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REPORT AND RECOMMENDATIONS MADE BY THE PANEL OF COMMISSIONERS CONCERNING PART TWO OF THE FOURTH INSTALMENT OF "F4" CLAIMS

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Introduction

1. The Governing Council of the United Nations Compensation Commission (the "Commission"), at its thirtieth session held from 14 to 16 December 1998, appointed the "F4" Panel of Commissioners (the "Panel"), composed of Messrs. Thomas A. Mensah (Chairman), José R. Allen and Peter H. Sand to review claims for direct environmental damage and depletion of natural resources resulting from Iraq's invasion and occupation of Kuwait.

2. The fourth instalment of "F4" claims (the "fourth 'F4' instalment") consists of nine claims: three by the Government of the State of Kuwait ("Kuwait"); two by the Government of the Kingdom of Saudi Arabia ("Saudi Arabia"); one by the Government of the Islamic Republic of Iran ("Iran"); one by the Government of the Hashemite Kingdom of Jordan ("Jordan"); one by the Government of the Syrian Arab Republic ("Syria"); and one by the Government of the Republic of Turkey ("Turkey") (collectively the "Claimants").

3. This is part two of the report of the Panel concerning the fourth "F4" instalment. It contains the recommendations of the Panel on claim No. 5000454 of Kuwait in the fourth "F4" instalment, and is submitted to the Governing Council pursuant to article 38(e) of the Provisional Rules for Claims Procedure (the "Rules") (S/AC.26/1992/10). The Panel prepared a separate report on claim No. 5000454 so as to comply with the provisions of Governing Council decision 114 (S/AC.26/Dec.114 (2000)). Decision 114 stipulates that the panels of Commissioners shall prepare a separate report on each claim with a recommended value of 1 billion United States dollars (USD) or more.[1]

4. The Panel's recommendations concerning the other claims in the fourth "F4" instalment are presented in the "Report and recommendations made by the Panel of Commissioners concerning part one of the fourth instalment of 'F4' claims" (S/AC.26/2004/R.39).

5. Claim No. 5000454 was submitted to the Panel in accordance with article 32 of the Rules on 28 March 2003.

6. A portion of claim No. 5000454 had been transferred from claim No. 5000450, which was reviewed in the third instalment of "F4" claims (the "third 'F4' instalment"). By Procedural Order No. 6 of the third "F4" instalment, dated 9 July 2003, the Panel deferred the portion of claim No. 5000450 of Kuwait relating to the remediation and revegetation of raised roads contaminated by oil and the revegetation of areas affected by oil lakes and oil trenches to claim No. 5000454 to be reviewed in the fourth "F4" instalment.

7. The total compensation sought by Kuwait in claim No. 5000454, with amendments, is USD 6,799,491,526.[2] This amount has been corrected, where necessary, for computational errors.

I. OVERVIEW OF CLAIM NO. 5000454

8. Claim No. 5000454 is for expenses of measures already taken or to be undertaken to clean and restore environment alleged to have been damaged as a result of Iraq's invasion and occupation of

Kuwait. Kuwait seeks compensation for expenses of cleaning and restoration measures already taken or to be undertaken by it to remediate damage caused by:

(a) Oil released from damaged oil wells;

(b) Oil released from pipelines;

(c) Oil trenches and pipelines constructed by Iraqi forces; and

(d) Mines and other remnants of war.

II. PROCEDURAL HISTORY

A. Article 16 reports

9. Significant factual and legal issues raised by claim No. 5000454 were included in the Executive Secretary's thirty-sixth report, dated 10 July 2001 and thirty-seventh report, dated 18 October 2001, issued pursuant to article 16 of the Rules. These reports were circulated to the members of the Governing Council, to Governments that have filed claims with the Commission and to the Government of the Republic of Iraq ("Iraq"). In accordance with article 16(3) of the Rules, a number of Governments, including Iraq, submitted information and views in response to these reports.

B. Article 34 notifications

10. Pursuant to article 34 of the Rules, notifications were sent to Kuwait requesting additional information and documentation to assist the Panel in its review of claim No. 5000454.

C. Classification of claims and transmittal of claim files

11. On 12 September 2002, the Panel issued Procedural Order No. 1 of the fourth "F4" instalment, classifying the claims in the fourth "F4" instalment as "unusually large or complex", within the meaning of article 38(d) of the Rules. Procedural Order No. 1 directed the secretariat to send to Iraq copies of the claim files, comprising the claim form, the statement of claim and related exhibits, for each of the claims in the fourth "F4" instalment, including for claim No. 5000454. The secretariat transmitted copies of the claim files to Iraq. The secretariat also transmitted copies of Procedural Order No. 1 to Iraq and the Claimants.

12. The claim files for claim No. 5000450, referred to in paragraph 6, were also sent to Iraq pursuant to Procedural Order No. 1 of the third "F4" instalment, dated 30 July 2001.

13. The Commission received written comments from Iraq on the claims in the fourth "F4" instalment, including claim No. 5000454, on 9 February, 29 March and 17 May 2004.

14. Pursuant to Governing Council decision 35(c) (S/AC.26/Dec.35 (1995)), the Panel determined that it would not be able to complete its review of the fourth "F4" instalment within the 12-month

period specified in article 38(d) of the Rules and advised the Executive Secretary of the Commission accordingly. The Executive Secretary advised the Governing Council of the Panel's determination.

D. Monitoring and assessment data

15. On 13 September 2002, the Panel decided that monitoring and assessment data submitted by the Claimants, including data submitted by Kuwait in respect of claim No. 5000454, should be made available to Iraq.[3] This decision was intended to further one of the objectives of Governing Council decision 124 (S/AC.26/Dec.124(2001)), namely "assisting the 'F4' Panel of Commissioners in the conduct of its tasks, through ensuring the full development of the facts and relevant technical issues, and in obtaining the full range of views including those of Iraq."[4]

16. On 27 January 2003, the Panel issued Procedural Order No. 2 of the fourth "F4" instalment by which it requested Kuwait to identify previously submitted monitoring and assessment data and to provide any other monitoring and assessment data that it considered to be relevant to its claims in the fourth "F4" instalment. Kuwait submitted monitoring and assessment data pursuant to this procedural order.

17. In accordance with the decision of the Panel to transmit monitoring and assessment data to Iraq, the data referred to in paragraph 16 were transmitted to Iraq.

E. Oral proceedings

18. On 27 February 2004, the Panel issued Procedural Order No. 3 of the fourth "F4"instalment by which it informed the Claimants and Iraq that oral proceedings on the fourth "F4" instalment would be held on 27 and 28 April 2004. The procedural order stated, inter alia, that within the time allotted to them during the oral proceedings, the Claimants and Iraq could raise any legal, factual and scientific issues related to the claims in the fourth "F4" instalment on which they wished to elaborate further. Procedural Order No. 3 requested the Claimants and Iraq to submit to the Commission the issues which they intended to address during the oral proceedings. The Panel reviewed the issues submitted and a list of the issues approved by the Panel was communicated to Iraq and the Claimants.

19. Oral proceedings were held at the Palais des Nations in Geneva on 27 and 28 April 2004. Representatives and experts of Iraq and Kuwait attended the oral proceedings and presented their views on, inter alia, claim No. 5000454.

III. LEGAL FRAMEWORK

A. Mandate of the Panel

20. The mandate of the Panel is to review the "F4" claims and, where appropriate, recommend compensation.

21. In discharging its mandate, the Panel has borne in mind the observations of the Secretary-General of the United Nations, in his report to the Security Council of 2 May 1991, that:

> "The Commission is not a court or an arbitral tribunal before which the parties appear; it is a political organ that performs an essentially fact-finding function of examining claims, verifying their validity, evaluating losses, assessing payments and resolving disputed claims. It is only in this last respect that a quasi-judicial function may be involved. Given the nature of the Commission, it is all the more important that some element of due process be built into the procedure. It will be the function of the commissioners to provide this element."[5]

B. Applicable law

22. Article 31 of the Rules sets out the applicable law for the review of claims, as follows:

> "In considering the claims, Commissioners will apply Security Council resolution 687 (1991) and other relevant Security Council resolutions, the criteria established by the Governing Council for particular categories of claims, and any pertinent decisions of the Governing Council. In addition, where necessary, Commissioners shall apply other relevant rules of international law."

23. Paragraph 16 of Security Council resolution 687 (1991) reaffirms that Iraq is "liable under international law for any direct loss, damage, including environmental damage and the depletion of natural resources, or injury to foreign Governments, nationals and corporations, as a result of Iraq's unlawful invasion and occupation of Kuwait".

C. Compensable losses or expenses

24. Governing Council decision 7 (S/AC.26/1991/Rev. 1) provides guidance regarding the losses or expenses that may be considered as "direct loss, damage, or injury" resulting from Iraq's invasion and occupation of Kuwait, in accordance with paragraph 16 of Security Council resolution 687 (1991).

25. Paragraph 34 of Governing Council decision 7 provides that "direct loss, damage, or injury" includes any loss suffered as a result of:

(a) "Military operations or threat of military action by either side during the period 2 August 1990 to 2 March 1991;

(b) Departure of persons from or their inability to leave Iraq or Kuwait (or a decision not to return) during that period;

(c) Actions by officials, employees or agents of the Government of Iraq or its controlled entities during that period in connection with the invasion or occupation;

(d) The breakdown of civil order in Kuwait or Iraq during that period; or

(e) Hostage-taking or other illegal detention."

26. Paragraph 35 of Governing Council decision 7 provides that "direct environmental damage and the depletion of natural resources" includes losses or expenses resulting from:

(a) "Abatement and prevention of environmental damage, including expenses directly relating to fighting oil fires and stemming the flow of oil in coastal and international waters;

(b) Reasonable measures already taken to clean and restore the environment or future measures which can be documented as reasonably necessary to clean and restore the environment;

(c) Reasonable monitoring and assessment of the environmental damage for the purposes of evaluating and abating the harm and restoring the environment;

(d) Reasonable monitoring of public health and performing medical screenings for the purposes of investigation and combating increased health risks as a result of the environmental damage; and

(e) Depletion of or damage to natural resources."

27. As the Panel has observed in previous reports,[6] paragraph 35 of Governing Council decision 7 does not purport to give an exhaustive list of the activities and events that can give rise to compensable losses or expenses; rather it should be considered as providing guidance regarding the types of activities and events that can result in compensable losses or expenses.

D. Evidentiary requirements

28. Article 35(1) of the Rules provides that "each claimant is responsible for submitting documents and other evidence which demonstrate satisfactorily that a particular claim or group of claims is eligible for compensation pursuant to Security Council resolution 687 (1991)". Article 35(1) also provides that it is for each panel to determine "the admissibility, relevance, materiality and weight of any documents and other evidence submitted".

29. Article 35(3) of the Rules provides that category "F" claims "must be supported by documentary and other appropriate evidence sufficient to demonstrate the circumstances and amount of the claimed loss". In addition, Governing Council decision 46 (S/AC.26/Dec.46 (1998)) states that, for category "F" claims, "no loss shall be compensated by the Commission solely on the basis of an explanatory statement provided by the claimant".

30. When recommending compensation for environmental damage or loss that has been found to be a direct result of Iraq's invasion and occupation of Kuwait, the Panel has in every case assured itself that the applicable evidentiary requirements regarding the circumstances and amount of the damage or loss claimed have been satisfied.

E. Legal issues

31. In reviewing claim No. 5000454, the Panel considered a number of legal issues. Some of these issues were raised by Iraq in its written responses or in submissions during the oral proceedings and were commented upon by the Claimants during the oral proceedings.

1. Amendment of claim

32. Kuwait submitted amendments to claim No. 5000454, which it stated were based on the results of monitoring and assessment activities. The amendments significantly increased the compensation claimed.

33. In the third "F4" report, the Panel stated that "it is appropriate to receive and consider amendments to the amounts claimed, provided that such amendments are based on information and data obtained from monitoring and assessment activities".[7] Accordingly, the Panel accepted the amendments proposed by Kuwait.

2. Parallel or concurrent causes of environmental damage

34. Iraq contends that some of the damage for which compensation is sought by Kuwait cannot be attributed solely to its invasion and occupation of Kuwait. It alleges that some of the damage resulted from other factors that existed before and after the invasion and occupation of Kuwait. According to Iraq, the environment in Kuwait was not in pristine condition prior to the invasion and occupation.

35. With regard to Iraq's liability for environmental damage where there are parallel or concurrent causes, the Panel recalls that, in the second "F4" report, it noted that,

> "Iraq is, of course, not liable for damage that was unrelated to its invasion and occupation of Kuwait, nor for losses or expenses that are not a direct result of its invasion and occupation of Kuwait. However, Iraq is not exonerated from liability for loss or damage that resulted directly from the invasion and occupation simply because other factors might have contributed to the loss or damage. Whether or not any environmental damage or loss for which compensation is claimed was a direct result of Iraq's invasion and occupation of Kuwait will depend on the evidence presented in relation to each particular loss or damage."[8]

36. In reviewing the present claim, the Panel has considered whether, and if so to what extent, the evidence available indicates that the damage for which compensation is sought was wholly or partly the result of factors unrelated to Iraq's invasion and occupation of Kuwait. Where, on the basis of the evidence, the Panel finds that damage resulted from causes wholly unconnected with Iraq's invasion and occupation of Kuwait, no compensation is recommended for such damage or loss. Where the evidence shows that damage resulted directly from Iraq's invasion and occupation of Kuwait but that other factors have contributed to the damage for which compensation is claimed, due account has been taken of the contribution from such other factors in order to determine the level of compensation that is appropriate for the portion of the damage which is directly attributable to Iraq's invasion and

occupation of Kuwait. Where the information available does not provide a basis for determining what proportion of the damage, if any, can reasonably be attributed to Iraq's invasion and occupation of Kuwait, no compensation is recommended for the alleged damage.[9]

3. Duty of the claimant to prevent and mitigate environmental damage

37. Iraq contends that some of the damage for which Kuwait seeks compensation is not compensable, either because Kuwait has failed to take steps to mitigate damage resulting from Iraq's invasion and occupation of Kuwait or because the damage has been aggravated by acts and omissions of Kuwait after the invasion and occupation. According to Iraq, failure by a claimant to take reasonable and timely measures to mitigate damage from the invasion and occupation of Kuwait amounts to contributory negligence and justifies rejection of the claim for compensation or a corresponding reduction in the compensation to be awarded to the claimant. Iraq also contends that action by a claimant that causes additional damage or aggravates damage from the invasion and occupation constitutes an intervening factor that breaks the chain of causation so that the damage involved can no longer be attributed to Iraq's invasion and occupation of Kuwait.

38. The Panel recalls that in the third "F4" report, it stressed that,

> "each claimant has a duty to mitigate environmental damage to the extent possible and reasonable in the circumstances. Indeed, in the view of the Panel, that duty is a necessary consequence of the common concern for the protection and conservation of the environment, and entails obligations towards the international community and future generations. The duty to mitigate damage encompasses both a positive obligation to take appropriate measures to respond to a situation that poses a clear threat of environmental damage as well as the duty to ensure that any measures taken do not aggravate the damage already caused or increase the risk of future damage. Thus, if a claimant fails to take reasonable action to respond to a situation that poses a clear threat of environmental damage, the failure to act may constitute a breach of the duty to mitigate and could provide justification for denying compensation in whole or in part. By the same token, where a claimant takes measures that are unreasonable, inappropriate or negligent in the circumstances and thereby aggravates the damage or increases the risk of damage, the claimant may be required to bear some responsibility for the portion of the loss or damage that is attributable to its own acts or omissions."[10]

39. However, as the Panel noted in the third "F4" report,

> "whether an act or omission of a claimant constitutes failure to mitigate damage depends on the circumstances of each claim and the evidence available. The test is whether the claimant acted reasonably, having regard to all the circumstances with which it was confronted."[11]

4. Remediation objectives

40. In the third "F4" report, the Panel stated that "the appropriate objective of remediation is to restore the damaged environment or resource to the condition in which it would have been if Iraq's invasion and occupation of Kuwait had not occurred."[12] However, the Panel stressed that,

> "In applying this objective to a particular claim, regard must be had to a number of considerations. These include, inter alia, the location of the damaged environment or resource and its actual or potential uses; the nature and extent of the damage; the possibility of future harm; the feasibility of the proposed remediation measures; and the need to avoid collateral damage during and after the implementation of the proposed measures."[13]

41. With respect to the present claim, the Panel reiterates its view that, in determining what remediation measures are necessary, "primary emphasis must be placed on restoring the environment to pre-invasion conditions, in terms of its overall ecological functioning rather than on the removal of specific contaminants or restoration of the environment to a particular physical condition".[14] As the Panel noted in the third "F4" report, "even if sufficient baseline information were available to determine the exact historical state of the environment prior to Iraq's invasion and occupation of Kuwait, it might not be feasible or reasonable to fully recreate pre-existing physical conditions".[15] In particular, it is worth noting that, in some circumstances, measures to recreate pre-existing physical conditions might not produce environmental benefits and could, indeed, pose unacceptable risks of ecological harm. In the view of the Panel, where proposed measures for the complete removal of contaminants are likely to result in more negative than positive environmental effects, such measures should not qualify as reasonable measures to clean and restore the environment, within the meaning of article 35(b) of Governing Council decision 7.

5. Compensation for loss or depletion of natural resources

42. The fourth "F4" instalment only concerns claims for compensation for expenses of measures to remediate alleged environmental damage. The Panel did not consider the issue of possible compensation that may be due to Kuwait for loss or depletion of natural resources. This issue will be considered, as necessary, in the fifth instalment of "F4" claims.

IV. REVIEW OF PART TWO OF THE FOURTH "F4" INSTALMENT

43. Article 36 of the Rules provides that a panel of Commissioners may "(a) in unusually large or complex cases, request further written submissions and invite individuals, corporations or other entities, Governments or international organizations to present their views in oral proceedings" and "(b) request additional information from any other source, including expert advice, as necessary". Article 38(b) of the Rules provides that a panel of Commissioners "may adopt special procedures appropriate to the character, amount and subject-matter of the particular types of claims under consideration".

44. In view of the complexity of the issues raised by the claim and the need to consider scientific, engineering and cost issues, the Panel sought the assistance of a multi-disciplinary team of independent experts retained by the Commission ("the Panel's expert consultants"). The Panel's expert consultants were retained, inter alia, in the fields of desert ecology and desert botany, terrestrial remediation techniques, geology, hydrogeology, chemistry, civil engineering, ordnance disposal, health risk assessment, statistics and remote sensing.

45. At the direction of the Panel, the secretariat and the Panel's expert consultants undertook site visits in Kuwait and also met with representatives and experts of Kuwait in Geneva. The purpose of these visits and meetings was to enable the secretariat and the Panel's expert consultants to obtain information that would assist the Panel to:

(a) Assess the nature and extent of environmental damage resulting from Iraq's invasion and occupation of Kuwait;

(b) Evaluate the technical feasibility, reasonableness and cost-effectiveness of the remediation measures proposed by Kuwait; and

(c) Identify possible remediation alternatives.

46. Where necessary, the Panel requested additional information from Kuwait to clarify its claim.

47. The Panel also directed the secretariat to conduct two meetings between the Panel's expert consultants and legal, scientific and technical consultants of Iraq. During these meetings, the Panel's expert consultants provided explanations and clarifications on issues raised by Iraq.

48. In reaching its findings and formulating its recommendations on the present claim, the Panel has taken due account of all the information and evidence made available to it, including the evidence and information provided by Kuwait in the claim documents; results of monitoring and assessment activities; responses to requests for additional information; information and views submitted by Governments in response to article 16 reports; written responses submitted by Iraq; information obtained during the site visits; views presented by Iraq and Kuwait during the oral proceedings; and reports of the Panel's expert consultants.

49. In order to avoid multiple recovery of compensation, the Panel instructed the secretariat to carry out cross-claim and cross-category checks. On the basis of these checks, the Panel is satisfied that there is no risk of duplication between this claim and other awards of compensation.

50. In considering future measures proposed by Kuwait to clean and restore damaged environment, the Panel has evaluated the reasonableness of the measures by reference to, inter alia, the potential of the measures to achieve the remediation objectives set out in paragraphs 40 and 41; potential adverse environmental impacts of the proposed measures; and the cost of the measures as compared with other remediation alternatives that confer the same environmental benefits. In some cases, the Panel has found that certain modifications to the measures proposed are necessary or desirable to take account of these considerations. Details of the modifications are set out in technical annexes I to III to this report.

The amounts recommended for the claim are based on the proposed measures as modified. This is consistent with the approach adopted by the Panel in its previous reports.

51. The Panel's analysis of the claim is set forth in chapter V of this report. A glossary of scientific and technical terms is appended to this report.

V. CLAIM OF THE STATE OF KUWAIT – CLAIM NO. 5000454

A. Overview

52. Kuwait seeks compensation with an asserted value of USD 6,799,491,526 for expenses of measures already taken or to be taken in the future to remediate alleged damage to its terrestrial environment resulting from Iraq's invasion and occupation of Kuwait. This amount represents a significant increase in the compensation claimed, resulting from amendments made by Kuwait on the basis of new information obtained from monitoring and assessment activities.[16]

53. Claim No. 5000454 comprises (a) two claim units for expenses of measures to be undertaken in the future by Kuwait to remediate environmental damage alleged to have resulted from Iraq's invasion and occupation of Kuwait; and (b) one claim unit for expenses of measures already taken to remediate environmental damage alleged to have resulted from Iraq's invasion and occupation of Kuwait.

54. The first claim unit is for expenses of proposed measures to remediate areas in Kuwait alleged to have been damaged by oil contamination in the form of oil lakes, oil-contaminated piles, oil trenches and oil spills from pipelines.

55. The second claim unit is for expenses of proposed measures to revegetate desert areas alleged to have been damaged by oil contamination referred to in paragraph 54 above; and areas alleged to have been physically disturbed by the construction and subsequent backfilling of oil trenches by Iraqi forces and by the construction of pipelines by Iraqi forces to transfer oil to fill those trenches.

56. The third claim unit is for expenses incurred by Kuwait Oil Company ("KOC") for measures already taken or to be taken to recover or remove oil released from the many oil wells in Kuwait that were damaged or destroyed by Iraqi forces during Iraq's invasion and occupation of Kuwait. The compensation sought is for expenses resulting from the oil recovery programme after 31 December 1992.[17]

57. As indicated in paragraph 6 above, portions of this claim were transferred from claim No. 5000450 that was reviewed by the Panel in the third "F4" instalment.

B. Remediation of areas damaged by oil lakes, oil-contaminated piles, oil trenches and oil spills

58. Kuwait seeks compensation in the amount of USD 5,863,998,176 for expenses of future measures to remediate areas alleged to have been damaged by oil contamination (oil lakes, oil-contaminated piles, oil trenches and oil spills).

59. According to Kuwait, over 114 square kilometres of its desert have been damaged by oil that was released when retreating Iraqi troops detonated 798 oil wells in Kuwait. Oil flowing from the damaged oil wells formed oil lakes, which contaminated over 40 million cubic metres of soil. Kuwait alleges that contamination of the desert altered soil properties, caused extensive plant and animal mortality and continues to impair ecosystem functioning.

60. Kuwait also states that oil discharged from the damaged oil wells accumulated in depressions in the desert areas and that subsequent evaporation of lighter oil fractions resulted in the formation of a thick sludge with an underlying layer of contaminated soil. Kuwait describes the oil lakes either as areas of "wet oil contamination" or areas of "dry oil contamination".

61. According to Kuwait, wet contamination areas, covering over 7 square kilometres of the desert, are distinguished by the presence of a surface layer of weathered crude, oily liquid or sludge, sometimes covered by a thin, hardened crust. Kuwait states that the average depth of contamination in the wet contamination areas is 63 centimetres.

62. Dry contamination areas also consist mainly of thin crusts of heavily contaminated material but without the wet oily layers or sludge. According to Kuwait, the dry contamination areas cover almost 100 square kilometres of its desert, with an average depth of approximately 25 centimetres.

63. In addition to oil lakes, Kuwait states that it was necessary to create piles of oil-contaminated soil and liquid oil in order to stop the spread of oil flows and to clear areas of heavy oil contamination that impeded fire-fighting or subsequent KOC field operations. Earth-moving equipment was used to create these piles, which Kuwait estimates to cover over 8.5 square kilometres of the desert, totalling over 15 million cubic metres of contaminated soil.

64. Kuwait states that Iraqi forces dug over 110 kilometres of trenches along the border between Kuwait and Saudi Arabia and that these were filled with crude oil in an attempt to repel the advance of Allied Coalition Forces. According to Kuwait, this resulted in the contamination of approximately 136,000 cubic metres of soil. Kuwait points out that contamination from oil trenches has penetrated deep into the soil profile but has left very little visible contamination on the surface because the oil trenches have been covered either by backfilling or by wind-blown sand.

65. According to Kuwait, Iraq constructed a network of over 750 kilometres of pipelines to convey oil from Kuwait's oil fields to the oil trenches. This resulted in contamination of surface and subsurface soil where spills occurred, including a spill in the area of Wadi Al Batin in north-west Kuwait when the main pipeline supplying oil to the trenches was ruptured.

66. Kuwait conducted field studies that included the analysis of recent satellite imagery, combined with over 24,000 field observations, in order to determine the extent of the environmental damage. Kuwait also collected data at more than 6,000 sites in the oil lake areas in order to determine the volume of soil that is contaminated; and it sampled 1,300 sites to determine the nature of the contamination.[18]

67. Kuwait estimated the volume of contaminated material by relating the average depth of contamination for each oil field to the total contaminated area in that oil field, as identified through the field measurements. Kuwait concluded that approximately 64 million cubic metres of contaminated material is present in the areas of oil lakes, oil-contaminated piles, oil trenches and oil spills. Kuwait states that total petroleum hydrocarbon ("TPH") concentrations in the contaminated materials range between 25,000 micrograms per kilogram and 194,000 micrograms per kilogram.

68. According to Kuwait, oil contamination destroyed the vegetative cover of the affected areas and poses a risk to groundwater. Kuwait also alleges that the chemical and physical effects of the oil lakes have had adverse impacts on wildlife. For example, Kuwait states that animals continue to be trapped in the oil-contaminated areas.

69. Iraq argues that "the alleged area and volume of oil-contaminated soil in Kuwait are exaggerated." It states that some oil lakes existed before 1991, and contends that there is a discrepancy between estimates presented by Kuwait of the amounts of spilled and recovered oil and Kuwait's own calculations of oil present in oil-contaminated areas.

70. Iraq also argues that the oil lakes pose no significant risk to the environment, and refers to evidence which it claims shows that natural ecological recovery is taking place. According to Iraq, recent satellite imagery shows extensive rehabilitation of vegetation in fenced areas in Kuwait, whereas no such rehabilitation has taken place in areas of uncontrolled livestock grazing.

71. Iraq contends that Kuwait did not take adequate measures to mitigate the environmental damage caused by the oil lakes; and argues that there was undue delay in extinguishing the oil well fires and that earlier action could have reduced the amount of released oil.

72. The Panel notes that information in the published literature concerning Kuwait's efforts to control the oil well fires suggests that the oil well fires were extinguished much sooner than originally predicted. Moreover, as noted by the Panel in the third "F4" report, removal of the oil was initially prevented by mine clearance and further delayed by oil field reconstruction operations.[19] In the view of the Panel, the evidence available shows that the measures taken by Kuwait to mitigate environmental damage from the oil spills and oil well fires were reasonable and adequate.

73. As noted by the Panel in the first "F4" report, "there is abundant evidence in the scientific literature of the extensive contamination of Kuwait's environment by the oil lakes that were directly caused by the actions of Iraqi forces".[20] The Panel noted further that the oil lakes pose acute threats to wildlife and possibly to KOC employees working in and around these areas. Site visits to the affected areas confirm that the existing damage from oil contamination is severe since hardly any live vegetation is currently present in either areas of wet or dry oil contamination or in piles of oil-contaminated material. The barren oil-contaminated areas stand in sharp contrast to the surrounding desert areas, which have experienced ecological recovery. In addition to the visible damage to vegetation and soil, the oil lakes continue to impair water transport and nutrient cycling because water is unable to penetrate the pools of oil and crusts of weathered sludge that cover the oil lakes. In the

view of the Panel, near-term recovery of vegetation or ecological processes will not occur in the oil-contaminated areas without some form of active remediation.

74. The Panel notes Kuwait's assertion that subsurface contamination of the oil trenches extends deep into the soil profile. However, the Panel considers that the risk of contamination to water resources from these trenches exists only in the Wadi Al Batin area in the north-west of Kuwait. Wadi Al Batin serves as a regionally important natural water collection and transport system and oil contamination in this area could have serious adverse impacts on Kuwait's water resources.

75. In the areas outside Wadi Al Batin, the Panel considers that there is potential for continued natural ecological recovery in the areas of oil trenches. The evidence available suggests that there is ongoing natural recovery in these areas; and that the fill material in the trenches is non-toxic and does not hinder the re-colonization of the areas by native vegetation.

76. The Panel observes that there is no evidence to support Iraq's claim that oil lakes existed in Kuwait prior to 1991. Moreover, the Panel notes that the total area alleged by Iraq to be pre-existing oil lakes represents approximately 0.75 per cent of the total oil lake area as identified by Kuwait.

77. Regarding Kuwait's estimate of the quantity of oil remaining in the contaminated areas, the Panel considers that Kuwait has conducted a well-designed and thorough analysis of the area and volume of contaminated material. In the view of the Panel, Kuwait's estimate of the volume of oil still in the contaminated areas is reasonable.

78. On the basis of the evidence presented, the Panel is satisfied that oil contamination resulting from Iraq's invasion and occupation of Kuwait has caused environmental damage to Kuwait's terrestrial environment. The Panel considers that Kuwait's estimate of the total land area and soil volume affected by oil contamination, including the areas and volumes of oil lakes, oil-contaminated piles, oil trenches and oil spills, is reasonably accurate. Kuwait used appropriate methods, based on measurements conducted at individual oil fields, to estimate the average depths of contamination in the areas of wet and dry oil lakes.

79. The Panel, therefore, finds that damage to Kuwait's desert areas from oil lakes, oil-contaminated piles, oil trenches and oil spills constitutes environmental damage directly resulting from Iraq's invasion and occupation of Kuwait, and a programme to remediate the damage would constitute reasonable measures to clean and restore the environment.

80. Kuwait proposes to remediate oil-contaminated areas in four steps:

(a) clearance of mines and other ordnance from contaminated areas;

(b) excavation and screening of visibly contaminated soil and transport to treatment centres for treatment using high temperature thermal desorption ("HTTD");

(c) return of the treated soil to the excavated areas and stabilization of the area with a layer of gravel; and

(d) revegetation of the stabilized areas.

81. The revegetation programme for these areas is discussed in paragraphs 112 to 118 to this report.

82. Kuwait proposes to locate and remove ordnance prior to excavation of the oil-contaminated areas. Kuwait states that, although most areas were previously examined and cleared of mines and other ordnance, only an estimated 70 to 90 per cent of the mines and ordnance were found. Kuwait also points out that the areas of wet oil lakes have not previously been cleared of ordnance.

83. Kuwait proposes to excavate oil-contaminated material using mechanical excavating equipment. In the areas of wet oil lakes, it would be necessary to mix more heavily contaminated surface layers with less contaminated material from the oil-contaminated piles in order to provide access for equipment and personnel. According to Kuwait, this would also bring the TPH concentration of the mixture within the acceptable range for treatment by HTTD.

84. Kuwait proposes to remediate the excavated contaminated soil using HTTD. This will involve the transport of the contaminated material to an HTTD facility; storage and mixing, blending, screening and grinding the material; feeding the prepared material to the HTTD system; heating the material to between 371° and 482°C; and cooling the treated soil.

85. Kuwait proposes to backfill the excavated areas with the treated soil, followed by the stabilization of the backfilled areas with a gravel layer.

86. Although Iraq accepts that the oil lakes require some remediation, it argues that the remediation method proposed by Kuwait is not appropriate. Iraq asserts that HTTD treatment "is purely destructive of the hydrocarbons" and that this destruction is achieved "at the highest possible costs". Iraq notes that after HTTD, the treated soil "would be black, completely sterile and without soil structure." According to Iraq, alternative remediation methods such as asphalt batching, combustion for power generation and bioremediation, would be more appropriate.

87. Iraq states that dry oil lakes "should be dealt with by the fragmentation of the solid crust", as recommended by the Panel in the third "F4" report.[21]

88. Iraq argues that "trenches do not present any risk of contamination for the vegetation or human health as they are covered with sand".

89. In the view of the Panel, clearance of mines and other ordnance from contaminated areas is a reasonable safety measure. However, the Panel has concerns with Kuwait's proposal to use HTTD for the remediation of all contaminated soil. In the view of the Panel, HTTD treatment would result in soil that is sterile and devoid of biogenic structures, microorganisms, and other organic materials, and this would make it more difficult to successfully revegetate the damaged areas. The Panel considers that bioremediation is a suitable alternative for the less contaminated materials. In this regard, the Panel observes that studies in Kuwait and elsewhere show that bioremediation is likely to be successful for the less contaminated soil. The Panel considered other alternative remediation techniques, such as asphalt batching and use of the excavated material for power generation, but does

not find that any of them would offer significant environmental benefits or be more cost-effective than bioremediation.

90. The Panel considers that the more heavily contaminated materials in the surface layers of the oil lakes or in the oil-contaminated piles are not amenable to significant biodegradation. In particular, the Panel does not consider that fragmentation is an appropriate remediation option of the dry oil lakes, due to the nature of the subsurface contamination in the areas. The Panel considers that the most appropriate method for dealing with these materials is to dispose of them in engineered landfills. As the Panel has previously noted, landfilling is an internationally accepted waste disposal practice for oil-contaminated soil.[22]

91. The Panel notes that HTTD is also an internationally accepted remediation technique. However, on the basis of the information available to it, and in line with the criteria outlined in paragraph 50 and in the introduction to the annexes to this report, the Panel finds that, in this instance, using engineered landfills for the heavily contaminated materials is a more cost-effective option than HTTD.

92. Following excavation of the heavily contaminated surface layer, the remaining contaminated soil could be treated using a 12-month in situ bioremediation programme. The Panel considers that returning the oil lake areas to their original topographic conditions and revegetating them is necessary in order to promote recovery of ecological processes, particularly water transport and retention. The Panel notes that results of a bioremediation study by the Kuwait Institute for Scientific Research have demonstrated the ability of treated soil to support plant growth both in the laboratory and field. In the view of the Panel, the most appropriate approach for remediation of the oil lake areas is an in situ bioremediation programme to reduce TPH to levels that will no longer impede revegetation.

93. The Panel considers that remediation should be focused on the restoration of ecological functions, particularly in terms of regulating site stability, infiltration processes, and nutrient cycling. In the view of the Panel, although the restoration approach proposed by Kuwait might on its own restore ecological function to the affected areas in the long term, the modifications indicated will increase the possibility of early and successful recovery of ecological functions.

94. The Panel notes that residual contamination from the oil trenches and oil spills poses risks to surface and groundwater in the Wadi Al Batin area. The Panel considers that remediation of the residual contamination can be achieved by the removal and landfilling of this material at a location outside Wadi Al Batin. Although an alternative approach using bioremediation could work for the less contaminated soil underlying these spills, the Panel considers that complete removal of the contaminated materials will provide an added degree of protection for the valuable water resources of the Wadi.

95. The Panel is aware that contaminated soil in the trenches is buried under relatively clean soil, but it does not consider removal of contaminated materials to be necessary outside Wadi Al Batin. In the view of the Panel, this contamination is not hindering ecological recovery of these areas. Moreover, physical disturbance of the trenches could present a major impediment to continuing

ecological recovery. Consequently, the Panel considers that an enhanced natural recovery strategy, consisting of the placement of a thin layer of gravel to prevent wind and water erosion and the placement of organic amendments, is the appropriate option in the circumstances.

96. For the oil spill areas outside Wadi Al Batin, the Panel considers that contaminated materials should be excavated and landfilled in order to remove isolated patches of contamination that are preventing revegetation. The Panel also considers that, provided steps are taken to prevent overgrazing and off-road vehicle use, subsequent application of gravel and organic amendments will help create a surface that can promote revegetation and restoration of ecological functions in these areas. The costs of organic amendments for oil trench and oil spill areas are included in the revegetation programme discussed in paragraph 118 to this report.

97. Details of the various modifications indicated in paragraphs 89 to 96 are set out in annexes I and II to this report.

98. The Panel finds that, with the modifications outlined in annexes I and II, the remediation measures proposed by Kuwait constitute measures that are reasonably necessary to clean and restore the environment, within the meaning of paragraph 35(b) of Governing Council decision 7.

99. The Panel emphasizes that, to ensure the success of the remediation measures, it will be necessary for Kuwait to adopt appropriate measures to protect vulnerable areas, such as fencing to control grazing and the use of off-road vehicles.

100. The expenses of the proposed remediation programme have been adjusted to take account of the modifications in annexes I and II, and other adjustments including:

(a) Reduction in the volume of soil to be excavated;

(b) Elimination of HTTD treatment of excavated material;

(c) Landfilling of highly contaminated excavated material;

(d) In situ bioremediation of less contaminated soil; and

(e) Reduction of labour and production costs by applying appropriate rates.

101. These adjustments reduce the compensable expenses to USD 1,975,985,580.

102. Accordingly, the Panel recommends compensation in the amount of USD 1,975,985,580 for remediation of areas damaged by oil contamination resulting from Iraq's invasion and occupation of Kuwait.

103. For the reasons indicated in paragraph 134 of this report, no date of loss for the purposes of any potential award of interest is indicated for this claim unit.

C. Revegetation of areas damaged by oil lakes, oil-contaminated piles, oil trenches, oil spills and pipelines

104. Kuwait seeks compensation in the amount of USD 904,312,445 for expenses of future measures to revegetate areas of its desert that it alleges have been damaged as a result of Iraq's invasion and occupation of Kuwait.

105. The areas that Kuwait proposes to revegetate are the areas affected by oil lakes; oil-contaminated piles; oil trenches; oil spills; and the areas physically disturbed by the construction and backfilling of oil trenches and pipelines. Kuwait states that a revegetation programme is critical to the sustainability of the desert ecosystem, and will contribute to stabilization of the desert surface and minimize erosion.

106. As noted in paragraph 79 of this report, the Panel finds that damage to Kuwait's desert areas from oil lakes, oil-contaminated piles, oil trenches, and oil spills constitutes environmental damage directly resulting from Iraq's invasion and occupation of Kuwait, and a programme to revegetate these areas constitutes measures reasonably necessary to clean and restore the environment, in accordance with paragraph 35(b) of Governing Council decision 7.

107. Kuwait states that the oil trenches and pipelines referred to in paragraphs 64 and 65 of this report resulted in environmental damage to over 15 square kilometres of desert area in the southern and western regions of the country. Kuwait asserts that physical disturbance resulting from the construction and backfilling of the pipeline network and oil trenches caused rupture of the thin surface layer and the compaction and fracturing of the soil. According to Kuwait, the vegetative cover of the affected areas is lower than in undisturbed areas.

108. Kuwait states that the construction of the pipeline network resulted in physical disturbance of over 11.5 square kilometres along the pipeline corridors, and that the construction and backfilling of the trenches affected over 4.2 square kilometres of the desert area.

109. The Panel finds that the excavation and backfilling of trenches and pipelines altered the soil profile in the physically disturbed areas by burying biologically active topsoil and exposing infertile subsoil. These activities may also have disrupted run-on, run-off and infiltration patterns. The Panel notes, however, that the areas affected by these activities are not as extensive as claimed by Kuwait and, further, that there is evidence of natural recovery processes which are expected to continue.

110. The Panel finds that damage caused by the construction and subsequent backfilling of trenches and the construction of oil pipelines to transfer oil to fill the trenches constitutes environmental damage directly resulting from Iraq's invasion and occupation of Kuwait, and a programme to remediate the damage would constitute reasonable measures to clean and restore the environment.

111. The Panel considers that, provided steps are taken to prevent overgrazing and off-road vehicle use, an enhanced natural recovery programme that includes gravel stabilization of the areas, in conjunction with the application of organic amendments, would be adequate for the areas that have

been physically disturbed by the construction and backfilling of trenches and pipelines. In the view of the Panel, the areas concerned are small enough for seeds and organic matter to migrate easily into them from adjacent unaffected areas. Accordingly, the Panel does not consider that active revegetation is necessary in these areas.

112. Kuwait also proposes a revegetation programme for over 114 square kilometres of its desert area that is affected by the oil lakes and oil-contaminated piles. This programme involves the collection of seeds and development of a nursery facility for producing seeds and shrubs. Kuwait proposes to construct irrigation systems and to add soil amendments and inocula. The affected areas would then be seeded and planted with stock from the nursery.

113. According to Kuwait, transplanting would be undertaken "using native species of trees, shrubs, grasses, and forbs tailored to particular locations in Kuwait."

114. Maintenance of the revegetated areas would consist of replanting and reseeding for three years after the initial planting. Kuwait expects to replant up to 30 per cent of the vegetation each year, based on its projections of losses during the first three growing seasons. In addition, water and fertilizer would be applied for a total of five years in the oil lake areas, and for two and a half to three years in the oil trench, pipeline and spill areas. Finally, monitoring would be undertaken for the duration of the programmes to evaluate the success of the restoration efforts over time and to identify any adjustments needed to enhance the success of the programme.

115. Iraq argues that the revegetation plan proposed by Kuwait "is necessary only because of the destructive remediation method chosen by the Claimant". Iraq further argues that the proposed programme "goes far beyond the restoration of vegetation to the pre-Conflict levels and seeks substantial improvements with respect to density and quality of the vegetation".

116. As previously noted in paragraph 73 of this report, the areas of the oil lakes and oil-contaminated piles are devoid of vegetation, and revegetation measures are essential for the restoration of ecological functioning in those areas. However, the Panel considers that Kuwait's proposed revegetation programme exceeds what is reasonably necessary in the circumstances and should be reduced in scope.

117. In the view of the Panel, while revegetation of the areas damaged by oil lakes and oil-contaminated piles is appropriate, planting density should be reduced, and the application of chemical fertilizers and soil inocula would not be necessary.

118. Kuwait also proposes a revegetation programme for the areas of oil trenches and oil spills. In its review of the remediation programme for these areas, the Panel recommends compensation based on remediation measures that rely on natural revegetation, assisted by the application of gravel and organic amendments. The costs of gravel for oil trench and oil spill areas are included in the remediation programme for oil-contaminated areas, discussed in paragraphs 95 and 96 to this report. Details of the modifications to the proposed revegetation programme are set out in annex III to this report.

119. The Panel finds that, with the modifications outlined in annex III, the revegetation measures proposed by Kuwait for areas damaged by oil lakes, oil-contaminated piles, oil trenches and oil spills constitute measures that are reasonably necessary to clean and restore the environment, within the meaning of paragraph 35(b) of Governing Council decision 7.

120. The expenses of the proposed revegetation programme have been adjusted to take account of the modifications indicated in annex III to this report.

121. These adjustments reduce the compensable expenses to USD 283,300,389.

122. Accordingly, the Panel recommends compensation in the amount of USD 283,300,389 for revegetation of the areas affected by oil lakes and oil-contaminated piles; by oil trenches and oil spills; by the construction and subsequent backfilling of oil trenches; and by the construction of oil pipelines by Iraqi forces.

123. For the reasons indicated in paragraph 134, no date of loss for the purposes of any potential award of interest is indicated for this claim unit.

D. Oil recovery programme after 31 December 1992

124. Kuwait seeks compensation in the amount of USD 31,180,905 for expenses incurred or to be incurred by KOC to recover or remove large quantities of oil released from the many oil wells in Kuwait that were damaged or destroyed by Iraqi troops during Iraq's invasion and occupation of Kuwait. The compensation is claimed for expenses of the oil recovery programme after 31 December 1992. These expenses include labour costs, the costs of oil tank refurbishment and costs of materials and contracts.

125. In the second "F4" report, the Panel found that the activities undertaken by KOC to recover and remove oil from its operational areas prior to 31 December 1992 constituted abatement and prevention of environmental damage and measures reasonably necessary to clean and restore the environment, and that expenses resulting from these activities qualified for compensation in accordance with paragraph 35(a) and (b) of Governing Council decision 7.[23]

126. In the view of the Panel, the oil recovery activities for which compensation is sought in the present claim are the continuation of the oil recovery programme that was reviewed under claim No. 5000381 in the second "F4" instalment. Consequently, the Panel finds that expenses of the programme that were incurred after 31 December 1992 also qualify for compensation in accordance with paragraph 35(a) and 35(b), of Governing Council decision 7, except as indicated below.

127. As noted in the second "F4" report, the residual value of equipment as of 31 December 1992, originally part of claim No. 5000381, is to be taken into account in the review of the present claim.[24] This amounts to USD 4,031,240.

128. The evidence presented by Kuwait does not enable the Panel to substantiate the full amount of the expenses claimed. Accordingly, an adjustment has been made to take account of the risk of

overstatement. Equipment costs have been adjusted to take into account the residual value of the equipment. The costs of tank refurbishment have also been adjusted to take into account normal maintenance costs.

129. These adjustments reduce the compensable losses to USD 17,920,420.

130. Accordingly, the Panel recommends compensation in the amount of USD 17,920,420 for the oil recovery programme undertaken by KOC to remediate damage resulting from Iraq's invasion and occupation of Kuwait.

131. In accordance with the approach set out in paragraph 134, the Panel finds that the date of loss for this claim unit is 1 January 1996.

VI. RELATED ISSUES

A. Currency exchange rate

132. The Commission issues awards in United States dollars. Some losses were claimed in United States dollars after conversion from other currencies. In keeping with the practice of other panels of Commissioners, the Panel has used currency exchange rates reported in the United Nations Monthly Bulletin of Statistics. In calculating the value of recommended awards, the Panel determined that the exchange rates used by Kuwait were reasonable approximations of the applicable rates in the United Nations Monthly Bulletin of Statistics.

B. Interest

133. Governing Council decision 16 (S/AC.26/1992/16) provides that "interest will be awarded from the date the loss occurred until the date of payment, at a rate sufficient to compensate successful Claimants for the loss of use of the principal amount of the award". It also provides that the Governing Council will consider the methods of calculation and payment of interest at the appropriate time, and that interest will be paid after the principal amount of awards. Accordingly, the Panel must determine the date from which interest will run, where relevant.

134. A major portion of the present claim is for financial expenditures that have not yet been incurred. In that case, no interest is due and, accordingly, no date of loss has been indicated. With respect to past expenditures, the Panel has selected the approximate mid-point of the period during which expenses were incurred as the date of loss.

VII. SUMMARY OF RECOMMENDATIONS

135. Based on the foregoing, the Panel recommends that the amounts set out in the table below be awarded in respect of claim No. 5000454.

Summary of recommended award for claim No. 5000454

Claim unit	Amount claimed (USD)	Amount recommended (USD)
Remediation of areas damaged by oil lakes, oil-contaminated piles, oil trenches, oil spills and by the construction and backfilling of trenches and pipelines	5,863,998,176	1,975,985,580
Revegetation of damaged terrestrial ecosystems	904,312,445	283,300,389
Oil recovery programme after 31 December 1992	31,180,905	17,920,420
Total	6,799,491,526	2,277,206,389

Geneva, 3 August 2004

(Signed) Thomas A. Mensah
Chairman

(Signed) José R. Allen
Commissioner

(Signed) Peter H. Sand
Commissioner

Notes

[1] (S/AC.26/Dec.114 (2000), paragraph 12.

[2] The compensation claimed for claim No. 5000454 does not include interest or claim preparation costs.

[3] See paragraph 29 of the "Report and recommendations made by the Panel of Commissioners concerning the first instalment of 'F4' claims", S/AC.26/2001/16 ("first 'F4' report"). In the first "F4" report, the Panel recommended awards for monitoring and assessment projects to identify and evaluate damage or loss suffered as a result of Iraq's invasion and occupation of Kuwait. Some of these projects were intended to provide information to assist with the review of substantive claims by producing scientific and technical information about the nature and extent of environmental damage and potential remediation measures. Data produced by monitoring and assessment activities under claim No. 5000432 were transmitted to Iraq.

[4] S/AC.26/Dec.124 (2001), annex, paragraph 2.

[5] "Report of Secretary-General pursuant to paragraph 19 of Security Council resolution 687 (1991)", S/22559, paragraph 20.

[6] "Report and recommendations made by the Panel of Commissioners concerning the second instalment of 'F4' claims", S/AC.26/2002/26 ("second 'F4' report"), paragraph 22; "Report and recommendations made by the Panel of Commissioners concerning the third instalment of 'F4' claims", S/AC.26/2003/31 ("third 'F4' report"), paragraph 25.

[7] Third "F4" report, paragraph 32.

[8] Second "F4" report, paragraph 25.

[9] Third "F4" report, paragraph 39.

[10] Third "F4" report, paragraph 42.

[11] Third "F4" report, paragraph 43.

[12] Third "F4" report, paragraph 47.

[13] Ibid.

[14] Third "F4" report, paragraph 48.

[15] Ibid.

[16] The increase in the compensation claimed is primarily due to Kuwait's decision to excavate more material that needs to be remediated based on a re-evaluation of the volume of material that requires excavation and remediation. This decision was based on information produced by monitoring and assessment projects that were funded by an award in the first instalment of "F4" claims for claim No. 5000432 (see table 7 of the first "F4" report).

[17] The claim for expenses related to the oil recovery programme incurred up to 31 December 1992 was reviewed in the second "F4" report as part of claim No. 5000381, paragraphs 118 to 133.

[18] These results were based on information produced by a monitoring and assessment project funded by an award in the first "F4" instalment for claim No. 5000432. An award of USD 10,484,988 was recommended for monitoring and assessment of damage caused by oil lakes and assessment of oil lake treatment technologies (see first "F4" report, paragraphs 451 to 464).

[19] Third "F4" report, paragraph 73.

[20] First "F4" report, paragraph 456.

[21] Third "F4" report, paragraph 129 and annex IV.

[22] Third "F4" report, paragraph 182.

[23] Second "F4" report, paragraph 129.

[24] Second "F4" report, paragraph 131.

TECHNICAL ANNEXES OF THE REPORT ON PART TWO OF THE FOURTH "F4" INSTALMENT

Introduction

1. In reviewing the remediation measures proposed by Kuwait, the Panel found that modifications in the design, methodologies and the nature and extent of work to be undertaken would improve the net environmental benefit and reduce the cost of some of the measures. The general outlines and objectives of the modifications have been indicated in the parts of the report dealing with the relevant claim units. In some cases, the Panel considers it useful to set out technical details of the modifications. As stated in paragraph 50 of the report, these details are indicated in the respective annexes.

2. The Panel recognizes that, in implementing the remediation activities, Kuwait may find it necessary to make further modifications to take account of new information or changing environmental conditions. In this regard, the Panel stresses that its findings regarding the proposed remediation measures, and its suggestions of possible modifications, have been based on information available to it on the environmental conditions in Kuwait prior to 31 July 2004.

3. As noted in paragraph 41 of the report, remediation programmes must be implemented with utmost caution, taking due account of the need to avoid potential adverse environmental impacts of remediation activities. This requires the use of flexible and site-specific approaches, incorporating a broad set of remediation techniques that are capable of addressing the wide range of habitats, the varying levels of contamination and the different ecological conditions present.

4. The Panel has been guided by the following principles in considering modifications to the remediation programmes proposed by Kuwait:

(a) Remediation approaches or techniques that pose unacceptable risks of ecological harm should be avoided.

(b) Remediation activities should be undertaken only if they are likely to result in more positive than negative effects.

(c) Remediation techniques that facilitate natural recovery processes should be preferred, and active remediation should build on and enhance natural recovery that has already occurred.

(d) Remediation should rely on proven and well-established technologies and techniques in preference to experimental or untested approaches.

(e) The effectiveness of remediation activities should be monitored to ensure that remediation targets are met. Remediation programmes should be designed to be sufficiently flexible and responsive to new information obtained from such monitoring.

(f) Where more than one remediation approach or technique is appropriate to achieve the desired remediation goal, the most cost-effective option should be selected.

(g) Remediation decisions should consider both the short-term and long-term effects of remediation activities on neighbouring ecosystems, including transboundary effects.

Annex I

MODIFICATIONS TO REMEDIATION PROGRAMME – CLAIM NO. 5000454

AREAS DAMAGED BY OIL LAKES AND OIL-CONTAMINATED PILES
(PARAGRAPHS 58 to 103)

1. The Panel considers that an appropriate remediation programme should be one that protects human health, assists in the restoration of ecological functions and is also cost-effective. Such a programme should involve excavation and off-site landfilling for the most highly contaminated materials from the oil lakes and oil-contaminated piles, followed by bioremediation of underlying less contaminated soil. By relying partially on bioremediation, the programme should preserve ecologically valuable biological materials and soil structures present in the contaminated soil underlying the highly contaminated surface layers of the oil lakes. Preservation of biota and soil structure would accelerate the recovery of soil functions and promote revegetation.

2. For purposes of remediation, oil contamination is divided into three categories, namely, wet oil lakes, dry oil lakes, and contaminated piles. Wet oil lakes are distinguished by the presence of a surface layer of weathered crude, oily liquid or sludge. Dry oil lakes typically have a thin crust of heavily contaminated materials but without the wet oily layer. Oil-contaminated piles are mounds of contaminated material resulting from excavations and movements of soil during the activities to control the oil fires.

3. Prior to remediation, all the oil lakes and contaminated piles should be cleared of unexploded ordnance (UXO) to ensure the safety of workers.

4. The most contaminated materials from the oil lakes will have to be excavated and disposed of. Oil-contaminated piles should be excavated in their entirety and screened to remove any remaining UXO and ordnance debris. The heavily contaminated surface layer of the dry oil lakes should also be excavated and screened for UXO. An average excavation depth of approximately 10 centimetres should be adequate to remove the highly contaminated surface layer. The liquid sludge in the wet oil lakes should combined with oil-contaminated materials from the dry oil lakes and contaminated piles, in a ratio of six to one, and then excavated. The heavily contaminated layer beneath the sludge should then be excavated. On average, this will require removal and screening of approximately 10 centimetres of material, although this will vary considerably within and among sites.

5. All excavated materials should be transported to a landfill for permanent disposal. A total landfill capacity of approximately 26 million cubic metres will be required to accommodate the excavated materials. To minimize transportation costs, it would be more appropriate to construct a number of small facilities rather than one large landfill. For example, six to seven landfills, each with an approximate surface area of 25 hectares, a depth of 20 metres, and a total capacity of 4 million cubic metres, would provide the necessary capacity. Each landfill could be constructed below grade ensuring that, once closed, it would not be visible.

6. Each landfill should be constructed with double composite liners, each consisting of a synthetic membrane and a compacted low permeability soil line, and should be provided with a geomembrane and soil cover. In addition, pipes and pumps for leachate and gas collection systems should be installed. Once a landfill is suitably closed, there is an extremely low risk of infiltration of hydrocarbons into the underlying groundwater, especially given the low rainfall in Kuwait. As an additional precaution, it may be advisable to locate these landfills inside the fenced oil field areas in order to bring them under the institutional control applicable in those areas. Furthermore, any landfill facilities constructed in the northern oil fields should be located outside the infiltration catchment areas of the underlying potable groundwater.

7. Long-term monitoring and institutional controls should be an integral component of a waste containment and disposal strategy. The primary objective of long-term controls is to ensure the integrity of the landfill cover and to monitor for potential releases through the landfill liner. Without such controls, the landfill cover could erode or otherwise deteriorate, and thus allow precipitation to enter the landfill and generate leachate.

8. The less contaminated soil remaining after excavation of the highly contaminated surface materials could be treated using bioremediation techniques, which have been shown to be effective in reducing oil contamination (J. R. Haines and M. Alexander, “Microbial degradation of high-molecular-weight alkanes”, Applied Microbiology, 1974, pp. 1084-1085). In addition, this method of remediation should minimize disturbance to the structure of contaminated soil and disruption of any residual biological activity in this soil. This approach is more likely to create conditions that are conducive to revegetation than an approach that relies solely on HTTD treatment.

9. An effective bioremediation programme, involving the application of fertilizer and water as well as tilling, will require approximately 12 months of treatment. Fertilizer should be applied four times during this period. Slow release fertilizer should be applied at a rate that provides one part nitrogen for each 75 parts carbon to be degraded. Directly following fertilizer application, the soil should be tilled to distribute the nutrients properly within the upper soil layer. Tilling should not penetrate deeper than the upper layer: there is no need to provide aeration in this case, and deep tilling may damage soil structure. In addition to fertilizer application and tilling, the soil should be watered regularly. The optimal soil moisture for bioremediation is in the range of 5 to 10 per cent. Thus, weekly application of water is required to maintain proper soil moisture. As indicated in annex III (paragraph 9), it is advisable to make provisions for a separate well as the source of water for the revegetation programme for each of the oil lakes.

10. The oil lakes should be returned to their original topographic conditions in order to promote recovery of ecological processes, particularly those related to water transport and retention. To restore the natural contours of the land, the areas of the oil lakes should, after they have been treated, be backfilled with soil excavated in the construction of the landfills. This soil, which is likely to be quite sterile due to is subsurface origin, should be tilled into the bioremediated soil to receive biological components from the treated layer. While tilling will introduce some residual oil contamination into the clean surface layer, it should provide a net biological benefit because this process will transfer

residual biological activity, organic matter, and soil structure from the bioremediated layer. This should improve the physical and biological characteristics of the re-established surface layer and thus assist revegetation.

11. Finally, a 2.5-centimetre layer of gravel should be placed over the remediated areas to stabilize the soil surface and increase surface roughness so as to improve capture and retention of moisture, organic materials, and seeds.

12. A long-term remediation monitoring plan to collect relevant data before, during and after remediation implementation should be carefully integrated into the remediation programme. During the course of the project, remediation activities should be adapted to respond to new data and analysis that may be developed during the monitoring programme. This should provide opportunities to identify and address any negative impacts of remediation activities or any aspects of the programme that do not work as expected. It will also assist in identifying the most successful implementation approaches.

Annex II

MODIFICATIONS TO REMEDIATION PROGRAMME – CLAIM NO. 5000454

AREAS DAMAGED BY OIL SPILLS AND OIL TRENCHES (PARAGRAPHS 58 TO 103)

1. A cost-effective remediation programme should distinguish between areas of oil contamination that pose significant environmental risks and those that do not pose such risks. For the remediation of oil contamination inside Wadi Al Batin and other oil spill areas, excavation and off-site landfilling is appropriate. For other areas, no environmental benefits are likely to be gained from the physical removal of the contamination, since the potential for adverse environmental consequences of the contamination is low.

2. Prior to remediation activities, all oil spill and oil trench areas should be cleared of unexploded ordnance (UXO) to ensure the safety of workers.

3. For purposes of remediation, areas of environmental damage are subdivided into two categories, based on their potential to pose environmental risks. The first category includes oil trenches in Wadi Al Batin and oil spill areas. The second category includes all the remaining trenches identified in the claim.

4. Oil contamination in Wadi Al Batin poses a more serious environmental threat than the contamination in the other areas covered by the present claim. Wadi Al Batin is a regionally important water collection and transport system, and the geological materials in the Wadi are generally more porous than those in the other areas. (see Al-Sulaimi, J, Khalaf, F.J, and Mukhopadhyay, A., "Geomorphological analysis of paleo drainage systems and environmental implications in the desert of Kuwait", Environmental Geology 29, January 1997; and El-Baz, F. and Al-Sarawi, M. Z.,"Kuwait as an alluvial fan of a paleo-river", Geomorphologie Neue Folge, April 1996.) As a result, there is increased possibility of contaminants being transported through Wadi Al Batin and a greater likelihood of adverse environmental consequences created as water flows through the Wadi. The primary environmental concern with oil contamination outside Wadi Al Batin is the potential impairment of revegetation where contamination is located at or near the surface. The concerns are greatest in the areas affected by oil spills. The oil trenches outside the Wadi are typically buried below the surface and pose low risks to wildlife, groundwater, and human health. Moreover, there is evidence that natural revegetation is beginning in these areas.

5. Excavation and landfilling are appropriate approaches for remediation of the oil spills and oil trench areas within Wadi Al Batin as well as for the oil spill areas outside the Wadi. In these areas, all contaminated soil should be removed and screened for remaining UXO and debris. The excavated materials should then be transported to a landfill for permanent disposal. This landfill should be identical in design to the landfills used for the highly oil contaminated material from oil lakes and oil piles (see annex I, paragraphs 5 to 7). The excavated areas should then be backfilled with clean subsoil excavated during the construction of the landfill. The excavated areas should be provided with

a 2.5-centimetre thick stabilizing layer of gravel to prevent wind erosion and promote natural revegetation.

6. For the oil trench areas outside Wadi Al Batin, the only necessary remedial action is the placement of a 2.5-centimetre thick layer of gravel to prevent wind erosion and accelerate the ongoing natural recovery.

7. All contaminated materials in Wadi Al Batin and in the oil spill areas outside the Wadi are to be removed to a landfill for permanent disposal. Any remaining oil contamination would be only in the trenches outside Wadi Al Batin. As noted above, the risks from this oil contamination are low.

Annex III

MODIFICATIONS TO REMEDIATION PROGRAMME – CLAIM NO. 5000454

REVEGETATION OF OIL-CONTAMINATED AREAS AND AREAS PHYSICALLY DISTURBED BY THE CONSTRUCTION AND BACKFILLING OF OIL TRENCHES AND PIPELINES (PARAGRAPHS 104 TO 123)

1. For areas affected by oil spills, oil trenches, and areas that have been physically disturbed by the construction and backfilling of oil trenches and pipelines, natural recovery should be relied upon. Natural recovery in these areas would be accelerated by the application of gravel and organic amendments. Oil lake areas, however, will require active revegetation similar to what is proposed, but with certain modifications that would help to increase the chances of success and reduce costs.

2. An initial step in the revegetation process is the application of organic soil amendments. Although active replanting is necessary only in the areas that were actually covered by the oil lakes, it is appropriate to apply organic amendments to all damaged areas, including the oil spill areas, the oil trench areas, and the physically disturbed areas. Application of these amendments will provide additional nutrients which will accelerate recovery of soil biota and vegetation. The organic matter should be low in nutrients and slow to decompose. This will be important for improving the physical characteristics of the soil. Organic material that is too rich in nutrients (e.g., chemical fertilizers) would encourage the growth of unwanted invasive weed species.

3. Appropriate organic amendments include wheat or barley straw, bark or wood chips, fully composted biosolids, olive-cake residue or other readily available organic materials. Adding slowly decomposing materials of these types (i.e., materials with high carbon to nitrogen ratios) can accelerate soil processes by improving soil physical conditions, stimulating microbial activity and regulating levels of available nitrogen (S. Whisenant, Repairing Damaged Wildlands, Cambridge University Press, 1999.) Nevertheless, further field-testing of different soil amendments will be necessary to identify the types of organic materials that are most effective for particular areas. Such testing will also be needed to determine appropriate application methods and rates, as well as the timing of the applications.

4. A further beneficial effect of applying organic soil amendments is that they provide shelter and building materials for soil invertebrates. In particular, organic amendments can enhance the use of the sites by termites, which produce subsurface structures leading to the progressive burial of stones, gravel and solid deposits in these environments. The organic material will also be used by a number of other invertebrate decomposers and thus indirectly stimulate predators, especially ants, whose activities are also beneficial to the soil.

5. Because of the small size of the oil spill, oil trench and pipeline areas, seeds and other biota will readily migrate in from adjacent areas to promote revegetation in the areas where organic amendments

have been applied. However, the extensive oil lake areas will require more active revegetation measures.

6. Nurseries for seed and shrub seedling production are a key component of the oil lakes revegetation programme. It will be necessary to develop the facilities to produce large numbers of indigenous seeds and plants required by the programme. The focus of the revegetation programme should be on the restoration of a wide variety of native species. The germination laboratory included as part of the revegetation island programme for which compensation was awarded in the third "F4" instalment should be used to provide ongoing seed testing and evaluation during the life of that revegetation programme (see third "F4" report, annex V).

7. Planting an area equivalent to 25 per cent of the oil lake areas should mimic the vegetative density of a natural desert environment. To the extent practical, planting should take place in concentrated areas, particularly topographically low areas where run-off from heavy rain showers can concentrate. These areas can thus act as seed banks to facilitate the seeding and revegetation of adjacent or downwind areas via natural seed dispersal mechanisms.

8. The application of chemical fertilizer and the inoculation of plants with soil microbes will not be necessary for this programme. The organic amendments will provide adequate nutrients to support establishment of vegetation. Moreover, the application of fertilizer could promote excessive growth of undesirable non-native species, which are prey to fewer natural predators than native species. High local concentrations of chemical fertilizers are also likely to be deleterious to soil organisms. If the soil used to grow seedlings is taken from local sources, it will already contain the appropriate soil microbes needed to promote healthy vegetation.

9. The application of water is also a critical component of a revegetation programme for the oil lake areas. Drought can drastically affect vegetation, especially in stressed, degraded or recovering systems. It is, therefore, necessary to provide an irrigation system for the revegetated oil lake areas, in the event that rainfall is inadequate to support recovery and establishment of newly planted vegetation. However, instead of supplying water to the irrigation system by trucks, it would be more cost-effective and less disruptive environmentally to have an on-site water supply and drip irrigation system. Such a system would consist of a well and, where necessary, a reverse osmosis system for purifying brackish water prior to use. Such a system could also be used to supply water for the bioremediation process described in annex I (paragraph 9). An application of 42 millimetres of water per year over the areas requiring treatment during the first three years of the programme, and 21 millimetres per year for the last two years, should be sufficient.

10. While studies conducted in Kuwait have demonstrated that effective revegetation is possible on bioremediated soil, there have been no extensive experiments with native species on treated soil in Kuwait. Thus, a number of maintenance and monitoring measures will be needed to ensure the success of the revegetation programme. Careful monitoring will need to be conducted to assess the effectiveness of the production and planting methods, species selection, amendments and irrigation programme. The results of the monitoring will make it possible for the programme to be modified as necessary to maximize its success. A five-year monitoring programme should be sufficient to ensure

programme success. In addition, maintenance replanting will be required in order to achieve the desired species variety and density. This will involve three years of maintenance replanting at 30 per cent of the initial planting level each year, resulting in total replanting equivalent to 90 per cent of the initial planting.

11. Revegetation of the oil lakes through a properly designed revegetation programme should begin the process of ecological recovery and facilitate continued degradation of oil contamination by promoting nutrient cycling and recolonization by soil fauna.

GLOSSARY

asphalt batching:	Non-continuous manufacturing process in which raw materials are blended to produce asphalt paving.
biogenic:	Produced by living organisms or biological processes.
bioremediation:	Application of nutrients (e.g., chemical fertilizer) to stimulate natural microbial communities that biodegrade petroleum hydrocarbon contamination.
biota:	Living organisms of a particular locality, including plants, animals, fungi, and microorganisms.
double composite liner:	Landfill containment system that uses a primary liner consisting of a low permeability soil layer and a synthetic membrane and a secondary liner of the same materials.
forbs:	Broadleaf herbs other than grasses.
high temperature thermal desorption (HTTD):	Process using heat to separate contaminants from contaminated material. In the process, water and organic contaminants are volatilized from the material. The volatilized contaminants usually require further treatment.
inoculum (inocula):	Biological agent, such as soil bacteria or fungi, artificially introduced to a plant.
landfill:	Waste disposal facility on land. State-of-the-art landfills have liners, leachate collection and treatment systems to prevent contamination of surface and groundwater.
leachate:	Water that has percolated through waste material and leached out some of the constituents of the material.
nutrient cycling:	Transformation of chemical elements from inorganic form in the environment to organic form in organisms and, via decomposition, back to inorganic form.
oil lakes:	Pools of oil from damaged oil wells and oil spills.
ordnance:	Military materials such as weapons or ammunition.

organic amendments:	Soil additives such as wheat or barley straw, bark or wood chips, or fully composted biosolids, that hold water and nutrients and can accelerate the development of soil processes.
run-on, run-off:	Rainfall that the ground does not absorb which flows over the land surface or in open channels.
synthetic membrane:	Generic term for a specialty-plastic sheet, typically manufactured from various grades of polyethylene, which can be used to line the inside of a landfill.
total petroleum hydrocarbon (TPH):	Term used to describe a class of several hundred chemical compounds, comprising mainly hydrogen and carbon, originating from crude oil.
wadi:	Arabic term for streambed or other natural depression that is dry except during the rainy season.
