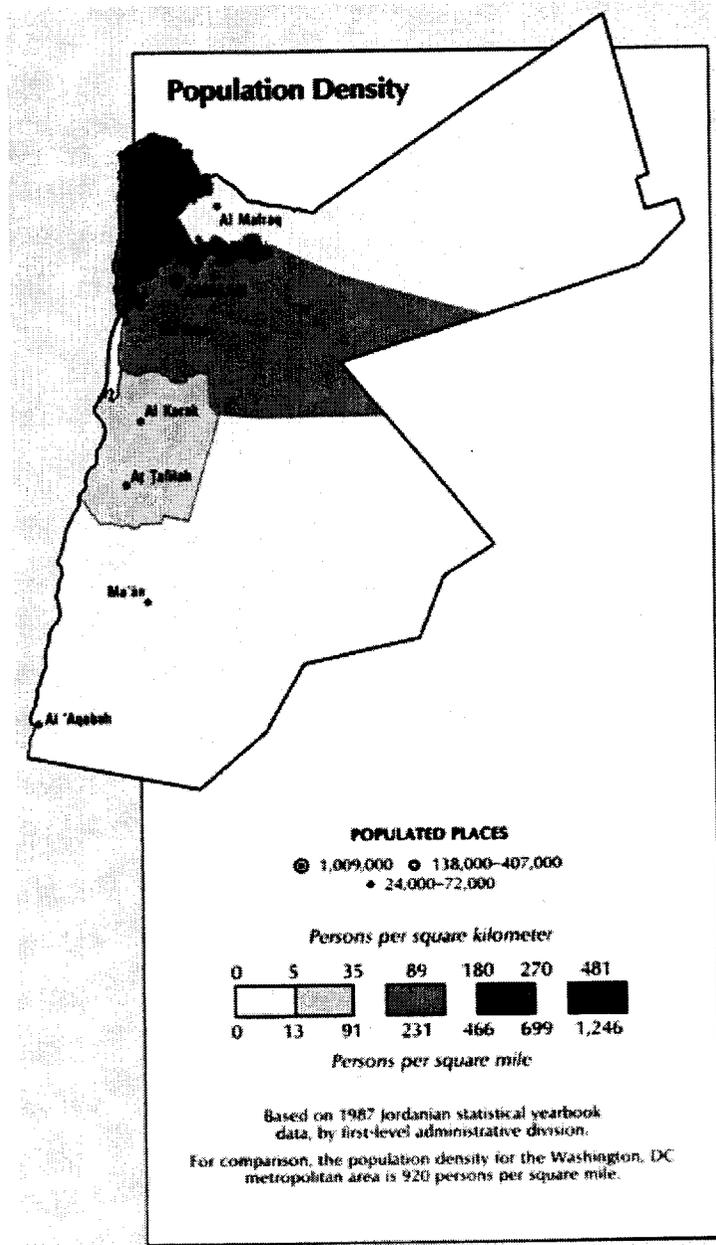
### **3.3 Border Monitoring**

#### **3.3.1 Effect of Jordan's Terrain on Border Monitoring**

Jordan's population is concentrated in the west near the Jordan River valley. Most of the southern, central, and eastern parts of the country are part of the great Syrian Desert. These areas support little life and are the least-populated regions of Jordan. Few roads traverse the broad expanses of sand dunes and salt flats, particularly in the south and the southeast. Occasional groups of sandstone hills or low mountains support only meager vegetation that thrives for a short period after the scanty winter rains.

The combination of Jordan's geography, population distribution, and land use (see Figures 8 and 9) has both negative and positive impacts on establishing a border monitoring system. Long borders, rough terrain, and few roads complicate monitoring and patrolling by security forces. These factors also have a negative impact on potential intruders by forcing them to move long distances through rough country until they reach major roads and population centers. The absence of population means that movement across the border outside of official crossings is likely to be illicit. This significantly reduces the problem of false alarms caused by

innocent civilian activity and enhances the value of remote monitoring equipment. Most of the northern, eastern, and southern borders, and the western border with Israel south of the Dead Sea to just north of Eilat/Aqaba, fit this description.



A comprehensive terrain analysis of the border area is necessary early in the planning stage of a unilateral or cooperative monitoring system. Accurate mapping of the area is essential. The international boundary line should be physically marked on the ground, if possible. If this is not possible, a line somewhat to the rear should be established and treated as if it were the actual border. Global Positioning System (GPS) equipment may be useful in accurately establishing border markers. An analysis of the soil, vegetation, and climatic conditions of the border area can guide the selection of monitoring tools. Actual installation of a border security system requires the identification of the most favorable terrain near the borderline.

Figure 8. Population Density in Jordan

### 3.3.2 Strategy for Use of Monitoring Hardware Along Jordan's Borders

It would be prohibitively expensive to attempt to install a system of sensors to monitor every meter of Jordan's borders. In general, a border monitoring system focuses on the most likely threats. The system may be integrated with observation activities by security forces both for redundancy and because human judgment is often needed.

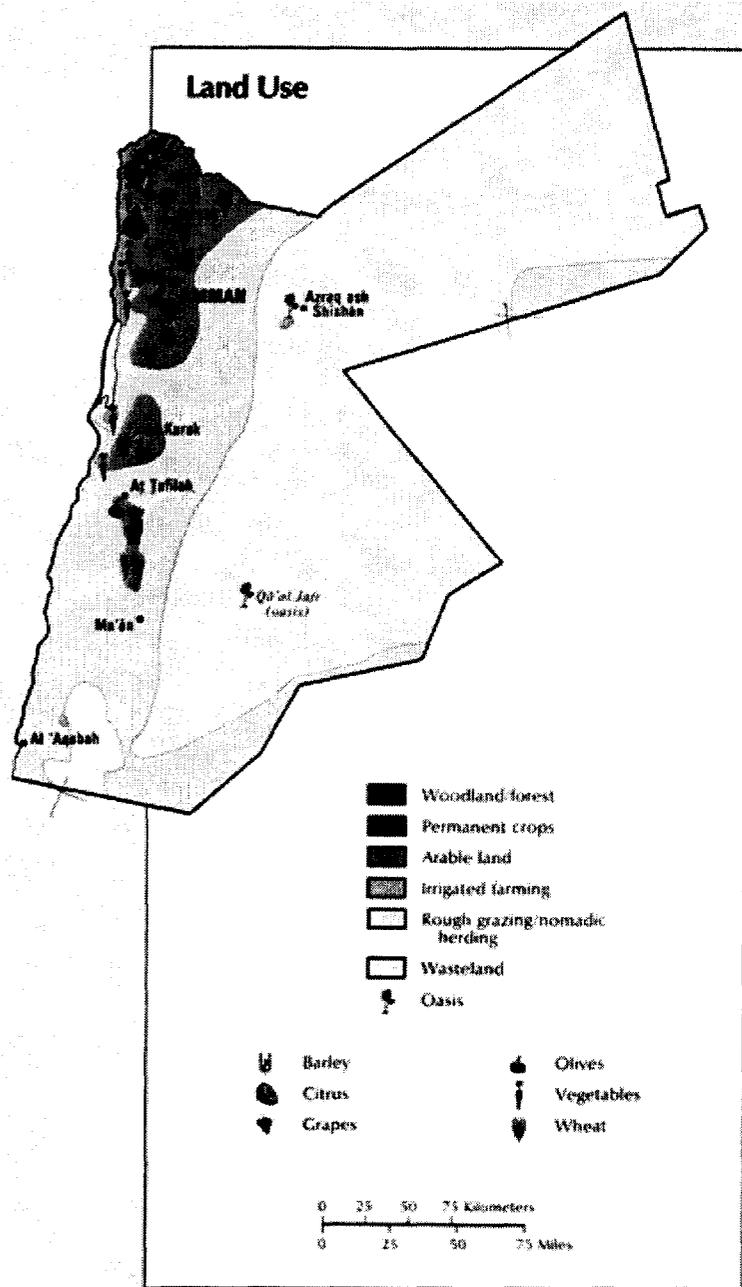


Figure 9. Land Use in Jordan

Figure 10 shows a diagram of the conceptual Jordan system including security unit deployment, command centers, and monitoring equipment. The selection of monitoring equipment described in the following sections is based on these concepts:<sup>13</sup>

- Observables and Signatures for Border Monitoring
- Candidate Sensors for Various Observables
- Sensor-Terrain Matrix for Border Monitoring

Using the model for border security presented in *A Generic Model For Cooperative Border Security* (SAND 98-0505/7), a system of zones for detection, identification, and reaction should be established. The general model has been adjusted to fit Jordanian conditions in the unpopulated desert areas and the populated areas along the Israeli and Syrian borders. Selection of potential monitoring sensors for the Jordanian border is based on the characteristics of the security threats described in Section 2.3. *Observables* are those features (for example, people, military vehicles, etc.) being monitored. They define what the monitoring system is intended to detect and characterize and may include objects, activities, processes, or movements. *Signatures* are the physical characteristics associated with the observables (such as weight, length, magnetic properties, etc.) that can be measured. These signatures allow sensor systems to detect and classify differences between the items observed.

<sup>13</sup> Netzer, Gideon; *A Generic Model for Cooperative Border Security*, SAND 98-0505/7, Sandia National Laboratories, Albuquerque, NM, March, 1999.

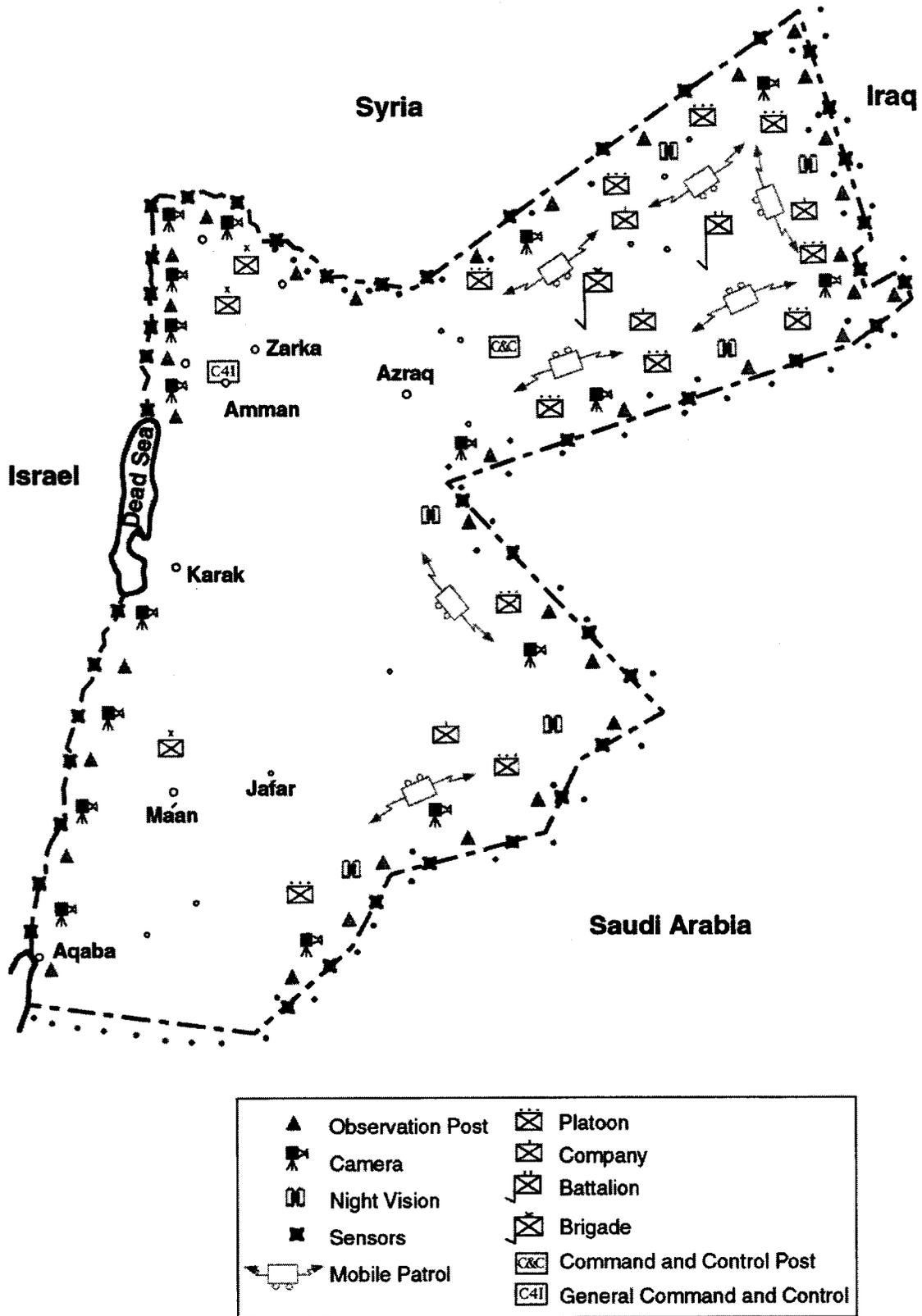


Figure 10. Conceptual Design of Jordan Border Monitoring System

### 3.3.2.1 Unpopulated Desert Areas

The combination of rugged terrain, weather, and ease of maintenance argues for a simple system of intrusion detection that will enhance the JAF's ability to stop intruders at night or during times of poor visibility. Sensors should be relatively inexpensive and reliable to permit a wide front to be monitored. Careful mapping of sensor locations is critical. Choosing sensors with the ability to transmit a location beacon upon command would ease periodic maintenance.

Years of experience have given security forces insight into where the most likely border crossing locations are. Images from commercial satellites can assist the planning and operation of a security system by confirming the location of paths and identifying new ones. For example, Figure 11 clearly shows the town of Ash Shubah in Saudi Arabia (just south of the border with Iraq) and trails made in the desert surface by Bedouins going to Ash Shubah to trade.

The image was made by a French SPOT satellite with a spatial resolution of 10 meters. Satellite images of border areas should be periodically evaluated to see if smugglers have changed their preferred routes. An evaluation would be particularly useful after storms have changed the surface of the ground. Security forces can modify the monitoring system and their operations to adjust to the changed threat.

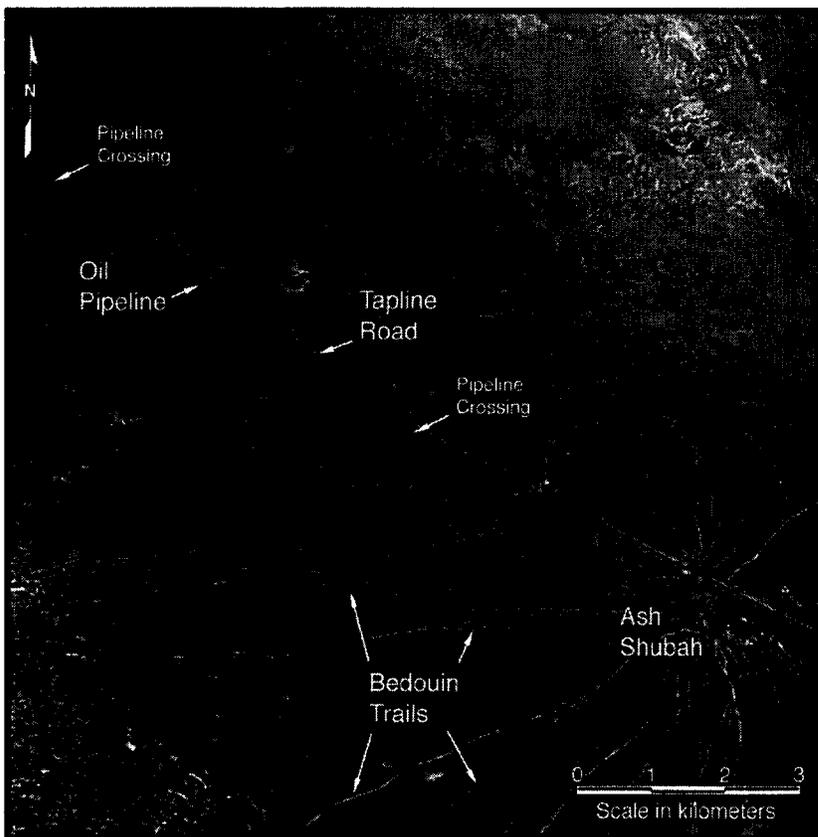


Figure 11. SPOT Satellite View of Ash Shubah Area

### Detection Zone Monitoring Hardware

The detection zone is intended only to provide an alert to security forces. If the intrusion is not confirmed in the identification zone, the alarm was either false, or the intruder has stopped or retreated. The ability to monitor all likely intrusion routes is most important.

The detection zone should be 3 to 5 km wide. Sensors should be buried or camouflaged to prevent tampering or destruction by intruders along likely routes of intruders. The local terrain will often create preferred routes or chokepoints. Placement in sand dunes and areas where sand dunes move should be avoided because sand can bury sensors deeply and block their ability to function. This is not a significant disadvantage, since intruders, seeking to move as easily as possible, will tend to avoid dunes. Locations subject to seasonal flooding, such as dry steam beds, should be avoided because moving water may dislodge and damage sensors.

Several technologies are applicable (see Appendix B for detailed descriptions):

1. **Seismic sensors** (Figure 12) could be installed in a linear formation across potential routes. If the two parallel rows of sensors are used, the direction of travel by an intruder might be estimated. The effectiveness of these sensors varies greatly with local geology. Hard, dry, sandy soil, found along much of Jordan's borders, normally works well. Potential sites must be tested to determine if seismic sensors can function effectively. The Middle East is a seismically active area, and Jordan's border sectors must be assessed for such activity. Frequent, naturally occurring seismic shocks would cause false alarms.

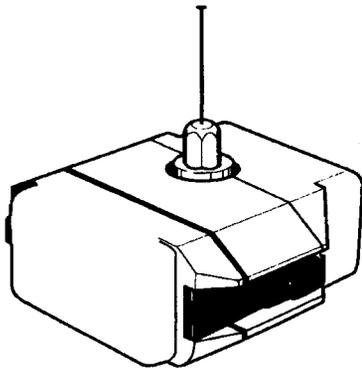


Figure 12. Seismic Sensor

2. **Break-wire sensors** (Figure 13) are simple and reliable devices. Jordan has the capability to manufacture them. Because these sensors require direct contact with an intruder, several parallel rows would need to be placed perpendicular to the anticipated direction of traffic in order to have a high likelihood of detection. This would also provide information about direction of travel. Break-wire sensors would be most effective against vehicles but would also offer significant protection against people on foot or riding animals such as camels. These sensors require more maintenance because the break-wire must be replaced after each alarm. Roving wild animals

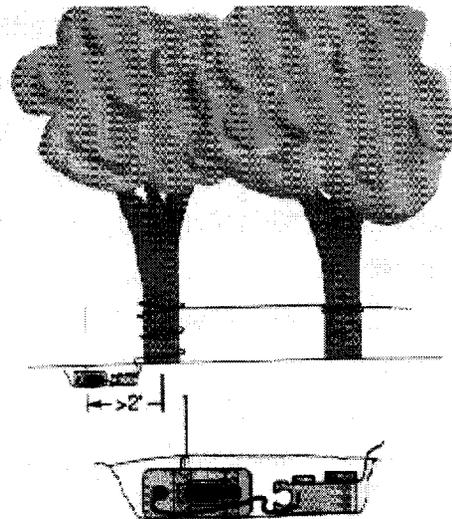


Figure 13. Break-wire Sensors

may cause alarms, and, if wildlife is common in an area, these sensors may not be effective. Jordan's desert border areas do not typically have high levels of wildlife. Rodents in the desert may be attracted to the break-wire sensors and cause damage or activation. This needs to be tested.

3. **Magnetic sensors** (Figure 14) have complementary strengths to seismic and break-beam sensors. They are unaffected by background activity in the desert and do not require direct contact. Their disadvantage is that their detection range is relatively short, particularly for armed people on foot. Magnetic point sensors may be deployed in a formation across likely paths like seismic sensors. Given their shorter detection range, more magnetic sensors than seismic sensors would be needed to monitor the same area. Magnetic point sensors should therefore only be used to cover small paths or roads. A cable magnetic sensor offers better protection for areas that are relatively wide. This sensor consists of a buried control/communicator box and a buried electrical cable. When a vehicle, person, or animal carrying ferrous metal objects passes over the cable, the sensor detects the change in the magnetic field and radios an alarm. This sensor is most effective in detecting vehicles but still offers significant protection against people and animals carrying weapons or steel objects. There would be no false alarms from wildlife. The disadvantage is the higher cost of the sensor and more complex installation. Hard ground surfaces with extensive rock cover might prevent installation.

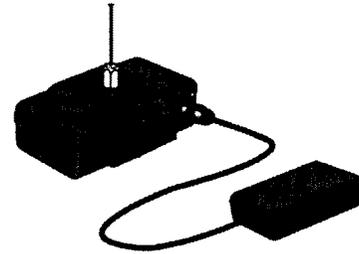


Figure 14. Magnetic Sensor

4. **Pressure-sensing cable sensors** (Figure 15) are able to monitor relatively wide areas like the magnetic cable sensor. They detect the presence of an object when it increases pressure of the ground as it passes over it. Pressure sensors are most effective against vehicles because vehicles have a continuous track on the ground. A person or animal might step over a buried cable and avoid being directly over it. Parallel lines of pressure sensors would increase the likelihood of detecting foot traffic and provide information about the direction of travel. These sensors are cheaper than magnetic line sensors but require careful installation to function well. Hard ground surfaces with extensive rock cover might prevent installation.

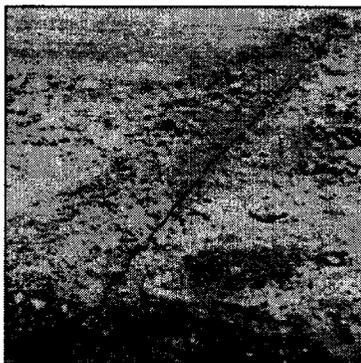


Figure 15. Pressure-Sensing Cable Sensors

5. Areas that permit vehicle travel over a wide area and do not have defined paths could be monitored with an operator-controlled ***ground radar or thermal imaging system***. Two types of thermal imaging systems could be used depending on the terrain, as follows:
  - 1) a long-range system with a range of 10 miles to cover areas where a long line-of-sight is possible, and
  - 2) a medium-range system with a range of up to four miles to be used in flat ground. These systems can be fixed or mobile. Towers might be constructed in flat areas to provide the most effective field of view. Permanent positions in remote areas create the logistic problem of supply and rotation of operators. A mobile patrol that sets up temporary positions randomly in areas of concern provides the best deterrent.

Whenever possible, at least two types of sensors should be combined to monitor potential intrusion routes. This provides redundancy in both physical reliability and modes of detection. It also provides information that could contribute to the later identification of the intruder. The selection of specific sensors depends on the characteristics of the site to be monitored: physical environment, type of intrusion suspected, and size and importance of area to be monitored.

#### **Identification Zone Monitoring Hardware**

The mission of the identification zone is:

- 1) to determine whether an intrusion detected in the first zone is truly a threat, and
- 2) to provide commanders with adequate information needed to formulate an appropriate response. The identification zone could be about the same size as the detection zone.

Identification of intrusions is more difficult than detection. The same guidelines for use and placement of sensors in the detection zone apply in the identification zone. Identification typically relies on vision, either by a direct observer or a camera system. Indirect assessment of identity is also possible. For example, sensors in the detection zone may report when the intruder has a magnetic signature, its direction of travel, and approximate speed. This may permit a monitoring center to suspect a vehicle rather than an intruder on foot.

The use of sensors in the identification zone would provide observers and security forces on patrol with information about where to look. Observation tools such as night vision devices, high-power binoculars, and searchlights (both fixed and on vehicles) would greatly assist security forces in this task. Fixed or mobile observation posts should be equipped with thermal imaging equipment.

Unattended sensors may contribute as well. Detection-type sensors may be combined with video cameras. When an intruder is detected, the sensor commands the camera to transmit an image of the intruder to a monitoring center. Cameras may be combined with visible or infrared lights for operation at night. Cameras could also operate in standby mode and be activated by a command from the monitoring center when activity is suspected in its area. Cameras and their support equipment must be placed in containers that protect them from the

weather and deliberate attempts to damage them. Acoustic sensors constitute a new technology that might be used for both detection and identification. Such sensors may permit the distinction between people and animals and vehicles. The spectra of sounds may permit the identification of a specific type of vehicle.

### **Reaction Zone Needs and Equipment**

In the reaction zone, a security force responds in the appropriate manner based on the knowledge of the intruder's identity, location, and direction. The size of the reaction zone depends on the tactical deployment of the security force and should be centered on the proposed new patrol roads. Night vision and other optical devices would help them to carry out their mission. The primary need in the reaction zone is command and control for the security force commander. Security force bases should be located to permit rapid movement to as wide an area as possible. Response forces should be equipped with GPS units that transmit their location to the security force control center as well as assist their navigation. Helicopters with all-weather and night vision capability may be needed for response in particularly remote areas.

Particularly rugged and remote areas, such as parts of the Syrian border, may require a flexible approach using both high technology and traditional methods. The Desert Police have traditionally patrolled this area on camels. There are no roads and the area is nearly impossible for vehicles to cross. Such terrain means that intruders face the same logistic and travel difficulties as the security forces. The most cost-effective system may be to retain the camel patrol but improve their effectiveness by the use of GPS for navigation and control, a modern communication network, and night vision devices.

The Iraq border at Al-Karama and the Saudi Arabian border area south of Al-Aqaba are special cases that require a different strategy.

The security concern at the Al-Karama crossing is refugees and smugglers coming to the border in vehicles, disembarking, illegally crossing the border on foot, then rejoining commercial trucks on the highway to Amman. The ability of these persons to travel on foot for extended distances is quite limited. A good detection strategy would be to construct a taut-wire sensor fence parallel to the border for a distance of approximately 10 km north and south of the official crossing point. (See example in Figure 16.)



*Figure 16. Taut-Wire Fence Example*

A taut-wire fence of this distance would deter the entry of all but the most determined smugglers (including those in vehicles). Refugees do not have the resources to move so far from the main road to go around the fence. If placed to the west of the ditch barrier, the fence would provide confirmation of illicit intent in entering Jordan as well as provide a second barrier. Although relatively expensive per kilometer to build, the flat terrain in this area makes construction relatively easy. The system offers high reliability and a low rate of false alarms. The system requires AC electrical power, but this is available at the border crossing.

Near Aqaba, the security concern is smugglers taking advantage of the flat terrain and road to transport goods. A taut-wire fence sensor would block movement and detect illegal entry. Electrical power to operate the sensor is available from Aqaba and the local area. Road entry points can be built into the system to permit legal crossings. The system should extend from the coast to the escarpments inland – a distance of approximately 10 km. The system would deter intruders by forcing them to move to rougher terrain inland.

### 3.3.2.2 Populated Areas

Civilian activity creates a significant amount of background activity that a monitoring system must distinguish from threats of concern. The effective use of unattended sensors is thus more difficult. (This condition applies along the Syrian border north of Irbid and from the northern end of the Israeli border south to the Dead Sea.) Other factors, such as proximity to Jordan's centers of population and the sensitivity of the Israeli and Syrian borders, contribute to the need for a greater human presence with the monitoring system than in unpopulated desert areas.

These borders do not have the strategic depth that Jordan's other borders have. The need for a prompt response to avoid an international incident leads to the recommendation that the detection and identification zones of the generic model<sup>14</sup> be combined into a single zone with a width of 2 to 3 km. The reaction zone would serve the same function as before. A road network for rapid deployment from company and battalion bases needs to be completed.

A border observation post system could be established to cover gaps, low ground, densely populated areas, and thickly wooded terrain in combination with the sensors. (Figure 17 shows a notional diagram of the system.) Point seismic and magnetic sensors could be used near observation posts for site security. This system should make the best use of local terrain and be positioned on the high ground to permit observation of locations that cannot be covered by other means. The observers would use ship binoculars, night observation devices, field binoculars, night vision goggles, and loudspeakers (to deter accidental intrusion). In addition, fixed and mobile thermal imaging devices could be used for identification at night and during inclement weather. Ground radar should be used to detect crossings of large bodies of water such as Lake Kinneret, the Dead Sea, and the Gulf of Aqaba near Eilat and Aqaba.

Unattended sensors could be used for detection of intrusions. Identification could be done primarily by security forces from observation posts and patrols. The detection/identification zone would contain no normal civilian activity. If economic activity prevented total exclusion, the area could be closed from dusk to dawn. Taut-wire and fiber-optic fences could be installed in the areas where there is the greatest risk of intruders crossing the border because they also provide a physical barrier. Sensors may be added to an existing fence. A combination of pressure and magnetic line sensors should be installed along other likely intrusion corridors. Sensors should be placed on both edges of the detection/identification zone to detect intruders either leaving or entering Jordan. These sensors would report to a local observation post. A portable unattended system using detection sensors combined with a video camera might be deployed temporarily at locations where there is intelligence or other

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<sup>14</sup> Netzer, Gideon; *A Generic Model for Cooperative Border Security*, SAND 98-0505/7, Sandia National Laboratories, Albuquerque, NM, March, 1999.

information indicating a high risk of crossings. Installation and use of sensors is subject to the same comments described in the section describing monitoring of the unpopulated desert.

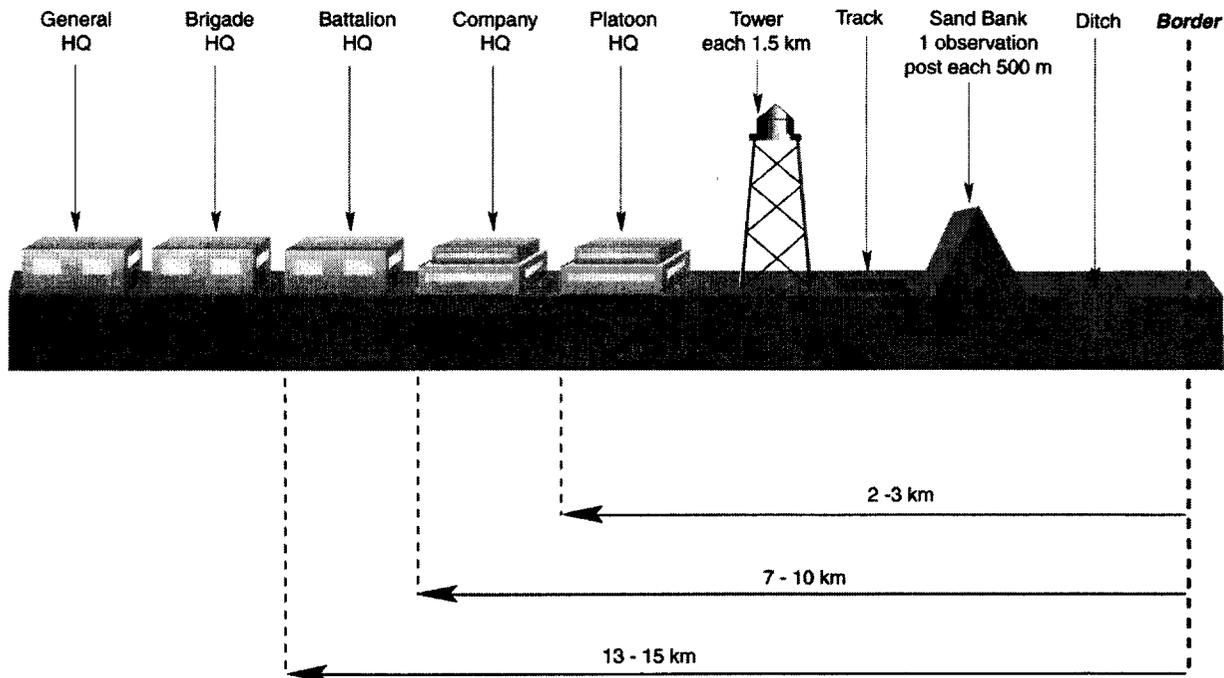


Figure 17. Observation Posts and Deployment at the Border Area

### 3.4 Plan for a Communications Network

The goal of Jordan's planned communication network is to provide an integrated system of communications for border security commanders. The objectives of the communications network are as follows:

1. To provide real-time information to security force commanders about intrusions within border areas.
2. To provide border posts and security patrols with necessary tactical information and access to central files.
3. To take the necessary measures to foil any attempt to cross the border and fight any subversive activity along the border.

#### 3.4.1 Levels of Communication

Figure 18 shows the levels of communication for the planned system.

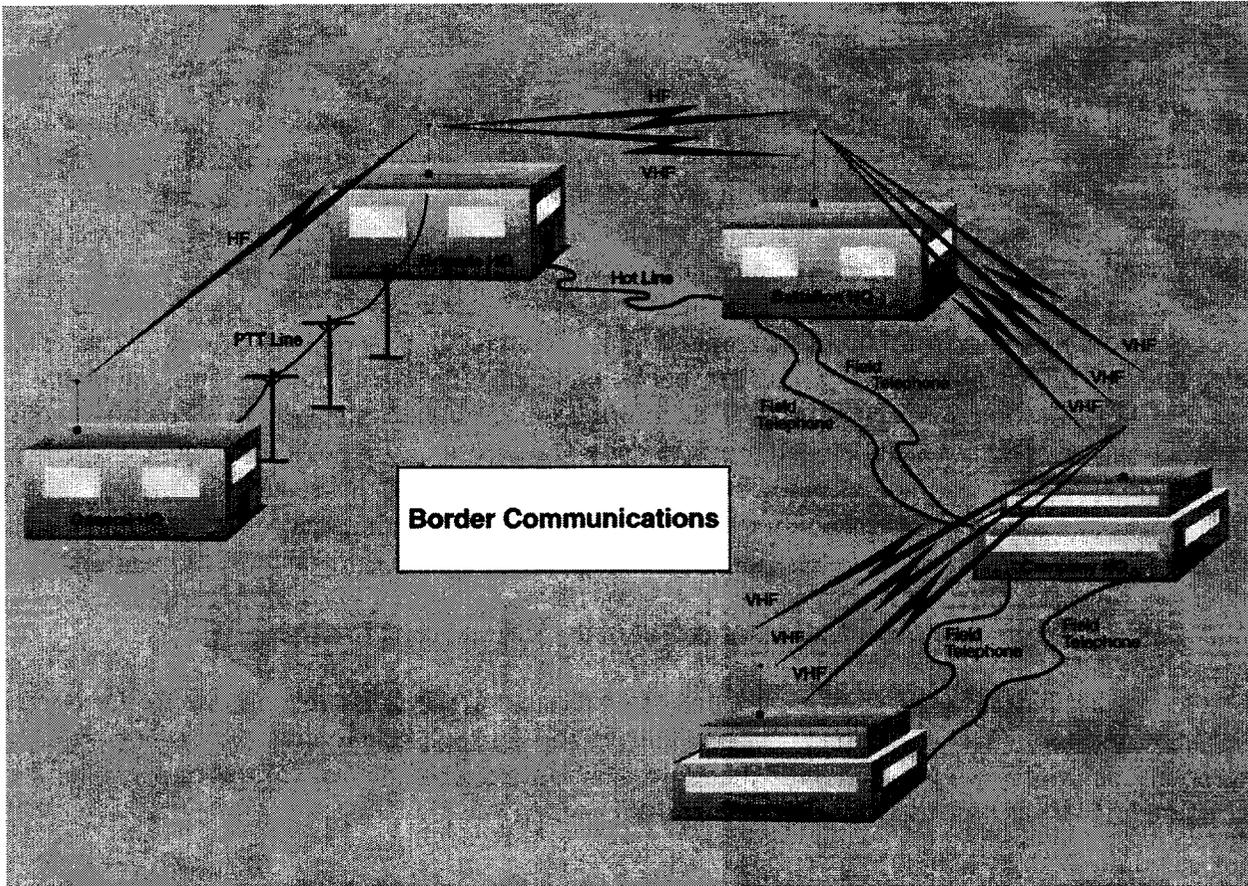


Figure 18. Communications System Example

The following describes the three planned communication levels:

Level 1. Between General Headquarters and the deployed brigade headquarters

- Main: High frequency (HF) radio links for voice and data
- Service and Backup: Continuous, open telephone lines (known as Push-to-Talk, or PTT) for voice and fax

Level 2. Between Brigade headquarters and Battalion headquarters

- Main: HF and very high frequency (VHF) radio link for voice and data message
- Service and Backup: Dedicated telephone hot lines for voice and fax

Level 3. Inside Battalions

- Main: VHF radio links for voice
- Service and Backup: Field telephone for voice

### 3.4.2 Command and Control

It is essential to establish an effective organization of command and control for border security forces to receive, evaluate, and then circulate the data according to need and priority. This organization must maintain control over all military activities on the borders. A wholly Jordanian organization could control the actions taken inside the country, and a bilateral or multilateral organization could coordinate activities with the neighboring countries.

The communication system permits a unit commander to direct his forces. The other elements of information the commander needs are real-time status reports from unattended sensors, observation posts, and patrols. This information should be integrated into a single report for each sector. The commander also needs to know the location of patrols and reaction forces in order to manage a timely and effective response to intrusions. This information can be provided by the use of GPS receiver/transmitters with each patrol and reaction unit. The command post should also have access to databases (intelligence, criminal, etc.) at the general headquarters.

### 3.5 List of Proposed Monitoring and Security Equipment for the JAF

Jordan has assigned a large amount of equipment from army inventories to the border security mission. Table 1 shows the breakdown for sensors, communication, transportation, weapons, engineering equipment, and manpower to improve existing capabilities and supplement existing JAF equipment used for border security.

**Table 1. Supplemental Equipment Needed for More Effective Border Security**

ITEM	QTY	ESTIMATED COST (US\$)
<b>UNATTENDED SENSORS</b>		
Seismic sensor	300	150,000
Magnetic point sensor	300	150,000
Passive infrared sensor	100	50,000
Infrared break-beam sensor	100	50,000
Break-wire sensor	500	150,000
Magnetic line sensor (50 m)	50	500,000
Pressure-sensing line cable (100 m)	50	250,000
Hand-held sensor radio receiver	300	165,000
Taut-wire fence intrusion sensor	40	8,000,000
Active infrared intrusion detection sensor	50	825,000
<b>ATTENDED SENSORS</b>		
Long-range infrared system	35	4,550,000
Medium-range infrared system	24	2,880,000
Ground radar (40 km)	12	2,400,000
Searchlight (18 million candlepower (cp))	137	685,000
Searchlight (12 million cp)	58	232,000

*Continued on the next page...*

**Table 1. Supplemental Equipment Needed for More Effective Border Security, continued**

ITEM	QTY	ESTIMATED COST (US\$)
Searchlight (6 million cp)	472	708,000
Hand-held (HH) searchlight (1 million cp)	200	240,000
Ship binoculars	61	122,000
Field binoculars	162	64,800
HH laser range finder	12	156,000
Night observation device	45	675,000
Night vision goggles	540	2,970,000
<b>COMMUNICATIONS</b>		
Loudspeaker	80	8,000
Telephone set	50	5,000
HF Radio	50	825,000
VHF Radio	75	1,125,000
Ultra-high frequency (UHF) Radio	3	60,000
HH Motorola	172	516,000
GPS Receiver/Transponders	78	390,000
<b>TRANSPORTATION</b>		
4 x 4 vehicles	70	3,850,000
Helicopters	6	36,000,000
Command post vehicles	12	840,000
Recon vehicles	22	1,540,000
Scout vehicles	16	1,120,000
Heavy-duty ambulance	6	180,000
<b>WEAPONS</b>		
NVS (M16A2)	1,220	6,100,000
NVS (M60MG)	88	528,000
NVS (CAL .50MG)	42	252,000
<b>ENGINEERING EQUIPMENT</b>		
Truck tractor (bulldozer)	2	520,000
Dozer shovel	6	316,000
Excavator, backhoe	2	316,000
Wheeled loader	2	316,000
Motor grader	2	366,000
Jackhammer	1	3,000
Mine detector	13	39,000
<b>MANPOWER (ANNUAL COSTS)</b>	1,100	5,520,900
<b>TOTAL</b>		<b>86,708,700</b>
Spare Parts (10%)		8,670,870
<b>GRAND TOTAL for Supplemental Equipment</b>		<b>95,379,570</b>

The use of army equipment for the border security mission has an adverse effect on the readiness of regular army units. If the Jordan Armed Forces were to create a unit devoted entirely to border security with its own equipment, the cost would be more than \$232 million (US). Table 2 shows the breakdown of costs for sensors, communication, transportation, weapons, engineering equipment, and manpower.

**Table 2. Equipment Required for a New Border Security/Monitoring System**

ITEM	QTY	ESTIMATED COST (US\$)
<b>UNATTENDED SENSORS</b>		
Seismic sensor	300	150,000
Magnetic point sensor	300	150,000
Passive infrared sensor	100	50,000
Infrared break-beam sensor	100	50,000
Break-wire sensor	500	150,000
Magnetic line sensor (50 m)	50	500,000
Pressure-sensing line cable (100 m)	50	250,000
Hand-held sensor radio receiver	300	165,000
Taut-wire fence intrusion sensor	40	8,000,000
Active infrared intrusion detection sensor	50	825,000
<b>ATTENDED SENSORS</b>		
Long-range infrared system	117	15,210,000
Medium-range infrared system	98	11,760,000
Ground radar (40 km)	12	2,400,000
Searchlight (18 million candlepower (cp))	137	685,000
Searchlight (12 million cp)	58	232,000
Searchlight (6 million cp)	472	708,000
Hand-held searchlight (1 million cp)	1,200	1,800,000
Ship binoculars	178	356,000
Field binoculars	534	213,000
Hand-held laser range finder	24	312,000
Night observation device	178	2,670,000
Night vision goggles	1436	7,898,000
<b>COMMUNICATIONS</b>		
Loudspeaker	442	44,200
Telephone set	487	48,700
High-frequency (HF) radio	212	3,498,000
Very-high frequency(VHF) radio	466	6,990,000
Ultra-high frequency (UHF) radio	10	200,000
Hand-held Motorola	466	1,398,000
GPS receiver/transponders	370	1,850,000

*Continued on the next page...*

**Table 2. Equipment Required for a New Border Security/Monitoring System, continued**

ITEM	QTY	ESTIMATED COST (US\$)
<b>TRANSPORTATION</b>		
4 X 4 vehicles	210	11,550,000
Helicopters	12	72,000,000
Command post vehicles	33	2,310,000
Recon vehicles	78	5,460,000
Scout vehicles	48	3,360,000
Heavy-duty ambulance	20	600,000
<b>WEAPONS</b>		
NVS (M16A2)	4,128	20,640,000
NVS (M60MG)	426	2,556,000
NVS (CAL .50MG)	252	1,512,000
<b>ENGINEERING EQUIPMENT</b>		
Truck tractor (bulldozer)	6	1,560,000
Dozer shovel	6	948,000
Excavator, backhoe	6	948,000
Wheeled loader	6	948,000
Motor grader	6	1,098,000
Jackhammer	3	9,000
Mine detector	30	90,000
<b>MANPOWER (ANNUAL COSTS)</b>	<b>5,019</b>	<b>17,000,000</b>
<b>TOTAL</b>		<b>211,151,900</b>
Spare parts (10%)		21,115,200
<b>GRAND TOTAL for New System</b>		<b>232,267,100</b>

Tables 1 and 2 show that the establishment of a border monitoring and security system will be expensive given Jordan's limited resources. The goal of a special border security unit with its own equipment is only achievable in the long term. In the short term, the acquisition of equipment (such as high-mobility vehicles, communications, and unattended ground sensors) to enhance the effectiveness of army units assigned to border security would be the best use of funds. These categories of equipment constitute a relatively small part of the total cost in both tables. International military aid would be useful in both acquiring the needed hardware and speeding its integration into the JAF.

## **4.0 Potential Cooperative Actions in Border Security Between Jordan and Its Neighbors**

### **4.1 Basis for Cooperation in Border Security**

Jordan will take whatever steps are necessary to protect its sovereignty and the security of its borders. Jordan's plans and concepts for improving its unilateral capability in border monitoring, including the use of monitoring technology, were described in Section 3. This unilateral monitoring system has the capability to *evolve into a cooperative monitoring system* upon the negotiation of the protocols for cooperation with Jordan's neighbors. A cooperative system has the potential to improve effectiveness while reducing the cost and administrative burden for the participating countries.

Jordan is receptive to cooperation with its neighbors to improve border security. The Hashemite vision described in Section 2 calls for cooperation and respect with Jordan's Arab neighbors and the scrupulous commitment to the 1994 peace treaty with Israel. All neighboring countries are hurt in some way by illegal border crossings. Cooperation in border monitoring would decrease the burden and improve security for all. For example, the peace treaty with Israel ensured the military security of Jordan's western border. With this assurance, Jordan has been able to reduce the size of its armed forces and redirect financial resources to strengthen the social safety net.<sup>15</sup>

Cooperation between states, including cooperative monitoring, is a political decision. Jordan's ability to cooperate in border security with Syria and Iraq is limited at this time. Cooperation with Saudi Arabia and Israel is more favorable but also has limitations. This section outlines a strategy for cooperation and identifies potential actions that might help Jordan. These actions are intended to complement or increase the effectiveness of Jordan's existing or planned unilateral border security measures. These concepts for cooperation are intended to define policy and technical options if political circumstances become more favorable in the future.

Cooperative monitoring involves collecting, analyzing, and sharing agreed information among parties to an agreement. Cooperative monitoring systems typically rely on the use of commercially available sensor technology. When combined with techniques for data management and analysis, these technologies become useful tools for implementing security-related agreements. Cooperative monitoring systems should have the following three features:

- Technologies that are sharable among all parties to the agreement
- The means to analyze and equally share information acquired by the system
- Procedures for dealing with anomalous data and false alarms

The nature of cooperation can vary from simple coordination of unilateral security activities (such as patrolling) to elaborate, jointly run cooperative monitoring systems with full sharing of information. Cooperation depends on the goals and level of confidence between two

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<sup>15</sup> *Jordan Diary 1997*, International Press Office, the Royal Hashemite Court, Amman, Jordan.

nations. Examples of increasing cooperation are: coordination between local commanders, active cooperation and communication between security units, permission for security forces to cross the border in hot pursuit of intruders, joint regional command and control centers, direct communication and coordination between the national military operations directorates, permission for aerial reconnaissance in the border region, and use of sensors on both sides of the border with the reports shared in some manner between the two sides.

#### **4.2 The Role of Diplomacy and Military Action in Cooperation**

The following factors influence the motivation and ability of countries to cooperate successfully:

1. A full understanding of the implications of illegal border crossings in all countries involved.
2. Sufficient political stability to implement stable and effective agreements.
3. The ability of the political and military departments of governments to coordinate activities and develop unified plans.
4. Formal recognition of established borders between countries.
5. A willingness to exchange information about the capability and plans for improvement in border security.
6. Relative economic, technological, and military strengths of the respective countries.

Collective action requires diplomacy to define a strategy. Successful diplomacy requires the following mechanisms:

1. **Defined roles for each party.** This ensures that each party does not deviate from its responsibilities or exploit a situation to fulfill its own political objectives rather than the collective goals. An agreement should stipulate the actions of each border force to assist the force on the other side of the border, particularly during emergencies.
2. **Cooperation through information exchange.** Successful diplomacy requires exchanging defined information between all concerned parties. The first step to prevent border violations is the collection of timely and accurate data. Data exchange should focus on the greatest concerns, such as terrorist groups and the smuggling of narcotics.
3. **Military support of diplomacy.** Border security operations are politically sensitive and affect the success of diplomacy. Political considerations influence the missions assigned to border security forces much more than those of regular military units. The actions of the military force in such environments are subject to scrutiny regardless of the motivation leading to their employment and might be used by political opponents to create adverse propaganda. The security mission and form of cooperation must be made clear to commanders.
4. **Participation in review meetings.** The parties should hold periodic meetings (1) to evaluate the process of cooperation, (2) to analyze the factors affecting success and weaknesses, and (3) to search for any element that would support or reinforce border security. Documentation of performance is also needed.

### **4.3 Sharing Information Cooperatively**

Communication is one of the most important elements in developing cooperation between partners because effective cooperation depends on information. Relatively little equipment is required to support the exchange of routine, formalized information. For example, the Nuclear Risk Reduction Centers in the United States and Russia (which manage information exchange under a number of bilateral and international agreements) consist of computer monitors, word processors, printers, fax machines, and telephone lines, with primary communication links provided by satellite.<sup>16</sup> More sophisticated capabilities would be required to collect and transmit data from remote monitoring systems associated with cooperative monitoring. The number of communications channels would depend on the number of different categories of exchanged information. For example, separate channels would be needed to support bilateral and multilateral communications, official and unofficial communications, and emergency and routine communications, and direct transmissions from sensors or observers. To prevent unauthorized access and ensure privacy, computer security would be needed.

The following are examples of ways to exchange information that have been used as part of security agreements:

- *Hot lines* to provide direct channels of communication and distribution of information at any time.
- *Bilateral or regional communication and information centers* to receive timely data and to distribute the data to participants according to defined protocols. These centers should maintain communication links, information databases, and any other resources needed to implement cooperative monitoring in security issues.
- *Periodic consultations and meetings*. Annual meetings at the government (political) and army levels, which provide country-to-country and military-to-military contact to resolve border security problems.

Achieving cooperative border security requires that the parties agree on the subject, importance, and timeliness of the types of information to be exchanged. The cooperating countries should perform several tasks:

- Conduct a joint study to determine the kind of information that affects border security issues while respecting the national security needs of both countries.
- Define the appropriate communications technology and obligations for reporting.
- Define protocols for the use of the shared information during false alarms, unconfirmed intrusions, and confirmed intrusions.

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<sup>16</sup> Pregoner, Arian; Vannoni, Michael; Biringer, Kent; *Cooperative Monitoring of Regional Security Agreements*, Sandia National Laboratories, SAND96-1121, November 1996.

#### **4.4 Factors along Jordan's Borders that Affect Cooperation and Cooperative Monitoring**

Section 1.2 described the physical environment of Jordan's borders. Strategic-political, economic, and sociological factors also affect how cooperative border monitoring can be implemented.

##### **4.4.1 Strategic-Political Factors**

The national security of Jordan can only be achieved through and in conjunction with the national security of its neighboring countries. Jordan's comprehensive approach to security involves cooperation in economic and human topics as well as the security dimension. The political environment is dominated by two major elements that affect cooperation with Jordan's neighbors: (1) Israel and the Palestinian Question and (2) Inter-Arab Politics and Inter-Arab Divisions.

###### **4.4.1.1 Israel and the Palestinian Question**

The conclusion of the Jordanian-Israeli peace treaty has reduced the Israeli military threat to Jordan and brought an end to long-standing territorial and water disputes. The treaty has paved the way for extensive economic and technical cooperation, including the establishment of joint ventures for both countries' benefit. Despite ongoing consultations about potential cooperation in the economic and financial fields, Jordan fears being overwhelmed by Israel's large economy. There is a strong lobby in Jordan against normalization of relations with Israeli groups and associations. Developments in the negotiation of the final Palestinian-Israeli status will affect the stability of Jordan. Jordan has concerns about a new wave of Palestinian refugees if the Palestinian-Israeli efforts falter.

###### **4.4.1.2 Inter-Arab Politics and Inter-Arab Divisions**

Jordan seeks full understanding and cooperation with other Arab countries to achieve security. The absence of harmonious inter-Arab relations has been harmful to Jordan's security. Although the political issues and security concerns are quite different from Jordan's relationship with Israel, Jordan has had periodic difficulty with all its Arab relationships. Various countries have pursued some form of military threat, economic sanction, or policy of political isolation against Jordan. This environment limits Jordan's ability to cooperate and conduct cooperative border monitoring with its Arab neighbors.

##### **4.4.2 Economic Factors**

The arbitrary nature of Jordan's borders has resulted in key economic resources and activities being concentrated along some parts of its borders (see Figure 19). This adversely affects Jordan's ability to create monitoring areas (e.g., detection, identification, and reaction zones) or demilitarized zones along its borders. For example, some vital economic resources (such as farms and water sources) lie immediately on the borders with Israel. It is impossible to relocate these resources. Jordanian border security units have to work hard to distinguish the legitimate activity of farmers and others in these areas from illegal intrusions. Although cooperative monitoring systems offer the potential to reduce costs and increase effectiveness, they will face the same problem of "background noise."

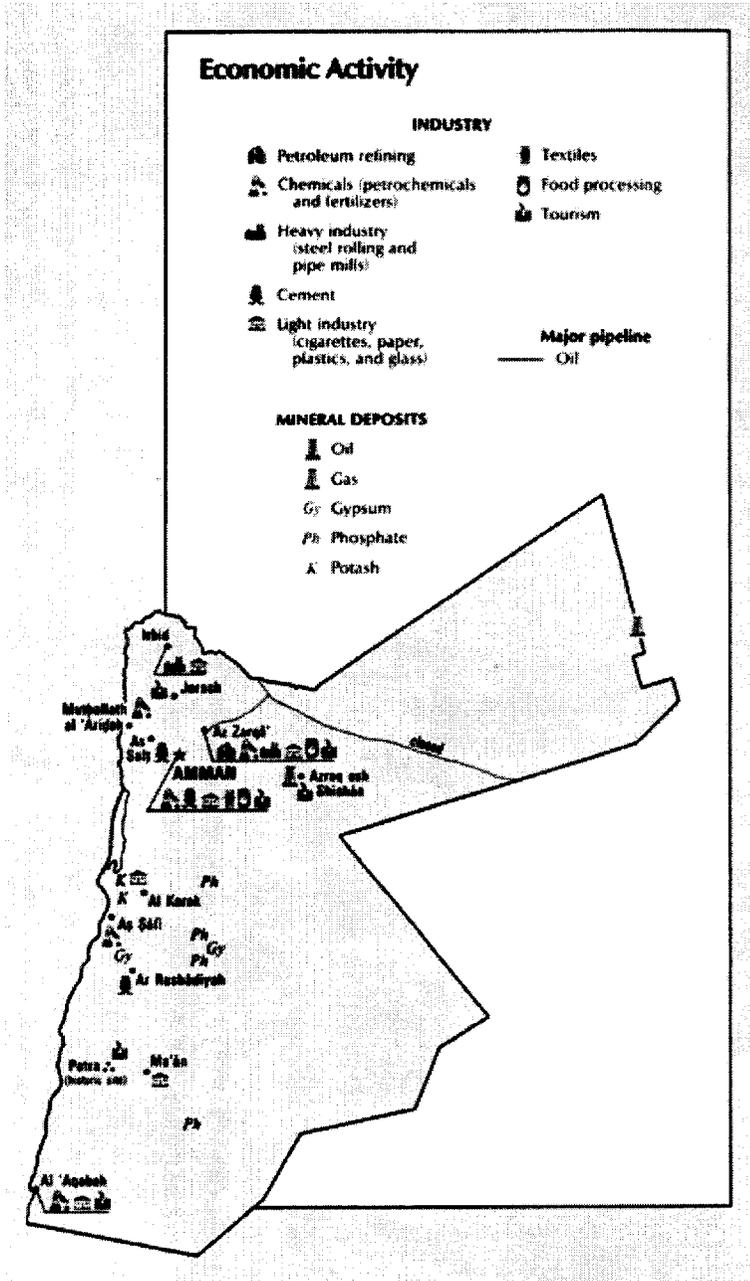


Figure 19. Jordan's Economic Activity

- The lack of an effective system for issuing visas and managing legal immigration encourages otherwise law-abiding people to commit illegal border crossings.
- Border areas are sometimes overlooked politically and economically by the national capital. Economic deprivation is an incentive for people in border communities to engage in smuggling. Neighboring countries should take coordinated action to improve social services for their citizens along the border.
- Restrictive trade laws stimulate smuggling when there are dissimilar laws in neighboring countries.

The ability of a country to effectively monitor its borders is proportional to its economic and military strength. It is uncommon that two countries with the same economic and military strength share a border. More prosperous countries must commit to share their resources, technologies, and experience with weaker neighbors in order to achieve effective cooperative border monitoring. Solutions imposed by the stronger party will result in ineffective cooperative monitoring. Jordan has limited resources. It can effectively protect and monitor its borders only with unbiased and unconditional cooperation of its neighbors.

#### 4.4.3. Sociological Factors

Cultural issues affect border security and cooperative monitoring by influencing what is normal activity. Reportable events as a result of cooperative monitoring should be filtered to account for this behavior. The following are examples of factors that affect cooperation and effective cooperative monitoring:

- Restricted flow of information through the media will tend to isolate a country from its neighbors and cause it to misinterpret activity.

- The effectiveness of border security forces can be affected by how they interact with the local population. Some units live as separate military communities while others interact with neighboring towns. Cultural isolation contributes to ignorance about the behavior of local people (e.g., Bedouins, farmers) and reduces cooperation with them.
- Social norms may vary greatly between communities that are only a few kilometers apart. Cooperative monitoring must be structured with an understanding of the local social environment. For example, people in Jordan still celebrate social events, such as weddings, by firing guns into the air despite government admonitions to the contrary. An Israeli observation post might interpret those shots as a provocative action.
- Cross-border family and tribal relationships influence the type and frequency of illegal border crossings. Jordan must involve the Bedouin tribes to effectively monitor its borders. Tribal leaders need to understand that the border patrol will restrict their movements and trade to their relatives in neighboring countries.
- The existence of a civil society with impartial application of laws influences how information from a cooperative monitoring system will be collected and used. Jordan has invested significant effort to build a professional army and police force trained in how to deal with people of different cultures, languages, and religions in the application of the law. Other countries have not instituted similar policies.

#### **4.5 Conceptual Options for Cooperation Along Jordan's Borders**

Cooperation can occur at different levels. Forecasting the exact nature of future cooperation with Jordan's neighbors is beyond the scope of this paper. Generic descriptions of potential cooperation, however, can be made. The following scenarios define three levels of cooperation that might conceivably be achieved with Jordan's neighbors in the future. Cooperation would most likely be bilateral at first, but this does not exclude the possibility of multilateral agreements for cooperation with Jordan's neighbors in the future.

There is limited cooperation today in border security between Jordan and Iraq and Jordan and Syria, with opportunities for growth. Jordan's current relationships with Israel and Saudi Arabia are similar to systems with low-level cooperation.

##### **4.5.1 Low Cooperation Scenario**

One, several, or all of the following features might characterize a low level of cooperation:

- Communication between the border security forces of each state would occur indirectly through a system of military liaison officers assigned to border sector headquarters. Information about border security matters would not be exchanged directly between units along the border. Reports of border activity from sensors, patrols, and observation posts would be shared and received through the liaison system. A weakness of this system is that the receiving party has no independent means to verify the report and would have to trust the accuracy of the information.
- The establishment of transparency measures to describe planned military exercises or redeployments. Declarations could be submitted in advance through the border security liaison system or military attaches describing dates, units involved, operating areas along the border, and routes.

- The countries would exchange descriptive information about the types of equipment used, general deployment, and capabilities of their monitoring systems. Plans for procurement and installation could also be provided.
- The countries would negotiate protocols for the arrest of intruders, extradition of their citizens, and the legal status of citizens from other countries who have been arrested.
- The countries would define a protocol for cooperation in the emergency evacuation and medical treatment of injured members of security forces.
- The schedule and routing for patrols on each side of the border could be coordinated to enable more effective coverage.
- The establishment of a collaborative system of support (e.g., water and food) for observation posts or remote garrisons.
- The establishment of a collaborative program for the physical demarcation of the border and maintenance of markers, fences, and ditches.

#### **4.5.2 Medium Cooperation Scenario**

The following features (in addition to or in place of those defined in the low cooperation scenario) might characterize a medium level of cooperation:

- The centralization of the military liaison system into a “Joint Monitoring Group” (JMG) organization. The JMG would act as a facilitator of monitoring policy and procedures and not have an operational role in border security. It would receive data and reports from both sides for archiving but not receive data in real time. Regular reports from both sides would be given to the JMG. A permanent staff would carry out JMG functions. The JMG would typically be located in one of the participating countries but modern communication technology might permit partner centers to be established in all participating countries. Equipment would be relatively simple and consist of:
  - Communications (telephone, fax, email, or the Internet) with the capability to encrypt private communications between the participating countries.
  - Computer equipment to maintain databases of shared information, reference material, maps, and terrain data. Paper records would be maintained as necessary.
  - Hot line to the respective military operation centers and foreign ministries.
  - Meeting rooms and related equipment for conferences, workshops, training, and formal negotiations.
- While direct data sharing would not be implemented under this scenario, a voice communication network between local commanders (at the battalion level) would be established to permit communication and coordinated response to intrusions. This would help prevent misunderstandings that could cause incidents.
- The establishment of joint patrols with the authority to cross the border within specified distances to arrest intruders.
- Collaborative procurement, installation, and maintenance of detection sensors placed close to the border.
- The collaborating countries would establish a system of assistance to each other in their areas of respective strength. Assistance could take the form of transfer or loan of logistic and monitoring equipment, technical training, and financial grants or loans.

- Placement of observation posts and attended/unattended sensors near the boundary would be coordinated to optimize observational coverage. This strategy would remove redundancy and require fewer posts and equipment than unilaterally planned monitoring systems.
- The establishment of a collaborative program to construct and maintain patrol roads to improve the efficiency of security force response.
- The establishment of joint training programs for border security forces in operations, law and human rights, and language.
- The initiation of direct exchange of inspection information between both sides at official border crossings to improve efficiency. Inspection equipment could be jointly procured and used.

#### 4.5.3 High Cooperation Scenario

The following features (in addition to, or in place of, those defined in the medium cooperation scenario) might characterize a high level of cooperation:

- The Joint Monitoring Group would take new responsibilities for operational control of border security and cooperative monitoring activities. The JMG would need communication equipment to link with the military or border security communications networks of participating countries. In addition, it would need receivers from GPS and sensor communication systems in the field. The JMG would need equipment to integrate, display, and act upon information from the monitoring cooperative system. The new JMG responsibilities would include:
  1. Data from sensors and reports from human observers would be sent in real time. Reports would then be sent to the officials of participating countries.
  2. Any necessary responses to intrusions would be coordinated by the JMG.
  3. Joint border patrols would be supervised and tracked by the JMG with real-time communications and the GPS. The patrols would issue a report to the JMG, which would then issue a joint report to the national parties.
  4. Sensors in the border area would transmit data in real time directly to the JMG.
  5. Official border crossing points would have communication links to the JMG.
  6. The JMG would manage monitoring system maintenance and improvements.
  7. The JMG would create and maintain shared databases for intelligence, criminal, and operational information.
- There would be collaborative design of a fully integrated border monitoring system based on a generic model<sup>17</sup> to remove remaining redundancy resulting from a unilateral approach. The monitoring system is based on the establishment of three zones on each side of the border that act together as a single integrated system. Each monitoring zone has a specific function (detection, identification, and reaction). (See Figure 20.) The design of this cooperative system is the *reverse* of traditional unilateral border security systems. The system looks *both* ways: It seeks to detect and identify intrusions originating within the country itself and directed at its neighbor as well as intrusions originating from its neighbor. Since information is shared and security response coordinated by the two neighbors, the detection zone is moved to the outside of the border area. Security forces are moved from a position behind the border to a deployment directly along the border.

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<sup>17</sup> Netzer, Gideon; *A Generic Model for Cooperative Border Security*, SAND 98-0505/7, Sandia National Laboratories, Albuquerque, NM, March, 1999.

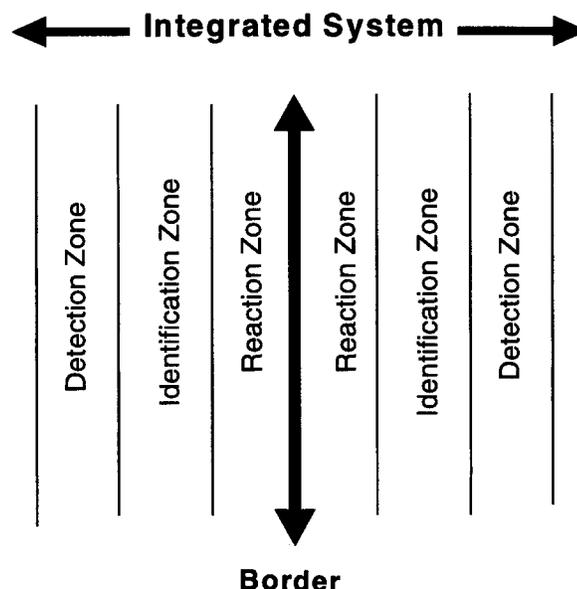


Figure 20. Model for Integrated Cooperative Border Monitoring System

- There would be collaborative procurement of logistic and monitoring equipment with costs shared by both countries.
- Maintenance of logistic and monitoring equipment would be integrated into a system of compatible maintenance centers in each country using NATO procedures as a model.
- A system for joint training for equipment maintenance personnel would be established.

## 5.0 Conclusions

Security in the Middle East contributes to global security. For decades, the absence of a comprehensive and just peace between the Arab nations and Israel has created a dangerous political atmosphere in the Middle East. Although not as publicized, inter-Arab tensions contribute significantly to instability. Jordan is a small country, but it occupies a key strategic location between four countries (Saudi Arabia, Iraq, Syria, and Israel) that have different political systems and ideologies. Jordan plays a vital stabilizing role in the region because of its geographical location and history of moderate policies.

Each of Jordan's borders has been a source of tension and has created foreign policy and security concerns at one time or another. Regional arms races and intrusions into Jordan's territory and airspace by other countries have imposed great pressure on Jordan to maintain stability and preserve its national security. It has been necessary for security forces to maintain a high state of alert and readiness for defense against external and internal threats. Since the signing of the peace treaty between Jordan and Israel in 1994, Israel no longer poses a military threat to Jordan. The focus of Jordanian national security interests has shifted towards preserving security on the borders to prevent terrorists, smugglers, and other intruders from destabilizing Jordan or using Jordanian territories to initiate activities against neighboring countries, including Israel. Jordan has adopted a moderate policy of protecting its borders against all kinds of illegal activities regardless of the perpetrators' political, economic, or military objectives.

States in the region have historically used unilateral measures for security, instead of seeking cooperative measures to achieve security on their borders and elsewhere. This paper proposes that neighboring states cooperate in border security with the goal of designing, implementing, and operating cooperative monitoring systems to achieve mutual border security. A cooperative border security system should be based on an integrated system of three monitoring zones around the border for detection, identification, and reaction. Ground surveillance equipment, unattended sensors, mobile patrols, and an integrated system for communication and reporting are used in the system. Communication is particularly important because cooperation is based on the exchange of information, and cooperation will build trust over time. As trust and confidence increase, cooperation can evolve from relatively low to quite high levels. Successful cooperation requires understanding each other's security concerns and political stability, creating unified plans for political and military cooperation, and exchanging information between partners.

The definition of security should be broadened to cover not only military factors, but also the political, economic, and human dimensions. For comprehensive security in the region, Jordan seeks broad cooperation and international help in introducing new technologies for cooperation. New military, political, and cultural mechanisms are needed to cope with problems of security now and in the future.

## **6.0 Recommendations**

The following recommendations are proposed for consideration in the short term to increase the security of Jordan's borders. They are grouped into organizational, technical, and operational categories, but the options for cooperation could be negotiated and implemented in any number or combination, depending on the political circumstances at the time.

### **6.1 Organizational Recommendations**

- Create a permanent committee, either bilateral or multilateral, for border security to investigate options and define an agenda to increase cooperation between Jordan and its neighbors. The committee would have representatives of the respective ministries of foreign affairs and defense, assisted by advisers that are designated by the respective authorities. This committee would meet twice a year to discuss all security issues, plan for the future, and strengthen institutional channels of communications.
- Create a military liaison system to increase bilateral communication and coordination of security activities and to provide a mechanism for ongoing consultations. Liaison officers could be based at the General Headquarters and local headquarters for monitoring major sections of the border. Liaison representatives of lower rank could be exchanged at unit levels (typically battalion).
- Propose bilateral studies to define the structure for an effective command and control organization between Jordan and each of its neighbors for the receipt, evaluation, and circulation of information relating to border security.
- Establish consultative groups between police, customs, and other government ministries involved with maintaining the effective function of the border.
- Develop joint training in law enforcement, human rights, and extradition of criminals.

- The United States remains a key stabilizing factor for security in the Middle East and Jordan. Jordan has strong relations with the U.S. In 1994, the United States was the second largest donor, totaling about 13% of donor funding. The current U.S. aid program in Jordan is directed at all threats to Jordan's stability. A key to overall security is effective control of Jordan's borders; therefore, the conversion of some U.S. aid from conventional military or other applications to obtaining border monitoring and control equipment could be considered.
- The illicit use of Jordan's territory as a transportation route influences many countries both in the region and adjacent areas such as Europe. Jordan could submit proposals for financial, technical, or training support to individual countries and regional organizations such as the Arab League, Gulf Cooperation Council, and the European Economic Community.

## **6.2 Technical Recommendations**

- Conduct field experiments in Jordan with various components of cooperative monitoring (sensors, communication equipment, etc.) to determine which ones operate most effectively under local conditions. Jordan might propose that its neighbors participate with proportional sharing of the cost of the monitoring experiment. Monitoring experiments provide a forum for collaborations among technical communities in neighboring countries, increase confidence, and produce results that can aid national leaders in the formulation of potential cooperative agreements.
- Improve communications in remote border areas through the installation of radio signal repeaters for communication.
- Propose cross-border communication between observation posts and patrols and develop a common encryption plan for communication (use a common frequency and compatible equipment).

## **6.3 Operational Topics and Confidence Building**

- While each country would maintain its own regulations, increase cooperation at official border crossing points by establishing direct communication links and a liaison presence, and by sharing monitoring and inspection technology.
- Negotiate protocols for cross-border pursuit, arrest, and joint punishment of intruders to fight terrorism and deter cross-boundary infiltration.
- Establish a regular schedule of military exercises and training and exchange this information in advance of operation. Provide pre-notification of military movements for redeployment.
- Share plans for restructuring and improving border security operations.
- Develop joint training exercises with neighboring border security forces.
- Exchange and coordinate operational plans for patrols.
- Define a common training strategy for border security operations with neighbors.
- Establish collaborative operational plans for medical first aid and evacuation of injured members of security forces.
- Coordinate placement of observation posts to cover the border more effectively.

## **About the Author**

**Mazen Qojas** is a Colonel in the Jordan Armed Forces. He holds two Bachelor of Arts degrees in Administration and Military Sciences from Mutah University in Jordan and Plojestan University in Pakistan. His military service includes commander of a Jordanian battalion in the United Nations Protection Forces in former Yugoslavia. Other positions have included work as an instructor at the Royal Command and Staff College at Mutah University and as chief of the Planning Branch for the Military Operations Directorate. In conjunction with his experience in international law, he has written on the subject of the conformity of international law with international peace operations. His research has included papers on the impact of the Gulf War on the local environment, on current threats against Jordan, on the application of preventive strategy against weapons of mass destruction, and on Jordan's participation in international peace operations.

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## **APPENDIX A: Treaty of Peace between the State of Israel and the Hashemite Kingdom of Jordan**

**NOTE: The treaty is not been printed in its entirety. The sections dealing with borders and security are included: other sections have been cut and appendices to the treaty have been excluded.**

October 26, 1994

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### **PREAMBLE**

The Government of the State of Israel and the Government of the Hashemite Kingdom of Jordan:

Bearing in mind the Washington Declaration, signed by them on 25th July, 1994, and which they are both committed to honour;

Aiming at the achievement of a just, lasting and comprehensive peace in the Middle East based on Security Council resolutions 242 and 338 in all their aspects;

Bearing in mind the importance of maintaining and strengthening peace based on freedom, equality, justice and respect for fundamental human rights, thereby overcoming psychological barriers and promoting human dignity;

Reaffirming their faith in the purposes and principles of the Charter of the United Nations and recognising their right and obligation to live in peace with each other as well as with all states, within secure and recognised boundaries;

Desiring to develop friendly relations and co-operation between them in accordance with the principles of international law governing international relations in time of peace;

Desiring as well to ensure lasting security for both their States and in particular to avoid threats and the use of force between them;

Bearing in mind that in their Washington Declaration of 25th July, 1994, they declared the termination of the state of belligerency between them;

Deciding to establish peace between them in accordance with this Treaty of Peace;

Have agreed as follows:

### **ARTICLE 1 ESTABLISHMENT OF PEACE**

Peace is hereby established between the State of Israel and the Hashemite Kingdom of Jordan (the "Parties") effective from the exchange of the instruments of ratification of this Treaty.

### **ARTICLE 2 GENERAL PRINCIPLES**

The Parties will apply between them the provisions of the Charter of the United Nations and the principles of international law governing relations among states in times of peace. In particular:

1. They recognise and will respect each other's sovereignty, territorial integrity and political independence;
2. They recognise and will respect each other's right to live in peace within secure and recognised boundaries;
3. They will develop good neighbourly relations of co-operation between them to ensure lasting security, will refrain from the threat or use of force against each other and will settle all disputes between them by peaceful means;

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4. They respect and recognise the sovereignty, territorial integrity and political independence of every state in the region;
5. They respect and recognise the pivotal role of human development and dignity in regional and bilateral relationships;
6. They further believe that within their control, involuntary movements of persons in such a way as to adversely prejudice the security of either Party should not be permitted.

### ARTICLE 3 INTERNATIONAL BOUNDARY

1. The international boundary between Israel and Jordan is delimited with reference to the boundary definition under the Mandate as is shown in Annex I (a), on the mapping materials attached thereto and co-ordinates specified therein.
2. The boundary, as set out in Annex I (a), is the permanent, secure and recognised international boundary between Israel and Jordan, without prejudice to the status of any territories that came under Israeli military government control in 1967.
3. The parties recognise the international boundary, as well as each other's territory, territorial waters and airspace, as inviolable, and will respect and comply with them.
4. The demarcation of the boundary will take place as set forth in Appendix (I) to Annex I and will be concluded not later than nine months after the signing of the Treaty.
5. It is agreed that where the boundary follows a river, in the event of natural changes in the course of the flow of the river as described in Annex I (a), the boundary shall follow the new course of the flow. In the event of any other changes the boundary shall not be affected unless otherwise agreed.
6. Immediately upon the exchange of the instruments of ratification of this Treaty, each Party will deploy on its side of the international boundary as defined in Annex I (a).
7. The Parties shall, upon the signature of the Treaty, enter into negotiations to conclude, within 9 months, an agreement on the delimitation of their maritime boundary in the Gulf of Aqaba.
8. Taking into account the special circumstances of the Naharayim/Baqura area, which is under Jordanian sovereignty, with Israeli private ownership rights, the Parties agreed to apply the provisions set out in Annex I (b).
9. With respect to the Zofar/Al-Ghamr area, the provisions set out in Annex I (c) will apply.

### ARTICLE 4 SECURITY

1.
  - a. Both Parties, acknowledging that mutual understanding and co-operation in security-related matters will form a significant part of their relations and will further enhance the security of the region, take upon themselves to base their security relations on mutual trust, advancement of joint interests and co-operation, and to aim towards a regional framework of partnership in peace.
  - b. Towards that goal the Parties recognise the achievements of the European Community and European Union in the development of the Conference on Security and Co-operation in Europe (CSCE) and commit themselves to the creation, in the Middle East, of a CSCME (Conference on Security and Co-operation in the Middle East). This commitment entails the adoption of regional models of security successfully implemented in the post World War era (along the lines of the Helsinki process) culminating in a regional zone of security and stability.
2. The obligations referred to in this Article are without prejudice to the inherent right of self-defence in accordance with the United Nations Charter.
3. The Parties undertake, in accordance with the provisions of this Article, the following:
  - a. to refrain from the threat or use of force or weapons, conventional, non-conventional or of any other kind, against each other, or of other actions or activities that adversely affect the security of the other Party;
  - b. to refrain from organising, instigating, inciting, assisting or participating in acts or threats of belligerency, hostility, subversion or violence against the other Party;
  - c. to take necessary and effective measures to ensure that acts or threats of belligerency, hostility, subversion or violence against the other Party do not originate from, and are not committed within, through or over their territory (hereinafter the term "territory" includes the airspace and territorial waters).

4. Consistent with the era of peace and with the efforts to build regional security and to avoid and prevent aggression and violence, the Parties further agree to refrain from the following:

a. joining or in any way assisting, promoting or co-operating with any coalition, organisation or alliance with a military or security character with a third party, the objectives or activities of which include launching aggression or other acts of military hostility against the other Party, in contravention of the provisions of the present Treaty.

b. allowing the entry, stationing and operating on their territory, or through it, of military forces, personnel or materiel of a third party, in circumstances which may adversely prejudice the security of the other Party.

5. Both Parties will take necessary and effective measures, and will co-operate in combating terrorism of all kinds. The Parties undertake:

a. to take necessary and effective measures to prevent acts of terrorism, subversion or violence from being carried out from their territory or through it and to take necessary and effective measures to combat such activities and all their perpetrators.

b. without prejudice to the basic rights of freedom of expression and association, to take necessary and effective measures to prevent the entry, presence and co-operation in their territory of any group or organisation, and their infrastructure, which threatens the security of the other Party by the use of or incitement to the use of, violent means.

c. to co-operate in preventing and combating cross-boundary infiltrations.

6. Any question as to the implementation of this Article will be dealt with through a mechanism of consultations which will include a liaison system, verification, supervision, and where necessary, other mechanisms, and higher level consultation. The details of the mechanism of consultations will be contained in an agreement to be concluded by the Parties within 3 months of the exchange of the instruments of ratification of this Treaty.

7. The Parties undertake to work as a matter of priority, and as soon as possible in the context of the Multilateral Working Group on Arms Control and Regional Security, and jointly, towards the following:

a. the creation in the Middle East of a region free from hostile alliances and coalitions;

b. the creation of a Middle East free from weapons of mass destruction, both conventional and non-conventional, in the context of a comprehensive, lasting and stable peace, characterised by the renunciation of the use of force, reconciliation and goodwill.

#### ARTICLE 5 DIPLOMATIC AND OTHER BILATERAL RELATIONS

1. The Parties agree to establish full diplomatic and consular relations and to exchange resident ambassadors within one month of the exchange of the instruments of ratification of this Treaty.

2. The Parties agree that the normal relationship between them will further include economic and cultural relations.

#### ARTICLE 6 addresses WATER PROBLEMS

#### ARTICLE 7 addresses ECONOMIC RELATIONS

#### ARTICLE 8 addresses REFUGEES AND DISPLACED PERSONS

#### ARTICLE 9 addresses PLACES OF HISTORICAL AND RELIGIOUS SIGNIFICANCE

#### ARTICLE 10 addresses CULTURAL AND SCIENTIFIC EXCHANGES

#### ARTICLE 11 addresses MUTUAL UNDERSTANDING AND GOOD NEIGHBOURLY RELATIONS

1. The Parties will seek to foster mutual understanding and tolerance based on shared historic values, and

#### ARTICLE 12 COMBATING CRIME AND DRUGS

The Parties will co-operate in combating crime, with an emphasis on smuggling, and will take all necessary measures to combat and prevent such activities as the production of, as well as the trafficking in illicit drugs, and will bring to trial perpetrators of such acts. In this regard, they take note of the understandings reached between

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them in the above spheres, in accordance with Annex III and undertake to conclude all relevant agreements not later than 9 months from the date of the exchange of the instruments of ratification of this Treaty.

ARTICLE 13 addresses TRANSPORTATION AND ROADS

ARTICLE 14 addresses FREEDOM OF NAVIGATION AND ACCESS TO PORTS

ARTICLE 15 addresses CIVIL AVIATION

ARTICLE 16 addresses POSTS AND TELECOMMUNICATIONS

ARTICLE 17 addresses TOURISM

ARTICLE 18 addresses ENVIRONMENT

ARTICLE 19 addresses ENERGY

ARTICLE 20 addresses RIFT VALLEY DEVELOPMENT

ARTICLE 21 addresses HEALTH

ARTICLE 22 addresses AGRICULTURE

ARTICLE 23 addresses AQABA AND EILAT

ARTICLE 24 addresses CLAIMS

ARTICLE 25 addresses RIGHTS AND OBLIGATIONS

ARTICLE 26 addresses LEGISLATION

ARTICLE 27 addresses RATIFICATION

ARTICLE 28 addresses INTERIM MEASURES

ARTICLE 29 SETTLEMENT OF DISPUTES

1. Disputes arising out of the application or interpretation of this Treaty shall be resolved by negotiations.
2. Any such disputes that cannot be settled by negotiations shall be resolved by conciliation or submitted to arbitration.

ARTICLE 30 REGISTRATION

This Treaty shall be transmitted to the Secretary General of the United Nations for registration in accordance with the provisions of Article 102 of the Charter of the United Nations.

Done at the Arava/Araba Crossing Point this day Heshvan 21st, 5775, Jumada Al-Ula 21st, 1415 which corresponds to 26th October, 1994 in the Hebrew, English and Arabic languages, all texts being equally authentic. In case of divergence of interpretation the English text shall prevail.

List of Annexes, Appendices and Other Attachments

\* Annex I:

- a. International Boundary
- b. Naharayim/Baqura Area
- c. Zofar Area

\* Annex II: Water (not included in this document)

- \* Annex III: Crime and Drugs
- \* Annex IV: Environment (not included in this document)
- \* Annex V: Interim Measures (not included in this document)
- \* Agreed Minutes (not included in this document)

## **Annex I to the Israel-Jordan Peace Treaty**

### **ISRAEL-JORDAN INTERNATIONAL BOUNDARY DELIMITATION AND DEMARCATION**

1. It is agreed that, in accordance with Article 3 of the Treaty, the international boundary between the two states consists of the following sectors:

- A. The Jordan and Yarmouk Rivers
- B. The Dead Sea
- C. The Emek Ha'arava/Wadi Araba
- D. The Gulf of Aqaba

2. The boundary is delimited as follows:

**A. Jordan and Yarmouk Rivers:**

1. The boundary line shall follow the middle of the main course of the flow of the Jordan and Yarmouk Rivers.
2. The boundary line shall follow natural changes (accretion or erosion) in the course of the rivers unless otherwise agreed. Artificial changes in or of the course of the rivers shall not affect the location of the boundary unless otherwise agreed. No artificial changes may be made except by agreement between both Parties.
3. In the event of a future sudden natural change in or of the course of the rivers (avulsion or cutting of new bed) the Joint Boundary Commission (Article 3 below) shall meet as soon as possible, to decide on necessary measures, which may include physical restoration of the prior location of the river course.
4. The boundary line in the two rivers is shown on the 1:10,000 orthophoto maps dated 1994 (Appendix III attached to this Annex).
5. Adjustment to the boundary line in any of the rivers due to natural changes (accretion or erosion) shall be carried out whenever it is deemed necessary by the Joint Boundary Commission or once every five years.
6. The lines defining the special Naharayim/Baqura area are shown on the 1:10,000 orthophoto map (Appendix IV attached to this Annex).
7. The orthophoto maps and image maps showing the line separating Jordan from the territory that came under Israeli Military government control in 1967 shall have that line indicated in a different presentation and the legend shall carry on it the following disclaimer: "This line is the administrative boundary between Jordan and the territory which came under Israeli military government control in 1967. Any treatment of this line shall be without prejudice to the status of the territory."

**B. Dead Sea and Salt Pans**

The boundary line is shown on the 1:50000 image maps (2 sheets, Appendix II attached to this Annex). The list of geographic and Universal Transverse Mercator (UTM) coordinates of this boundary line shall be based on Israel Jordan Boundary Datum (IJBD 1994) and, when completed and agreed upon by both parties, this list of coordinates shall be binding and take precedence over the maps as to the location of the boundary line in the Dead Sea and the salt pans.

**C. Emek Ha'arava/Wadi Araba**

1. The boundary line is shown on the 1:20,000 orthophoto maps (10 sheets, Appendix I attached to this Annex).
2. The land boundary shall be demarcated, under a joint boundary demarcation procedure, by boundary pillars which will be jointly located, erected, measured and documented on the basis of the boundary shown in the 1:20,000 orthophoto maps referred to in Article 2-C-(1) above. Between each two adjacent boundary pillars the boundary line shall follow a straight line.
3. The boundary pillars shall be defined in a list of geographic and UTM coordinates based on a joint boundary datum (IJBD 94) to be agreed upon by the Joint Team of Experts appointed by the two parties (hereinafter the JTE) using joint Global Positioning System (GPS) Measurements. The list of coordinates shall be prepared, signed and approved by both parties as soon as possible and not later than 9 months after this Treaty enters into force and shall become part of this Annex. This list of geographic and UTM coordinates when completed and agreed upon by both parties shall be binding and shall take precedence over the maps as to the location of the boundary line of this sector.
4. The boundary pillars shall be maintained by both Parties in accordance with a procedure to be agreed upon. The coordinates in article 2-C-(3) above shall be used to reconstruct boundary pillars in case they are damaged, destroyed or displaced.

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5. The line defining the Zofar/Al-Ghamr area is shown on the 1:20,000 Emek Ha'arava/Wadi Araba orthophoto map (Appendix V attached to the Annex).

### D. The Gulf of Aqaba

The parties shall act in accordance with Article 3.7 of the Treaty.

### 3. Joint Boundary Commission

A. For the purpose of the implementation of this annex, the Parties will establish a Joint Boundary Commission comprised of three members from each country.

B. The Commission will, with the approval of the respective governments, specify its work procedures, the frequency of its meetings, and the details of its scope of work. The Commission may invite experts and/or advisors as may be required.

C. The Commission may form, as it deems necessary, specialized teams or committees and assign to them technical tasks.

## ANNEX I (b) THE NAHRAYIM/BAQURA AREA

1. The two Parties agree that a special regime will apply to the Naharayim/Baqura area ("the area") on a temporary basis, as set out in this Annex. For the purpose of this Annex the area is detailed in Appendix IV.

2. Recognising that in the area which is under Jordan's sovereignty with Israeli private land ownership rights and property interests ("land owners") in the land comprising the area ("the land") Jordan undertakes:

a. to grant without charge unimpeded freedom of entry to, exit from land usage and movement within the area to the land-owners and to their invitees or employees and to allow the land-owners freely to dispose of their land in accordance with applicable Jordanian law;

b. not to apply its customs or immigration legislation to land-owners, their invitees or employees crossing from Israel directly to the area for the purpose of gaining access to the land for agricultural or any agreed purposes;

c. not to impose discriminatory taxes or charges with regard to the land or activities within the area;

d. to take all necessary measures to protect and prevent harassment of or harm to any person entering the area under this Annex;

e. to permit with the minimum of formality, uniformed officers of the Israeli police force access to the area for the purpose of investigating crime or dealing with other incidents solely involving the landowners, their invitees or employees.

3. Recognising Jordanian sovereignty over the area, Israel undertakes:

a. not to carry out or allow to be carried out in the area activities prejudicial to the peace or security of Jordan;

b. not to allow any person entering the area under this Annex (other than the uniformed officers referred to in paragraph 2(e) of this Annex) to carry weapons of any kind in the area; unless authorized by the licensing authorities in Jordan after being processed by the liaison committee referred to in Article 8 of this Annex.

c. not to allow the dumping of wastes from outside the area into the area.

4.

a. Subject to this Annex, Jordanian law will apply to this area.

b. Israeli law applying to the extra territorial activities of Israelis may be applied to Israelis and their activities in the area, and Israel may take measures in the area to enforce such laws.

c. Having regard to this Annex, Jordan will not apply its criminal laws to activities in the area which involve only Israeli nationals.

5. In the event of any joint projects to be agreed and developed by the parties in the area the terms of this Annex may be altered for the purpose of the joint project by agreement between the Parties at any time. One of the options to be discussed in the context of the joint projects would be the establishment of a Free- Trade Zone.

6. Without prejudice to private rights of ownership of land within the area, this Annex will remain in force for 25 years, and shall be renewed automatically for the same periods, unless one year prior notice of termination is given by either Party, in which case, at the request of either Party, consultations shall be entered into.

7. In addition to the requirement referred to in Article 4 (a) of this Annex, the acquisition of land in the area by persons who are not Israeli citizens shall take place only with the prior approval of Jordan.

8. An Israeli-Jordanian Liaison Committee is hereby established in order to deal with all matters arising under this Annex.

## ANNEX I (c) THE ZOFAR/AL-GHAMR AREA

1. The two Parties agree that a special regime will apply to the Zofar/Al-Ghamr area ("the area") on a temporary basis, as set out in this Annex. For the purpose of this Annex the area is in Appendix V.

2. Recognising that in the area which is under Jordan's sovereignty with Israeli private land use rights ("land owners") in the land comprising the area ("the land") Jordan undertakes:

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- a. to grant without charge unimpeded freedom of entry to, exit from land usage and movement within the area to the land-owners and to their invitees or employees and to allow the land-owners freely to dispose of their land in accordance with applicable Jordanian law;
  - b. not to apply its customs or immigration legislation to land-owners, their invitees or employees crossing from Israel directly to the area for the purpose of gaining access to the land for agricultural or any agreed purposes;
  - c. not to impose discriminatory taxes or charges with regard to the land or activities within the area;
  - d. to take all necessary measures to protect and prevent harassment of or harm to any person entering the area under this Annex;
  - e. to permit with the minimum of formality, uniformed officers of the Israeli police force access to the area for the purpose of investigating crime or dealing with other incidents solely involving the landowners, their invitees or employees.
3. Recognising Jordanian sovereignty over the area, Israel undertakes:
- a. not to carry out or allow to be carried out in the area activities prejudicial to the peace or security of Jordan;
  - b. not to allow any person entering the area under this Annex (other than the uniformed officers referred to in paragraph 2 (e) of this Annex) to carry weapons of any kind in the area; unless authorized by the licensing authorities in Jordan after being processed by the liaison committee referred to in Article 8 of this Annex.
  - c. not to allow the dumping of wastes from outside the area into the area.
- 4.
- a. Subject to this Annex, Jordanian law will apply to this area.
  - b. Israeli law applying to the extra territorial activities of Israel may be applied to Israelis and their activities in the area, and Israel may take measures in the area to enforce such laws.
  - c. Having regard to this Annex, Jordan will not apply its criminal laws to activities in the area which involve only Israeli nationals.
5. In the event of any joint projects to be agreed and developed by the parties in the area the terms of this Annex may be altered for the purpose of the joint project by agreement between the Parties at any time.
6. Without prejudice to private rights of use of land within the area, this Annex will remain in force for 25 years, and shall be renewed automatically for the same periods, unless one year prior notice of termination is given by either Party, in which case, at the request of either Party, consultations shall be entered into.
7. In addition to the requirement referred to in Article 4 (a) of this Annex, the acquisition of land in the area by persons who are not Israeli citizens shall take place only with the prior approval of Jordan.
8. An Israeli-Jordanian Liaison Committee is hereby established in order to deal with all matters arising under this Annex.

## Annex III to the Israel-Jordan Peace Treaty

### COMBATTING CRIME AND DRUGS

#### A. Co-operation on Combating Dangerous Drugs

1. The two Parties shall co-operate in fighting illicit drugs according to the legal system of their countries.
2. The two Parties shall take all necessary measures to prevent drug smuggling between the two countries.
3. The two Parties shall exchange information regarding drug trafficking and dealers' activities concerning the two countries.
4. Information given by one of the Parties may not be shared with a third party without the consent of the Party which provided the information.
5. The two Parties shall exchange and share the experience of fighting against drugs, including anti-drug education, prevention, treatment, rehabilitation programs, technical means and methods of concealment.
6. In order to identify the persons involved in drug activities, the two Parties shall facilitate controlled deliveries of drugs between the two countries according to their laws.
7. Drug law enforcement officers from both sides shall meet periodically to coordinate efforts pertaining to drug problems concerning the two countries.
8. The two Parties shall maintain open channels of communication such as fax, telephone and telex for liaison purposes in drug matters concerning the two countries.
9. The two Parties shall cooperate with the multilateral forums which deal with drug issues in the area.
10. The two Parties shall cooperate in investigating procedures necessary for collecting evidence and indictment in cases against drug dealers which concern either or both countries.
11. The two Parties shall exchange information regarding statistics on the type and number of drug crimes committed in each country including detailed information regarding suspected and convicted persons involved in these cases.
12. The two Parties shall exchange all relevant information regarding the narcotic drug producing laboratories if revealed in either of the two countries, including structure, working methods and technical features of the laboratory as well as the type and trademark of the product.
13. The cooperation described in this document will be carried out in accordance with the legal system of the two countries.

#### B. Crime

## *Cooperative Border Security for Jordan: Assessment and Options*

Exchange of information concerning all aspects of smuggling, theft (including art objects, vehicles, national treasures, antiquities and documents), etc. Apprehension of criminals and exchange of information including transmission of evidence in order to carry out judicial procedures in each of the two countries, subject to the relevant treaties and regulations.

### General Cooperation

- Exchange of information regarding technical matters.
- Exchange of information regarding training and research.
- Joint police research projects on topics of mutual interest to both countries.

### Additional Issues

- Rescue.
- Unintentional border crossing, fugitives from justice.
- Notification of detention of nationals of the other country.
- Establishment of a liaison mechanism between the sides.

### C. Cooperation on Forensic Science

1. The two Parties shall cooperate on the subjects of criminal identification and forensic science.
2. The two Parties shall share and exchange professional experience and training programmes, inter alia:
  - a. Use of field kits for preliminary examinations
  - b. Analysis of illicit drugs.
  - c. Analysis of poisons and toxic materials.
  - d. Forensic biology and DNA examinations.
  - e. Toolmarks and materials examinations.
  - f. Questionable documents examinations.
  - g. Analysis of voice prints.
  - h. Analysis of fire arms.
  - i. Detection of latent fingerprints.
  - j. Analysis of explosive traces.
  - k. Examination for arson in laboratories.
  - l. Identification of victims in mass disasters.
  - m. Research and development in forensic science.

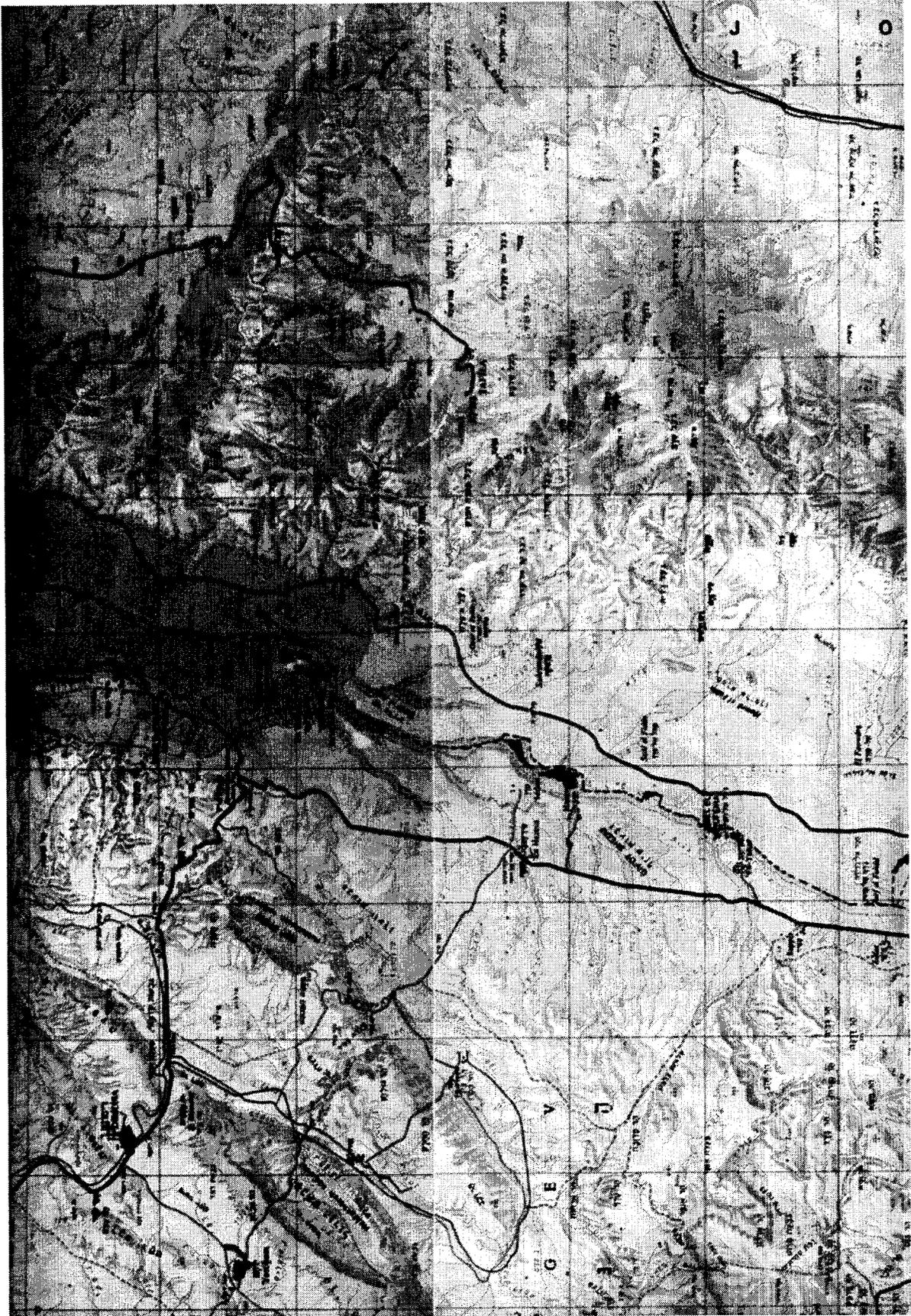
## **Official Map of the Jordan-Israel Border**

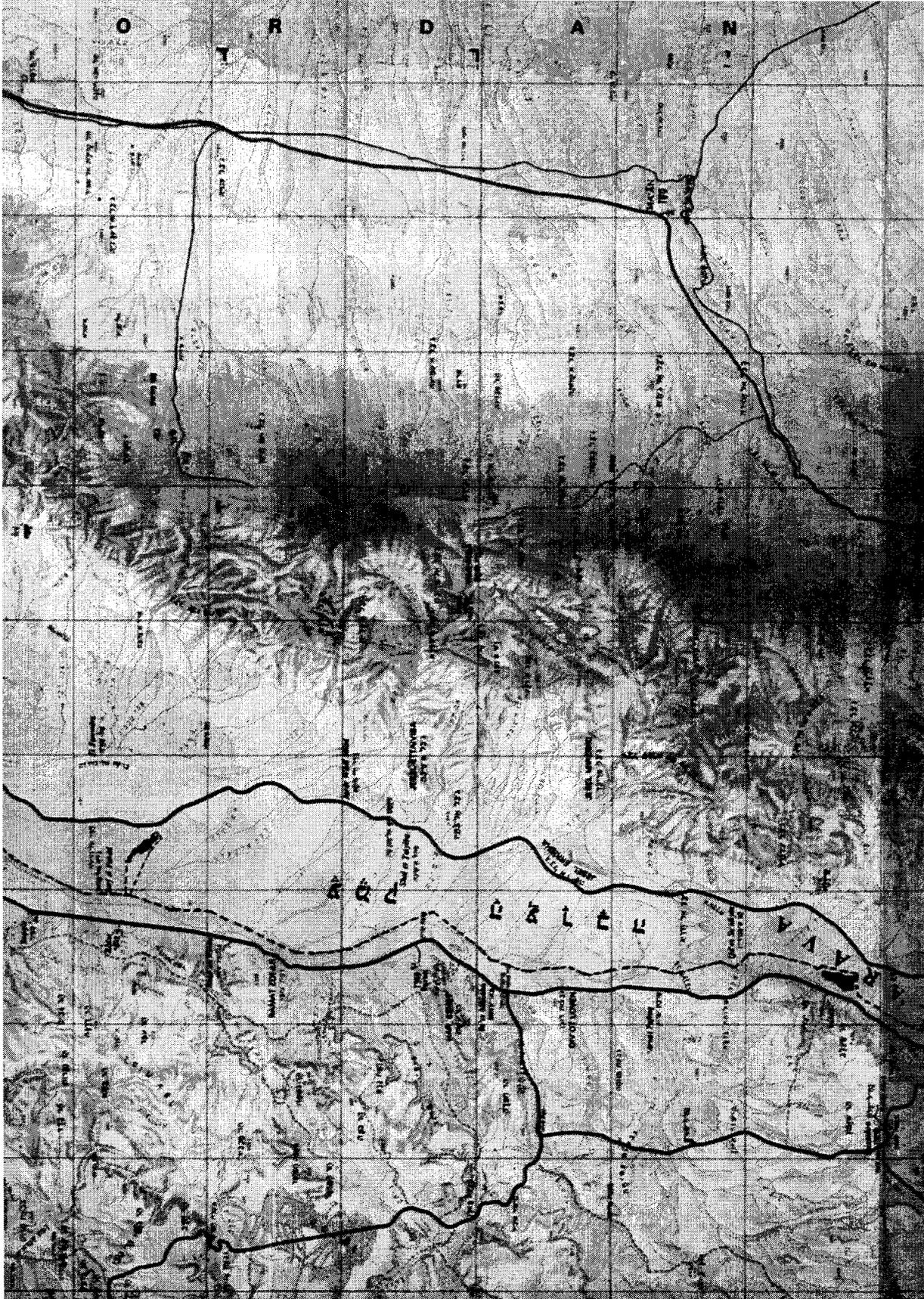
The official map of the Jordan-Israel border follows, divided into six sections.

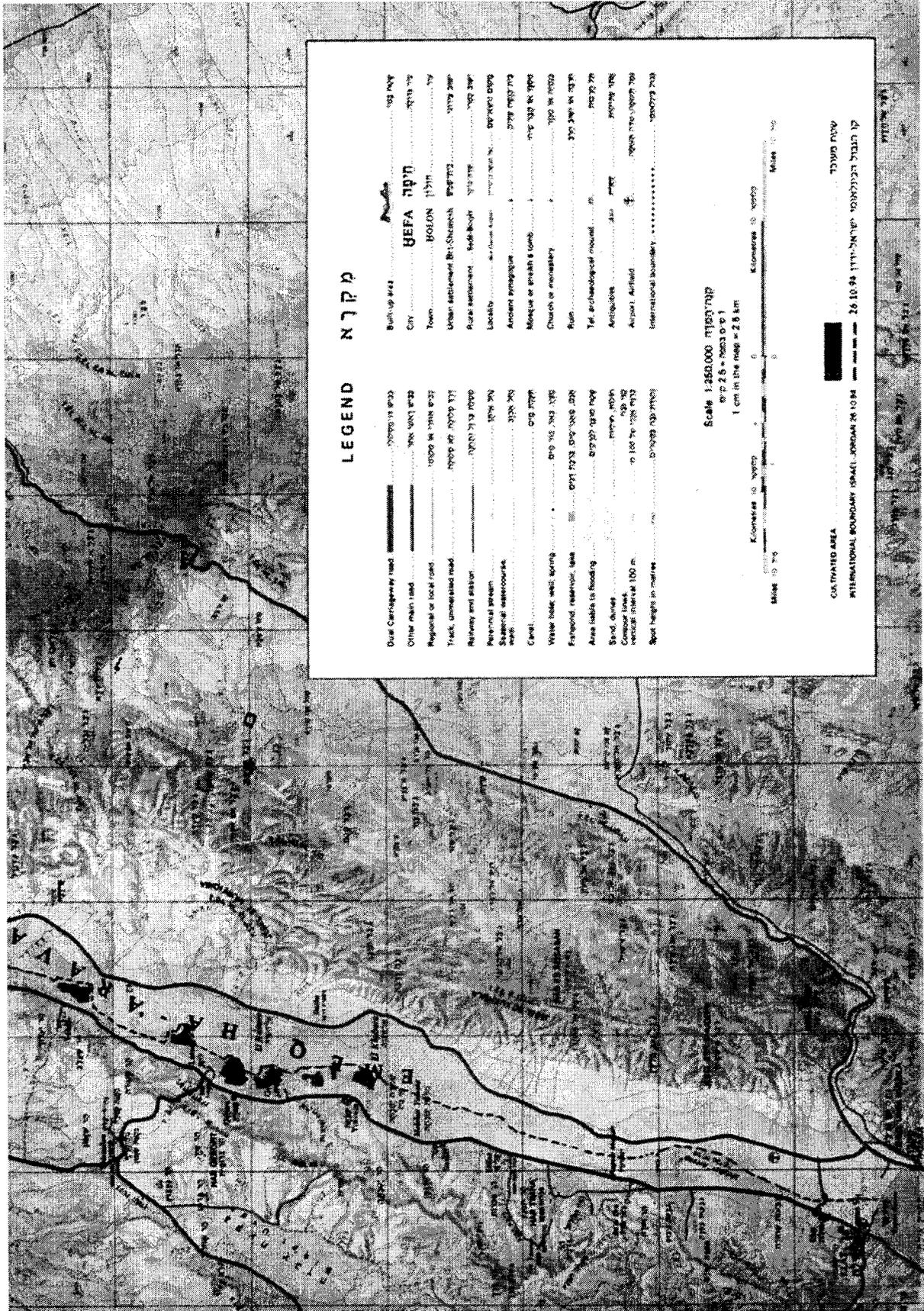












## **APPENDIX B: Potential Technologies for a Cooperative Monitoring System**

A variety of sensor technologies can be used in cooperative monitoring systems. This appendix provides a brief functional description of sensors that were considered for border monitoring. There are multiple manufacturers for most types of sensors and this section is not intended to endorse a particular brand. Different models of the same type of sensor may have different features and capabilities.

Sensors of different types may be combined into a system that performs a specific function. For example, road traffic might be monitored by a combination of different types of sensors that detects and counts vehicles as well as measures certain parameters such as weight. Alarms and descriptions of vehicles that do not meet the monitoring criterion need not be transmitted. The system design might seek to detect vehicles that try to bypass the system by leaving the road.

### **B-1 Unattended Ground Sensors**

Unattended sensors operate without routine human intervention. Their primary purpose is to detect activity in the area they monitor. A secondary purpose is to measure characteristics of the activity (e.g., weight, magnetic properties, length, etc.) to permit identification. Sensors are powered by batteries or, if available, direct AC electric power. A number of sensors using detection and measurement phenomenologies are available commercially. A system may be assembled using sensors with different detection phenomenologies. Each sensor is assigned an identification number. When activity occurs, a sensor transmits its identification code by radio as a short digital burst. An operator at the reception station notes the identification number and cross-references to a location. Receiving stations may vary from hand-held units (costing \$550 to \$1,300) to permanent monitoring stations. A large number of sensors typically require a computer to display sensor status on a map.

#### **B-1.1 Fence Type**

The *taut-wire fence sensor* uses the physical property that a steel wire will act as a spring. High-tensile strength wires, usually barbed, are strung horizontally between posts and placed under tension. Each wire is connected to a sensor located in a post mid-way along the wires. Attempting to climb over the fence or to spread the wires activates the sensors and causes an alarm. Cutting the wire also activates the sensor. The taut-wire fence has a very low false-alarm rate and is not generally affected by weather.

There are several different manufacturers of taut-wire sensors. The principle of operation is the same for all systems although various models use mechanical switches, piezo-electric devices, and strain gauges. A taut-wire fence is relatively expensive (approximately \$154,000 per kilometer when installed) and is thus primarily applicable to zones or facilities that are to be monitored intensely.

An alternative type of fence sensor uses fiber optic cables to detect intrusions. The fiber optic cables are woven through a new or existing chain-link fence. An optical

communication unit continually transmits a coded signal through the cable. Disruptions to the signal caused by cutting or movement generate changes in the light pattern that are detected by a receiver. The cost of this type of system, including the fence, is about \$60,000 per kilometer.

**Comments on use:**

Fence sensors provide both a physical barrier and a detection sensor. The system should be designed to detect attempts to penetrate the fence by digging under it. Activations provide location information based on the sector of the fence. The smaller the sectors, the more precise the location information. Taut-wire fence sensors are highly reliable and have a low rate of false alarms. Fiber-optic fence sensors are somewhat more likely to generate false alarms than the taut-wire system but can be installed in more rugged terrain. Both systems typically use AC power but could be converted to battery systems.

***B-1.2 Microwave Type***

Microwave sensor technology has been used for 20 years in a variety of security protection applications. An antenna continually broadcasts microwave energy. A receiver measures the reflected microwave energy to obtain a reference level of signal strength. Intruders entering the zone cause a change in the strength of the reflected signal and generate an alarm. Microwave sensors are classified as either monostatic or bistatic, depending on the configuration of the antennas. Bistatic models have separate transmit and receive antennas located at opposite ends of the detection zone. Monostatic models have the transmission and receiver antennas located together in a single housing. Some systems can be portable and powered by batteries. Many models are available and a unit costs in the range of \$3,000 to \$5,000.

Monostatic and bistatic microwave sensors both transmit in the X (10.525 Ghz) frequency band or K (24 Ghz) frequency band, but bistatic systems generally have longer range. The detection zone is adjustable by the operator. Monostatic systems have a cone shape and can be set from 20 m to 125 m in length with a width of 1 m to 8 m. Bistatic systems have an oval detection zone up to 500 m long and 6 to 12 m wide. When the microwave sensor unit is carefully positioned, the detection zone can follow moderate undulations in the local terrain.

**Comments on use:**

Microwave sensors are most effective in open areas. Special consideration must be given to screening false alarms. Movements of animals and vegetation moved by wind can cause false alarms. Thresholds for detection can be set to counter this problem. Rain and snow can reduce operational ranges. Because of their operational characteristics, an intruder could conceivably jam these sensors using electrical transmission equipment.

***B-1.3 Active Infrared Type***

Infrared break-beam sensors detect changes in the signal power of an infrared beam created between a transmitter and a receiver (referred to as an “active system”). These systems require an unobstructed optical path. When an intruder breaks the beam

(not visible to the human eye), the signal strength at the receiver lens is reduced, generating an alarm. The technology has been used around buildings for security purposes for about 25 years. They can also be employed along roads, paths, or waterways that provide routes of approach into secure areas.

The typical separation of the transmitter and receiver is about 100 m but new systems can have a line-of-sight separation as far apart as 150 m. The simplest version of a break-beam system consists of a single pair of sensors mounted on tripods. A pair of sensors costs approximately \$500 (not including the communication equipment). Such a system can be portable. Tiny, highly portable systems with more limited range (about 30 m) can be used for temporary applications.

A more complex system of multiple transmitters and receivers can be installed on poles at each end of the detection zone. The detection zone thus becomes a vertical plane and can measure the profile of an object passing through it. If parallel sets of break beams are used, the system can determine if an object is greater than a specified length as well as its direction of travel.

**Comments on use:**

Fog, rain, and dust reduce the strength of the infrared beam between transmitter and receiver. Blowing vegetation or any objects that break the beam can cause false alarms. False alarms can be reduced by the use of multiple beam system that requires a specific number of beams to be broken in order to report an intrusion.

***B-1.4 Passive Infrared Type***

Passive infrared detectors measure the background level of infrared radiation being reflected in its field of view. The entry of an intruder changes the strength of the reflected energy because people and vehicles are warmer than the background. A sudden change in background causes an alarm to be transmitted. Nominal detection range is 30 m for people and 50 m for vehicles. A small, portable, battery-powered sensor of Mini Intrusion Detection System (MIDS) costs about \$500, including its radio transmitter.

**Comments on use:**

The sun can cause false alarms during dawn and sunset. Hot summer weather can cause some objects to radiate infrared energy longer than others, causing a “hot spot” in the sensor’s field of view and a false alarm. The sensor can be tuned to reduce false alarms resulting from natural activity. The sensor needs to be carefully placed to avoid looking directly at the sun during dawn or sunset.

***B-1.5 Pressure (Weight) Type***

In well-defined locations such as roads and paths, vehicles passing a point can be detected using a weigh-in-motion system (WIM). A WIM system consists of two magnetic sensors and a capacitance-type sensor. The system can be calibrated to report only vehicles weighing greater than a specified weight and thus screen extraneous information. WIM systems cost approximately \$25,000.

An alternative pressure sensor uses a buried fiber-optic cable. Heavy objects passing over the cable cause it to deflect and change the path of light passing through it. An alarm is reported if the cable is deflected above some threshold. This sensor does not measure the weight of the system as the above system does. The fiber optic cables can be hundreds of meters long but only report that a disturbance has occurred within one of its defined sectors. Smaller segments should be used if more precise location information is sought.

**Comments on use:**

These sensors are used most effectively across roads or paths. These sensors can require significant installation effort and are not suitable for rapid or temporary installation. In open country, rocky areas may prevent their use.

***B-1.6 Seismic Type***

The Mini Intrusion Detection System (MIDS) is representative of commercially available seismic sensors (\$400-500 cost with transmitter). Figure B-1 shows the MIDS sensors. The sensors can operate for two to three months from a common 9-volt battery, depending on the level of activity in the area being monitored. An external weatherproof battery pack assembly can replace the internal battery and extend the operational life by a factor of 10. An antenna is normally attached to the sensors to provide line-of-sight radio communication (138-MHz to 153-MHz band) up to 800 m. Radio signal repeaters (approximately \$1,200) can greatly increase this range.



*Figure B-1. MIDS Sensors*

The nominal detection range is 10 to 30 m for people walking and 100 to 300 m for vehicles. Vibrations can travel extended distances, but the sensor detection range is limited by the ability of the soil at the local site to transmit them. Dry, hard, sandy soil typically provides the longest detection ranges. Wet soil or soil with a high proportion of chalk absorbs vibrations, reducing the detection range. Limitations in the detection range can be overcome by careful placement or by using large numbers of sensors.

**Comments on use:**

Seismic sensors are unable to distinguish between vibrations originated by extraneous sources from those caused by intruders. High false alarm rates caused by

extraneous seismic vibrations may prevent their effective use. Common causes of false alarms are small earthquakes, vibrations caused by low-flying aircraft or bushes blown by the wind, heavy rain or hail, and rapidly flowing water. The frequency of such false alarms may be reduced by sensitivity adjustments. Seismic sensors are useful for detecting tunneling activities.

An intruder could conceivably jam radio transmissions from sensors with another transmitter. A “state of health” radio beacon can be positioned among the sensors to indicate if signals are being jammed. This transmitter broadcasts every 10 minutes to verify that the system is operating and is not being jammed.

### ***B-1.7 Magnetic Type***

These sensors detect the movement of ferrous metal at very limited ranges. The Mini Intrusion Detection System (MIDS) magnetic sensor has a nominal detection range of 3 m for a person with a rifle and 20 m for a medium-sized truck. The cost is about \$500 with transmitter. These devices can be effectively employed against vehicles, and they serve as confirmatory devices to other unattended ground sensors.

#### **Comments on use:**

There is no analytical system to estimate detection ranges from the sensor as a function of ferrous mass. A sensor cannot distinguish between a small ferrous mass at a short range and a large mass at a long range. Placement in the field typically requires experimentation. Magnetic sensors tend to have high false alarm rates during electrical storms. Sensitivity can be adjusted in most sensors.

### ***B-1.8 Disturbance Type***

Disturbance devices require a physical interaction or contact with the intruder. Employment should be along roads, paths, or other avenues of approach. A break-wire detector consists of a fine wire that is stretched across a potential path for intruders. When the wire is broken, an alarm is transmitted by radio. The length is selected to match local conditions. The devices are often used with other sensors.

#### **Comments on use:**

Break-wire sensors can only report once and must be restrung after their report to be used again. Thus they should only be used in areas with infrequent traffic.

### ***B-1.9 Video Cameras***

Video cameras are used primarily in combination with other sensors to determine the cause of alarms and to document events. They may also be used as part of a video motion detection system that detects changes within its field of view. When operating in an assessment mode, an interface unit interprets signals from a detection sensor, determines if an alarm condition exists, and instructs the video camera to operate. The camera takes still video images that it transmits to a remote receiving station. The receiver station displays the alarm information and provides the operator interface to the system.

Many commercial models of cameras are available at a cost between \$100 and \$3,000. A motion detection unit with adjustable sensitivity, if added, costs about \$500. A typical capability under low-light conditions is .07 lux (defined as the intensity of one candle at a distance of 1 meter). Most cameras have an automatic iris control to adjust to changing light conditions. Rugged containers permit operation in adverse climates. Extreme cold may require a heater and blower to warm circuitry and prevent condensation.

## **B-2 Attended Ground Sensors**

These sensors require a human operator. This is usually because human vision is part of the sensor operation. Examples of attended sensors in order of increasing complexity are binoculars, night vision devices, thermal imagers and ground surveillance radars.

### ***B-2.1 Light Intensification Devices***

These devices electronically amplify ambient light in order to produce an image that the human operator can recognize. Devices that might be commercially available have detection ranges for a person of 0.4 to 1 km. Vehicles could be detected at ranges of 2 to 3 km. Commercially available devices are available in the range from \$1,400 to \$10,000. All night vision devices require an unobstructed line of sight. They are made temporarily inoperable by direct bright light sources.

### ***B-2.2 Thermal Imagers***

These use the infrared radiation emitted by targets for night operation. Detection ranges of up to 10 km against vehicle targets are reported. These devices cost from \$5,000 up to several tens of thousands of dollars.

### ***B-2.3 Ground Surveillance Radars***

These radars detect the motion of humans or vehicles. Ten-to fifteen-km ranges against humans and 20+ km ranges against vehicles have been claimed. Long-range ground surveillance radars cost several tens of thousands of dollars.

General operational degradation due to inclement weather averages about 25 percent in range. Placement on elevated platforms or terrain features will increase the line of sight. Rough terrain and forest growth increase radar masking. Radar is most effective in open, smooth terrain.

### ***B-2.4 Aerial Sensors***

Sensors mounted on aircraft can monitor large expanses or border territory relatively quickly and can achieve a much higher resolution than is currently available from commercial satellites. In addition, aircraft are not limited to fixed revisit times, as are satellites. Aircraft could be dispatched at random intervals to deter evasion attempts or could be used at times when other information indicates that border crossing attempts are likely.

The Open Skies Treaty provides an example of the type of monitoring system that might be used. The treaty was originally intended to provide transparency in significant military activities and build confidence between the North Atlantic Treaty Organization (NATO) and the Warsaw Pact countries. Negotiations continued after the Warsaw Pact disbanded, and the treaty was opened to the new republics and non-NATO members. The four types of permitted Open Skies sensors and their associated resolutions are listed in Table B-1. It should be noted that better resolution is physically possible, but the resolutions shown here are the result of treaty negotiations.

**Table B-1. Open Skies Treaty Aircraft-Mounted Sensors**

<b>Sensor Type</b>	<b>Spatial Resolution</b>
Optical Camera	30 cm
Video Camera	30 cm
Infrared Line Scanner	50 cm
Synthetic Aperture Radar	3 m

### **B-2.5 Optical and Video Cameras**

Large-format aerial cameras are commonly used for mapping purposes. A typical camera uses a film width of 24 cm with a film length of 120 m. A useful image area of 23 by 23 cm per frame results in 420 high-resolution images per roll. Images can be acquired at three-second intervals during flight, which permits overlapping coverage of the ground with aircraft speeds of 460 km/hr or slower at 300 m or greater altitude. Cameras are capable of shutter speeds of up to 1/10,000 of a second that produces clear images. High-resolution color video cameras can be used in daylight recording operations.

### **B-2.6 Infrared Line Scanner**

Infrared Line Scanner (IRLS) is a passive thermal infrared sensor that is especially useful for nighttime assessment of heat-generating objects. Operating much like a video camera, the imager is sensitive to only thermal infrared energy. Its lens usually permits the user to select one of several levels of magnification. Data acquired are recorded with a high-resolution video recorder using the 8mm format, which captures higher frequencies and bandwidths than the conventional VHS format.

### **B-2.7 Synthetic Aperture Radar**

Synthetic Aperture Radar (SAR) is imaging radar that forms images by transmitting electromagnetic energy and sensing the echoes of the reflected energy from the ground target area. This system produces high-resolution, two-dimensional images, similar in some ways to a photograph. The SAR gathers target echoes at many points along the aircraft's flight path and stores them in a digital form. The system's digital signal processor performs range and azimuth processing to create an image. The SAR can produce images during day or night operation and under adverse weather conditions, including heavy cloud cover and precipitation. As a result, radar images can be acquired when conventional photographic and video systems cannot be used.

### **B-2.8 Sensor Resolution**

The resolution of an imaging sensor defines the smallest items detectable and refers to the size of the picture elements that comprise the image. Table B-2 shows resolution requirements in meters for a few typical targets. Note that identification of a target requires must higher resolution than just detection

**Table B-2. Typical Requirements for Resolution (in meters)**

<b>Target</b>	<b>Detection</b>	<b>General ID</b>	<b>Precise ID</b>	<b>Description</b>	<b>Tech. Analysis</b>
Aircraft	4.5	1.5	1.0	0.15	0.045
Surface ships	7.5-15.0	4.5	0.6	0.3	0.045
Vehicles	1.5	0.6	0.3	0.06	0.045

### **B-2.9 Commercial Satellite Imagery**

Commercial satellites provide wide-area monitoring and can detect construction or changes in roads, large buildings or facilities, and vegetation patterns caused by human activity. Images can be digitally processed by commercial software for analysis of features. Combining different spectral bands permits viewing of the image in false color. For example, the near-infrared spectrum shows healthy vegetation as red. Currently, images with resolutions ranging from 2 m to 30 m are available. Digital images with resolution to 1 m are scheduled to be available beginning in 1999. Cost per image varies from \$2,000 to \$5,000.

Although useful for some monitoring applications, commercial satellite images do not have enough resolution to identify the subjects of border monitoring. While 1 to 2 m resolution imagery can detect vehicles, it is not enough to identify them with precision. People and animals require even better resolution. In addition, the images are not timely enough for use in border monitoring. Acquisition of images currently takes weeks. Planned improvements may shorten the acquisition process to a few days or less. In addition, all satellites are limited by the time required to repeat the image of the same location (revisit time). This can range from 12 hours to several days.

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