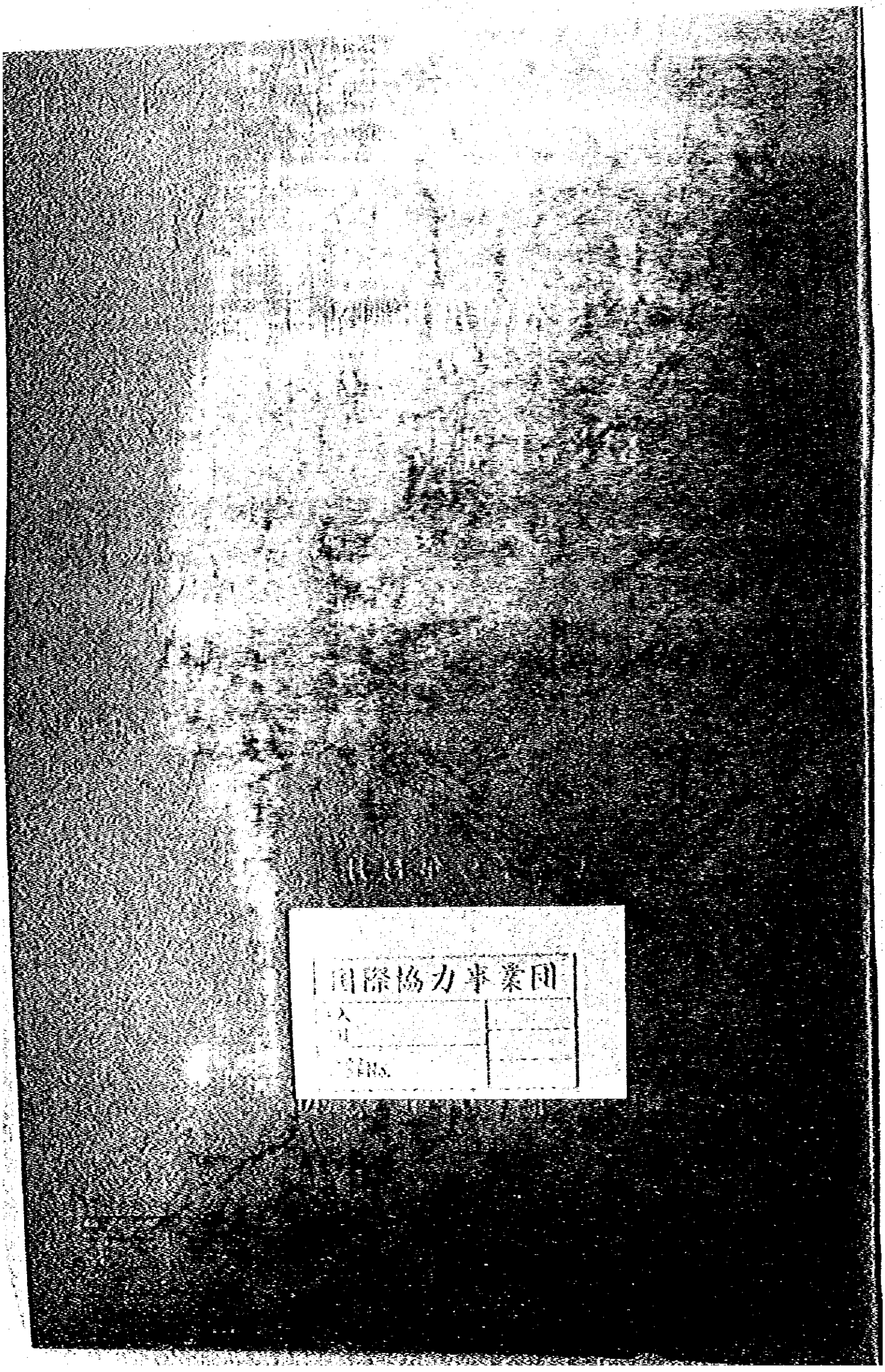

国際協力事業団

イラン－日本輸出用製油所調査

第3編 補完資料

1979年3月

国際協力事業団

総　目　次

第 1 巻

現 地 調 査 報 告 書

第 1 卷

現 地 調 査 報 告 書

目　　次

付　　録

1. 緒　　言

現地調査は1978年6月にJICA調査団によりフィージビリティスタディのための資料収集を目的として行なわれた。

調査中に行なわれた主な項目は次の通りである。

- Bushehrにおいて政府関係者およびNIOC 代表者との面談
- 製油所候補地および原油配管経路の航空調査
- 候補地の地上調査
- ボーリング試験による土質調査

尚、食料の調達、ヘリコプター／自動車の手配については、NIOC 等にBushehrでの調査に同行したAbtin氏に十分な便宜をはかって頂いた。

本報告書の構成は以下の通り。

- 調査団員の編成
- 調　査　経　要
- 土質調査報告書

2. 調査団の構成

1) JICA 調査団員

小松昭英	リーダー	プロセスエンジニア
橋本信之	工事計画	プロセスエンジニア
森　繁康	オフサイト・インフラ	メカニカルエンジニア
富山市生	港湾・土木	シビルエンジニア
栃川　木	土　質	シビルエンジニア
浜中治夫	積　算	シビルエンジニア

2) Bushehr 迄のNIOC 側の随行者

Mr. A. Abtin　　プロジェクトエンジニア

3) Dames and Moore ： 土質調査（ボーリングテスト）

Mr. M. Blackwell

Dr. V. Baroyant

3. 調 査 概 要

3.1 Bushehr地区踏査報告

6月16日　空路Bushehr着

Abtin氏と行程について打合せ

6月17日

09:00-11:00　NIOC のBushehr事務所にてAkghar氏（BushehrのNIOC 代表者）と面談

- 現地調査の目的と調査項目の説明
- 政府関係者との会合約束の確認

11:00-13:00　県庁（Goverment General Office）に於いて

- 調査団関係者の紹介
- Bushehr副知事のBehnamfar氏との面談

以下の人達の紹介を受ける。

Mr. Behnamfar	Deputy Governor General
Colonel Etehadieh	Ground Force
Captain Arjomandzadeh	Navy
Captain Haghnia	Police
Captain Shamshegi	Air Force
Dr. Fanaii	Head of Port Administration
Mr. Navaii	Head of Ministry of Road Bushehr
Mr. Hormozi	Atomic Power Organization
Mr. Bahraini	Governor of Suburbs of Bushehr
Mr. Afandi	Environmental Department

6月18日　関係当局者との面談（付録2参照）

08:30-10:30　Atomic Power OrganizationのIraj-Hormazi 氏、K. Thieme 氏と面談

11:00-12:30　Ministry of Road BushehrのNavaii 氏と面談

12:30-13:00　Bushehr空港の測候所を訪問

18:30-19:30　Port AuthorityのFanaii 博士と面談

6月19日　　ヘリコプターによる航空調査（付録1参照）

08：15　　Bushehr空港離陸

- Bushehr半島の付け根は広大な砂泥地帯
- Bushehr半島近傍は比較的緑地帯（デーツ林）
- 山岳地帯は侵食が著しく険しい。

08：45　　Ameri に着陸

09：15　　候補地Bの近くに着陸

- 平坦で広大な土地
- 湿　潤　地　帯

09：30　　Bushehr空港にて給油

10：00　　Helleh 川の河口に着陸

10：40　　Gureh ポンプステーション上空を旋回

- 原油配管径路の内、半分は平坦な地形であり、残り半分は丘陵又は山岳地帯である。
- Kharg 島への既設配管は埋設されている。
- ワジとの交差点および山岳地帯では地上配管である。

11：05　　Kharg 島にて給油

11：30　　Bushehrへ帰還（飛行延長：約360Km）

6月20日　　南部候補地の地上調査

	Bushehrからの距離（Km）	
07：15	0	Bushehr出発
		• Borazian/Shiraz 迄舗装道路
07：42	22	Shiraz へ通じる道路とAmeri へ通じる道路との交差点
		• 砂　利　道
		• デーツ林
08：08	40	Chah Talk-e-Palin
		• 未舗装道路
		• 村の周囲にデーツ林
09：20	55	Muhamad Ameri

Bushehからの距離（Km）

09：40　65　Bashi

- 運転困難な岩山地帯
- 深　い　ワ　ジ

10：25　80　Rustami

10：43　87　Ameri 候補地

- 村と村との間隔は約2Km
- 平坦部は海岸より約1Kmでそれより東は山岳地帯
- 海岸は砂浜
- 北側と南側の差は特になし
- 土質は良好と思われる。

（12：00-12：45）Rustam村て昼食

12：45　80　Rustami

13：33　60　Bashi

13：40　57　Muhammad Ameriの南側

- 第1および第2ボーリング地点の近くに停車
- 道路近くに砂丘

14：15　55　Muhammad Ameri

- 保安隊駐屯所

14：35　53　Muhammad Ameri候補地の北側

- 第3／第4ボーリング地点の近くに停車
- 南側より平坦地は広い。
- 間をおいて深さ1～1.5m位のワジが散在
- デ　ー　ツ　林

16：00　40　Chah Talk-e-Pain 候補地

- 第5ボーリング地点の近くに停車
- 道路際に村（東側）
- 海側には耕作物なし
- 土地の色は黒っぽい。

Bushehrからの距離（Km）		
16:30	22	Chughadak候補地（舗装道路の北側）
		• 第7ボーリング地点の近くに停車
		• 耕作物なし
18:00	–	Bushehr
6月21日		北部候補地の地上調査
Bushehrからの距離（Km）		
07:15	0	Bushehr出発
		• 舗 装 道 路
08:20	42	Hossinaki へ通じる道路と Bushehr Borazjan へ通じる道路との交差点
		• 以下の村々を通過：Kargazi, Zendan, Heydari, Haft Jush, Ziarat, Kolol.
		• 殆んど砂漠地帯、村落の近くは耕作地
09:25	70	Hellch 川に到着（Haft Jushの近く）
		• 川の水は家事に使用されているようである。
10:05	85	Borazjan–Ganaveh間のアスファルト舗装道路
		Hellch 川にかかる橋上（Ab Pakhsh の近く）
10:10	90	砂利道（延長25Km）
		• 道路沿いに運河
		• パームデーツの植林が17Km 続く。
10:40	115	次の村々を通過
		• Korreh–Band, Ghaleh–Sukhteh, Asgavi, Moerozi, Rustami, Farageh
11:30	136	Farageh候補地
		• Gendam駐在所
		• 耕作地無し
		• 平坦で広大
		• 海岸近く湿潤
(12:50~13:50) 昼 食		
15:00	85	アスファルト舗装道路

	Bushehrからの距離（Km）	
16：10	22	Chugadak の南側
		•第６ボーリング地点の近くで停車
17：30	0	Bushehr
18：30～19：30		打　合　せ
		•ボーリング地点の決定
6月22日		Teheranに戻る。
6月23日		候補地選定の打合せ
6月24日		NIOCとの打合せ
6月25日		
10：00～12：00		Dames and Mooreの事務所を訪問
		•ボーリング調査計画の確認
		空路東京へ

3.2　ボーリング調査

（付録3「土質調査報告」参照）

6月22日～28日	動　　員
6月29日～7月7日	ボ　ー　リ　ン　グ
7月10日～8月1日	試験室での分析
7月7日～8月12日	報　告　書　作　成
8月28日	報　告　書　提　出

4. 資　　料

4.1　NIOCからの受領資料

(1) 地　　図　1／50,000

(2) 道 路 地 図

(3) ブッシェール港平面図

(4) 気候に関する資料

(5) NIOC Bushehrのボーリング記録

4.2　調査団による収集資料

(1) イ ラ ン 年 鑑

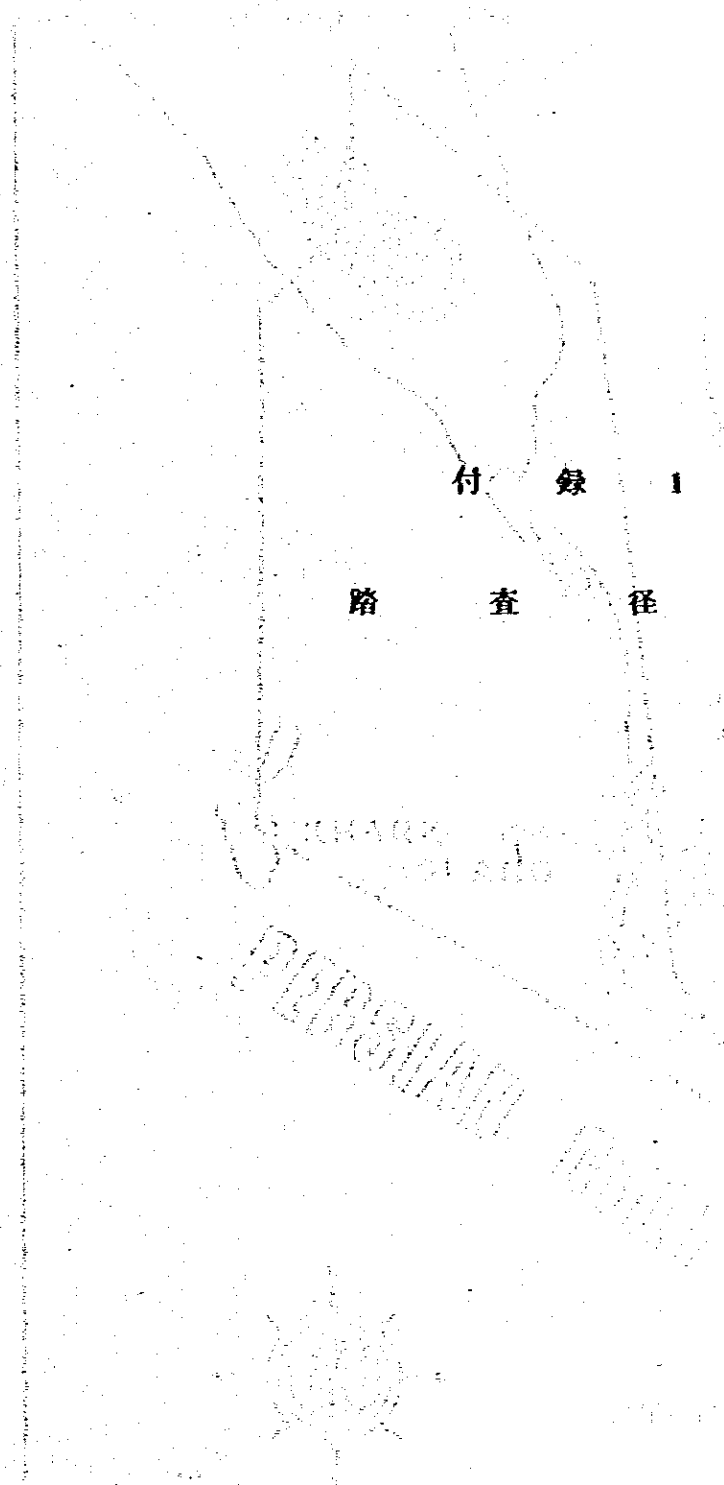
(2) イランのGeneral map

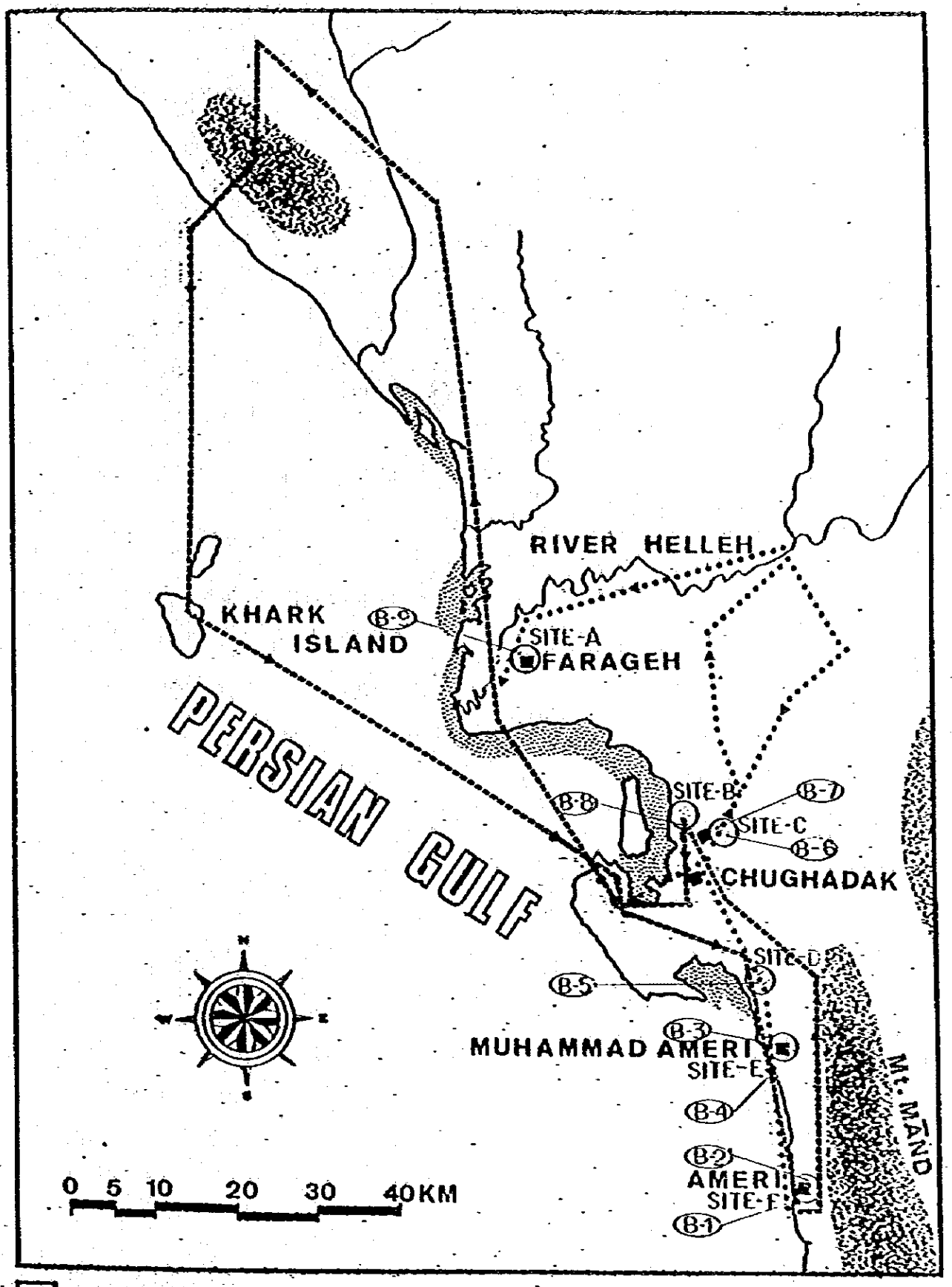
(3) Bushehrに関する一般事項（付録２参照）

(4) 土質調査報告書（付録３参照）

付　録　1

路　査　径　路





LEGEND

AERIAL SURVEY ROUTE

GROUND SURVEY ROUTE

CANDIDATE SITE

SITE RECONNAISSANCE ROUTE ATTACHMENT I

付　録　2

面　談　記　録

1. NIOCのBushehr事務所訪問

場　　所：NIOC Bushehr 事務所

日　　時：1978年6月17日　9:00~11:00

面 会 者：Akghar氏　（BushehrのNIOC代表者）

面談の要旨

- 現地調査の目的と調査項目の説明
- 政府関係者との会合約束の依頼

2. 関連当局者との面談

場　　所 : Gouerment General Office

日　　時 : 1978年6月17日 11:00~13:00

面 会 者 :

1) Mr. Behnamfar

(Deputy Governor General)

2) Mr. Akghar

(Head NIOC Bushehr)

3) Colonel Etehadieh

(Ground Force)

4) Captain Arjomandzadeh

(Navy)

5) Captain Haghnia

(Police)

6) Captain Shamshegi

(Air Force)

7) Dr. Fanaii

(Head of port Administration)

8) Mr. Navaii

(Head of Ministry of Road Bushehr)

9) Mr. Hormozi

(Atomic Power Organization Representative in Bushehr)

10) Mr. Bahraini

(Governor of Suburbs of Bushehr)

11) Mr. Afandi

(Environmental Department)

面 談 の 要 旨

1) 調査遂行上の取り決め

・航空調査および陸上調査には各々海軍、陸軍が同行する。

・陸上での写真撮影は許可される。

• Atomc Power Station, Ministry of RoadおよびPort Administrationの当局者との打合せを予定する。

2) Bushehr地区に関する情報

• 人　　口　　60,000人

10年前　　3,000人

10年後　　500,000人

• 産　　業

• 造　　船

• 漁　　業

• 貿　　易　（輸出，輸入）

• 農　　業

• 教育および公共福祉施設

• Bushehr市の開発は第6次5ケ年計画の一環である。

• 既存の大規模プロジェクト

• 原子力発電所が建設中

第1、第2発電所が各々1980年末および1981年末に運転を開始する。

200,000㎥／日の淡水化プラントが含まれる。

• アルミ精錬工場が計画中

• 労　働　力

原子力発電所の建設に伴って多数の労働者が全国から集って来ているが、Bushehr地区に限れば一般労働者のみが手当可能

• 日本側が推薦する候補地についてのコメント

• A－1、A－2地区

Hunting Organization およびEnvioomental Organization の管理下にある。

• B、C地区

ChoghadaiおよびAhmadi付近は政府の所有地である。

3. 原子力発電所当局者との面談

場　　所 ： 原子力発電所建設現場事務所

日　　時 ： 1978年6月18日　8:30~10:30

面 会 者 ：

1) Mr. Iraj-Hormazi

（BushehrのAtomic Power Organization代表者）

2) Mr. K. Thieme

（シビルエンジニア、スーパーバイザー）

建設に関して得た情報

・発電能力および淡水化設備容量

第1発電所　1,300MW

第2発電所　1,200MW

淡水化設備　100,000m³/日×2基

・設 計 条 件

・地 震 係 数

イランの建築設計基準　10%G

原子力発電所（Major）　50%G

・海 水 温 度

水温は年間を通じて20~30℃で最高は35℃位。供給水温を28℃としている。

・風向、風速

主たる風向 ： 北　西

風　　速 ： 45~50マイル/時

（最高70マイル/時）

・基 礎 構 造

Non pile foundation on stiff clay

・冷 却 水

Once though

1Km沖合で排水

• 調　　達

• セ　メ　ン　ト

建設開始当初はShiraz その他から購入していたが、後に輸入となった。

セメント工場建設計画がある。

• 鋼　　材

計100,000トンを輸入した。

• 骨 材 ・ 石 材

砕石プラントを建設して採取した。採取場は Borajan, Aharam である。

• 入荷および輸送

一 般 貨 物 ： Bushehr港から

重 量 貨 物 ： はしけを用いて専用桟橋から

最重量取扱貨物 ： 500トンの反応器

• 労働者の動員

労 務 者 総 計 ： 7,000~8,000人（ピーク時）

地 区 労 働 者 ： 4,500人（一般労働者）

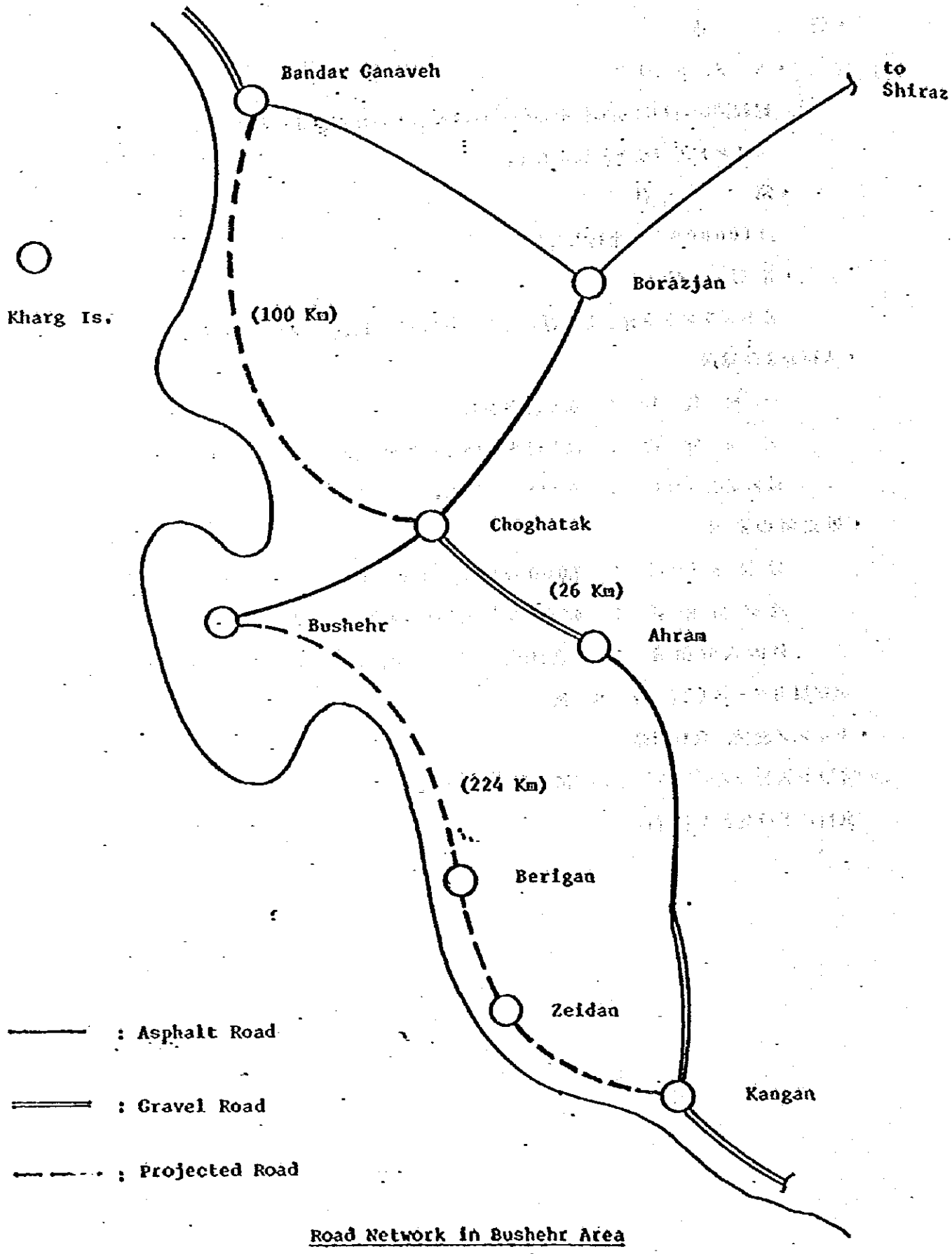
外国人労働者 ： 東欧諸国、パキスタン、アフガニスタン、トルコ、イラク等

直接雇用ベース（広 告 募 集）

• キャンプ設備、食料調達

イラン人労働者の½はキャンプに居住させている。

食料は下請業者から調達



Road Network in Bushehr Area

4. Ministry of Road当局者との面談

場　　所：BushehrのMinistry of Road

日　　時：1978年6月19日　11:00~12:30

面 会 者：Mr. Navali (Head of Ministing of Road, Bushehr)

要　　旨

・道　路　網　（添付図参照）

・橋　の　強　度

Bushehr周辺の道路橋は全て30トン／axleで設計されている。

・道路の土盛高さ：1.0～1.2m

5. 港湾当局者との面談

日　　時 ： 1978年6月19日 18:30~19:30

面 会 者 ： Dr. Fanali (Head of Port Administration)

要　　旨 ：

・バ　ー　ス （添付図参照）

・バ　ー　ス　数

海　軍　用　1

一　般　用　2

・一般用バースの寸法

延　　長　170 m × 2

深　　さ　29′ 6″

・プラットフォームの強度 ： 4 ton／m²

・構　　造 ： RC 構　造

・水　　路

幅　　幅　140′ ~150′

深　　さ　30′ ~ 33′

・年間稼動日数

1年中利用可能

・荷 揚 設 備

・荷揚用機材

50トンのモビールクレーン　3台

・貨物取扱い能力

設　　計　250,000 F. ton/annum

実　　績　最 高　900,000 F. ton/annum

(2,500 F. ton/day)

平 均　1,800~2,000 F. ton/day

・荷 揚 能 力

最 高 実 績　300 ton/piece

パイプ ： 80 m長、1.5 m径

・倉　　庫

900㎡×3棟

450㎡×8棟

・貯 蔵 用 地　　125,000㎡

・海 洋 条 件

・潮 の 干 満

Bushehrで約1.5 m

・海 底 土 質

爆破作業はしなかった。

浚渫工事は通常の浚渫機械で施行。

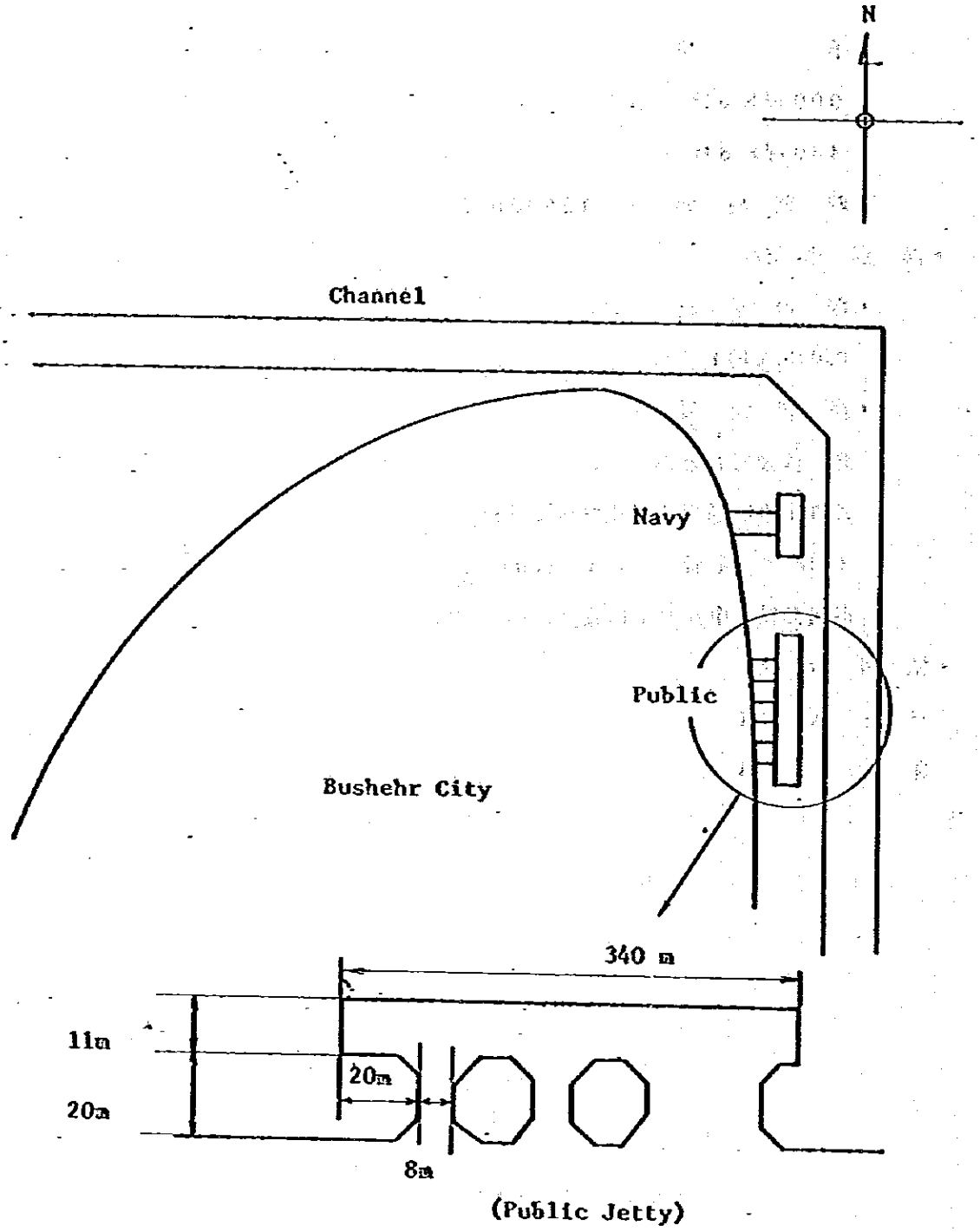
土 砂 堆 積 量　　1 ft/year

港湾荷役は中止せずに浚渫作業を常に行なっている。

・拡 張 計 画

バ ー ス　4

倉　　庫　3



Jetties at Bushehr Port

付　録　3

土　質　調　査　報　告

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REPORT PAGE

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REPORT
GEOTECHNICAL SITE RECONNAISSANCE
PROPOSED BUSHEHR EXPORT REFINERY
BUSHEHR, IRAN

1.0 INTRODUCTION

In this report we present the results of our preliminary soils investigation for the proposed Export Refinery to be constructed near Bushehr.

A total of 9 boring points, clustered in 4 general areas of Mohammad Ameri, Chah Talkh-e-Paiin, Choghadak and Ferageh were selected for this reconnaissance study. The selection was made after a visit to the general Bushehr area.

One reconnaissance boring was drilled at each potential site. The general boring locations are shown on Plate 1, Vicinity Map. Details of boring locations in each of the four areas are shown on Plates 1-A through 1-C, Boring Locations.

No boring was drilled at Ameri during this study. Previous Site Selection and Site Validation studies by Dames & Moore for nuclear power plants in that area indicated favorable foundation conditions.

1.1 PROPOSED CONSTRUCTION

We understand that for this preliminary study the proposed Grass-Roots refinery will have a capacity of 500,000 barrels per day. In addition to the main refinery, the planned construction would also include a crude oil pipeline from Gurreh

Station; product pipelines from the refinery to an offshore loading facility; an offshore loading facility; housing and related facilities and an all-weather highway to the refinery.

1.2 PURPOSE

The purpose of this reconnaissance study was to evaluate these 9 boring locations from a geotechnical viewpoint and rank them in order of foundation suitability.

1.3 SCOPE OF WORK

In accordance with your request, the scope of our work consisted of the following;

1. Participation in a field reconnaissance trip to select boring locations;

2. Drilling and sampling of a total of 9 borings, all to depth of 30 meters. The sampling for this reconnaissance study was requested to be carried out at one meter intervals and Standard Penetration Tests only. No undisturbed sampling and testing was planned for this phase of the study;

3. Grain size analysis of 90 samples (10 per boring);

4. Preparation of a written report consisting of boring logs, a description of field methods and a brief discussion of conditions at each boring location.

1.4 GENERAL SOILS CONDITIONS AT BUSHEHR AREA

The soils at the general Bushehr area vary from very soft muds and loose sands to hard clays, very dense sands, gravelly soils, sandstones and coral limestones. Generally speaking, the thickness and extent of softer soils increase towards the shore while more competent deposits prevail as one approaches the mountains east of the coast.

The thickness and depth of the soft soil layers vary along the coast from place to place. To the northeast of Bushehr and in the vicinity of Helleh River, soft soils start near ground surface and extent to depths as much as 30 meters. To the south of Bushehr Pennisula, the thickness and extent of these soft soils generally decrease and near Hallileh are basically non existant. In this area very stiff to hard clays and dense sands which are covered with a coraline limestone caprock are present.

The soft soils reappear south of Bushehr Pennisula but their extent is variable and are normally limited to the coastal region. Alluvial sands and gravels are normally encountered shortly to the east of the coast. The thickness and extent of alluvial sands and gravels increase in areas where the shore is close to the mountains. In Ameri area, for example, these alluvial deposits extend from near surface to depths in excess of 50 meters in some places.

The main source of most of the Bushehr area soils is Aghajari Formation which makes up most of the mountains immediately east of the coast. Due to the abundance of gypsum and anhydrite in this formation, nearly all shallow soils of the Bushehr area have high sulfate contents and hence use of sulfate resisting cement is a must for all concrete in contact with soils.

2.0 RESULTS

The surface and subsurface conditions encountered in each of the boring locations are presented in this section. A detailed description of field exploration methods and laboratory testing procedures are presented in the Appendix.

2.1 MOHAMMAD AMERI AREA

A total of 4 borings were drilled at four separate sites in this general area. The location of this area relative to Bushehr is shown on Plate 1, Vicinity Map. Details of boring locations in this area are presented on Plate 1-A. The conditions encountered in each boring locations are described in the following paragraphs:

2.1.1 ACCESS

The access to this area is through the main Choghadak-Ameri road. The road from Bushehr to the junction of Choghadak-Ameri road is about 24 km long and is paved. This is the main Bushehr-Borazjan road which the Ameri road joins about 2 km, southwest of Choghadak.

The Ameri road is a second class gravel road from this junction, up to a distance of about 19 kilometers. A third class dirt road follows the gravel road and is the main access to the Mohammad Ameri sites and other coastal villages beyond. The gravel section of the road is accessible all-year round while the dirt road that follows may not be usable in some places during wet seasons. When accessible, the Mohammad Ameri

area sites can be reached from Bushehr with a 4-wheel drive vehicle within 1.5 - 2 hours

2.1.2 SITE AROUND BORING NO. 1

A- Location:

This is the farthest site south of Bushehr and at about 63 kilometers (road distance) from it. The site is located between Mohammad Ameri (Medumeri) and Bashi villages and within a kilometer of the Persian Gulf. The boring location of this site (B-1) is shown on Plate 1-A.

B- Surface Conditions:

This site is traversed by several branches of a drainage system. Small bushes and weeds are scattered throughout the site. The ground surface is covered with very fine grained sandy and silty soils. A moving sand dune, of about 600 meters length, 250 meters width and 5-10 meters of crest height is located to the north of the site. The dune's movement is in an easterly direction.

According to local residents, the lower (western) part of the site is occasionally flooded for short periods. Based on the same source, the flood depth has not been observed to exceed 0.5 meter over most of the area, except in the drainage channels.

Photographs of this site taken from near boring No. 1 in north, south, east and west directions are presented on Plate 2-A.

C- Subsurface Conditions:

Details of the soils encountered in the boring drilled at this site (Boring No.1) are presented on Plate A-1A, Log of Boring. A plot of standard penetration resistance versus depth is also shown on the same Plate.

Based on this boring alone, the foundation conditions at this site are fair, down to a depth of about 8 meters. Below this depth, good foundation conditions prevail. The grain size distribution of selected samples recovered from this boring are presented on Plates A-2A through A-2D.

During the field exploration period, the groundwater level was measured to be 1.85 meters below the ground surface at the boring location.

2.1.3 SITE AROUND BORING NO. 2

A- Location:

This site is located about 1.5 kilometers northeast of site No. 1 and about 61.5 kilometers from Bushehr. The general location of the site is shown on Plate 1. Vicinity Map (B-1) and the location of the boring (B-1) drilled at this site is shown on Plate 1-A.

B- Surface Conditions:

This site is located between two main drainage systems south of Mohammad Ameri. Tributaries of these two drainage systems surround the site on the north, east and south sides.

The ground surface is relatively flat with a gentle westerly slope. Short bushes are scattered over the site.

The ground near the western end of the site and close to the Mohammad Ameri - Bashi road is occasionaly cultivated by local farmers. The land, however, is cultivated only during rainy years and is not owned by any private party.

According to local residents, flooding has not been observed at the site in the past 15 years. During the rainy season, the drainage channels around the site remove most of the flood water.

Photographs of this site taken from near boring No. 2 in north, south, east and west directions are presented on Plate 2-B.

C- Subsurface Conditions:

The soils encountered in the boring drilled at this site (Boring No. 2) are described in detail on Plate A-1B, Log of Boring. A plot of standard penetration resistance versus depth is also shown on the same Plate.

As seen from the boring log, the soils underlying the site are predominantly sandy and clayey in nature. The grain size characteristics of selected samples recovered from this boring are presented on Plates A-2E through A-2G.

The soils encountered in the boring drilled at this site indicate good foundation conditions.

The groundwater was measured to be 3.60 meters below

ground surface at the boring location.

2.1.4 SITE AROUND BORING NO. 3

A- Location:

This site is located about 3 kilometers northwest of Mohammad Ameri village and is about 58 kilometers from Bushehr. Its location with respect to the Bushehr area is shown on Plate 1, Vicinity Map (Marked as B-3). The location of the boring (B-3) that was drilled at this site is shown on Plate 1-A.

B- Surface Conditions:

The ground surface at this site is nearly flat, with an estimated maximum difference in elevations over the entire site of about 1-2 meters. Some parts of the site are cultivated irregularly. The land, however, is not owned by anyone.

Based on local residents, the site is occasionaly flooded but the depth of water has not been observed to exceed 0.3 meter at the deepest.

A general view of the site can be seen on Plate 2-C.

C- Subsurface Conditions:

Details of the soils encountered in the boring drilled at this site, along with a plot of the standard penetration resistances are presented on Plate A-1C.

This boring revealed dense silty and clayey sands extending to a depth of about 5 meters. From this depth down to about 7.5 meters, a soft clay underlies the site. Firm sandy and clayey soils extent from 7.5 meters down to the maximum depth drilled (30.0 meters).

The grain size characteristics of selected soils samples recovered from this boring are presented on Plates A-2H through A-2J.

The groundwater was measured to be 1.50 meters below ground surface at this boring location.

2.1.5 SITE AROUND BORING NO. 4

A- Location:

This site is located about 2 kilometers northeast of Mohammad Ameri and about 59 kilometers from Bushehr. The general location of the site (B-4) with respect to its neighborhood is illustrated on Plate 1, Vicinity Map. The as-drilled boring location of this site is shown on Plate 1-A.

B- Surface Conditions:

The ground surface at this site is relatively flat with a few shallow (0.5 - 1 m deep) gullies which form a drainage system, crossing the site. The ground has a gentle westerly slope and is covered with clayey soils.

The land has been cultivated in the past but it has not been used in recent years. The land is not owned by anyone.

Based on local information, portions of the eastern and northern parts of the site become flooded during heavy rainfalls for short periods but the observed flood depth has not exceeded 0.5 meter.

Photographs of this site, taken from near boring No. 4 in a north, south, east and west direction are presented on Plate 2-D.

C- Subsurface Conditions:

The soils encountered in the boring drilled at this site are presented in detail on Plate A-1D. A plot of standard penetration resistance versus depth is also shown on the same Plate.

Based on this boring, sandy and clayey soils representing fair to good foundation conditions extend to a depth of about 16.5 meters. Below this depth very firm soils underly the site down to the maximum depth explored.

The grain size distribution of selected samples that were recovered from this boring are presented on Plate A-2K through A-2M.

The groundwater was measured to be 7.50 meters below ground surface at the boring location.

2.2 CHAH TALKH-E-PAIIN AREA

One boring was drilled in this area for the reconnaissance study. The general location of this area with respect to Bushehr is illustrated on Plate 1, Vicinity Map. The detailed location

of the boring drilled in this area is shown on Plate 1-B.

2.2.1 ACCESS

This area is fairly easily accessible from Bushehr. The access is through the main Choghadak-Ameri and Bushehr-Borazjan roads. The site is located about 17 kilometers from the junction of Choghadak-Ameri and Bushehr-Borazjan roads. Its total distance from Bushehr is about 41 kilometers and the site can be reached within an hour or so, all year round.

2.2.2 SITE AROUND BORING NO. 5

A- Location:

This site is adjacent to and lies to the west of the Choghadak-Ameri gravel road. The general location of the site (B-5) is shown on Plate 1, Vicinity Map and the as-drilled boring location is shown on Plate 1-B.

B- Surface Conditions:

The ground surface at this site is nearly flat with a gentle westerly slope. The site is covered with many short bushes.

Based on information from local inhabitants, the site is occasionaly flooded to a depth not exceeding 0.7 meter.

The land is not cultivated and is not owned by anyone.

Photographs of this site are presented on Plate 2-B.

C- Subsurface Conditions:

The soils encountered in this area are presented in detail on Plate A-1E. The variation of standard penetration resistance with depth is also presented on the same Plate.

Based on the boring drilled at this site, a relatively poor soils condition prevails down to a depth of about 7 meters. The foundation conditions improve below 7 meters and become fair to good down to a depth of 12.5 meters. Below 12.5 meters and down to a depth of 30.0 meters, excellent foundation conditions prevail.

The grain size characteristics of selected soil samples recovered from this area are presented on Plates A-2N through A-2P.

The groundwater level inside the boring was measured to be 1.10 meters below ground surface.

2.3 CHOGHADAK AREA

A total of 3 borings were drilled in this general area (borings 6, 7 and 8). The location of this area relative to Bushehr is shown on Plate 1, Vicinity Map. The as-drilled boring locations of this area are presented on Plate 1-B.

2.3.1 ACCESS

The access to this area is by the main paved Bushehr-Borazjan road up to Choghadak and then over dirt tracks to each site.

The main paved road is usable all year round and Choghadak can be reached from Bushehr with any vehicle within half an hour. However, the tracks which depart from Choghadak to each of the 3 sites in this area, are not accessible during wet season because of flooding. At the time of the field exploration, all sites were easily accessible within less than 10 minutes from Choghadak.

2.3.2 SITE AROUND BORING NO. 6

A- Location:

This site is located about 2 kilometers east of the Bushehr-Borazjan road and approximately 1 kilometer south of the Choghadak Ameri gravel road. The general site location (B-6) is shown on Plate 1, Vicinity Map and the as-drilled boring location of this site (B-6) is illustrated on Plate 1-B.

B- Surface Conditions:

The ground surface at this site is nearly flat and is covered with scattered short bushes and weeds. Some areas in the northern and eastern parts of the site are occasionaly cultivated, but the land is not owned by anyone.

Based on local data, it appears that the site is flooded almost every year. The flood depth in some places is as great as 1.2 meters.

Photographs of this site are presented on Plate 2-F.

C- Subsurface Conditions:

Details of the soils encountered in the boring drilled at this site are presented on Plate A-1F. A plot of standard penetration resistance versus depth is also presented on the same Plate.

From ground surface down to a depth of about 6 meters, the site was underlain by medium stiff clayey soils, which make a fair foundation condition. Below 6 meters very dense sands were encountered at the site, representing good foundation condition.

The grain size characteristics of selected soil samples recovered from this area are presented on Plates A-2Q through A-2S.

The groundwater level was measured to be 2.75 meters below the ground surface during the field exploration period.

2.3.3 SITE AROUND BORING NO. 7

A- Location:

This site is located about 2 kilometers west of the Bushehr-Borazjan road. The general location of the site (B-7) is shown on Plate 1, Vicinity Map and the as-drilled boring location at this site is presented on Plate 1-B.

B- Surface Conditions:

The ground surface is nearly flat at this site. The maximum difference in elevations over the entire site is estimated to be less than 1 meter.

Small bushes are scattered over the site. The land is not owned by any private party.

Based on local information, the site is apparently flooded almost every year during the wet season. The depth of observed flooding in some places exceeds 1.5 meters.

Photographs of the site are presented on Plate 2-0.

C- Subsurface Conditions:

The soils encountered in the boring drilled at this site (Boring No. 7) are presented in detail on Plate A-1G. The variation of standard penetration resistances with depth is also presented on the same plate.

Medium stiff clays extend from near the ground surface down to a depth of about 10 meters representing poor foundation conditions. From 10 meters down to 16.5 meters stiff clays, hence fair foundation conditions were encountered. Below 16.5 meters dense sands and hard clays representing good foundation conditions were present at the boring location to the depth explored.

The grain size distribution for selected samples of the soils recovered from this site are presented on Plates A-2T through A-2V.

The groundwater level was measured to be 1.20 meters below ground surface at this location.

2.3.4 SITE AROUND BORING NO. 8

A- Location:

This site is located about 5 kilometers west of site No. 7

and about 7 kilometers west of Choghadak. The general location of this site (B-8) with respect to the Bushehr area is shown on Plate 1, Vicinity Map. The location of the boring drilled at this site (B-8) is shown on Plate 1-B.

B- Surface Conditions:

The ground surface at this site is covered with a thin loose silty soil and is nearly flat. A few very shallow and broad drainage channels cross the site. However, the maximum elevation difference over the entire site is estimated to be less than 1 meter.

The land is not owned by any private party and belongs to the government.

Local inhabitants inform that the site is flooded almost every year. However, no observations have been made of the depth of flooding at this site because of its remote location. Based on observations made in the vicinity of site No. 7 and considering the nearly flat topography, it is estimated that the flood depth at this site could be in excess of 1 meter.

Photographs of this site are presented on Plate 2-H.

C- Subsurface Conditions:

Details of the soils encountered in this area, along with a plot of the variation of penetration resistance with depth are presented on Plate A-1H.

At the boring location, the site is underlain with rather

poor foundation soils down to a depth of about 14.5 meters. Dense to very dense sands and very stiff to hard clays extend from 14.5 meters down to 30.0 meters.

The grain size characteristics of selected soil samples recovered from this site are presented on Plates A-2W through A-2Y.

The groundwater level was measured to be 1.20 meters below ground surface at the boring location.

2.4 HELLEH RIVER AREA

One boring was drilled in this area (Boring No. 9). The general site location with respect to the Bushehr area is shown on Plate 1, Vicinity Map.

2.4.1 ACCESS

This is the farthest site from Bushehr and is about 130 kilometers away from it. The access roads to the site can be divided into 3 sections. From Bushehr up to the Village of Ab-Pakhsh on the main Genaveh road, a distance of about 82 kilometers, the road is paved. A secondary gravel road extends from Ab-Pakhsh down to Mokaberi Village, a distance of about 25 kilometers. This part of the road, like the paved section, is accessible all year round. Dirt tracks extend for a distance of about 23 kilometers from Mokaberi Village down to the site. Some sections of this road are not passable during the wet season. During the field exploration the site was reached from Bushehr with a 4-wheel drive vehicle in about 3 hours.

2.4.2 SITE AROUND BORING NO. 9

A- Location:

The site is located about 2.7 kilometers east of Farageh village. The general site location with respect to the Bushehr area is shown on Plate 1, Vicinity Map. The location of the boring drilled at this site (B-9) is shown on Plate 1-C.

B- Surface Conditions:

The ground surface at this site is nearly flat. The maximum elevation difference over the entire site is estimated to be less than 1 meter. Several very shallow (less than 0.3 meter deep) and broad drainage channels cross the site. The ground surface is covered with a thin loose silty soil and many short bushes are scattered over the site.

The land is not cultivated and does not belong to any private party.

According to local residents, the site is apparently flooded on occasions, but no information was available on flood depth.

Photographs of this site are presented on Plate 2-I.

C- Subsurface Conditions:

Details of the soils encountered at this site are presented on Plate A-II. A plot of the variation of penetration resistance with depth is also presented on the same Plate.

Very poor foundation soils were encountered down to a depth of about 25.5 meters. Below this depth and down to 30.0 meters in depth, dense to very dense sands and very stiff clays underly the site.

The gradation characteristics of selected soil samples recovered from this area are presented on Plates A-2Z through A-2BB.

The groundwater level, measured one hour after the completion of the boring, was found to be 4.5 meters below ground surface.

3.0 CONCLUSIONS AND RECOMMENDATIONS

Each of the 9 sites investigated have their merits and potential problems. While it should be realized that the amount of information from each boring location is very limited, from the viewpoint of foundation suitability, the sites can be preliminarily ranked, in a decreasing order, as 2, 4, 3, 6, 1, 5, 8, 7 and 9. However, more detailed study is required to evaluate the overall economic and environmental suitability of each site.

We recommend that the potential for flooding, fill and aggregate sources, fresh water resources, and the availability of infra structures such as roads, power lines, etc. be studied in more detail during the next phase of this site selection investigation.

Considering the foundation conditions, estimated site grading and fill requirements, access, and the fact that most

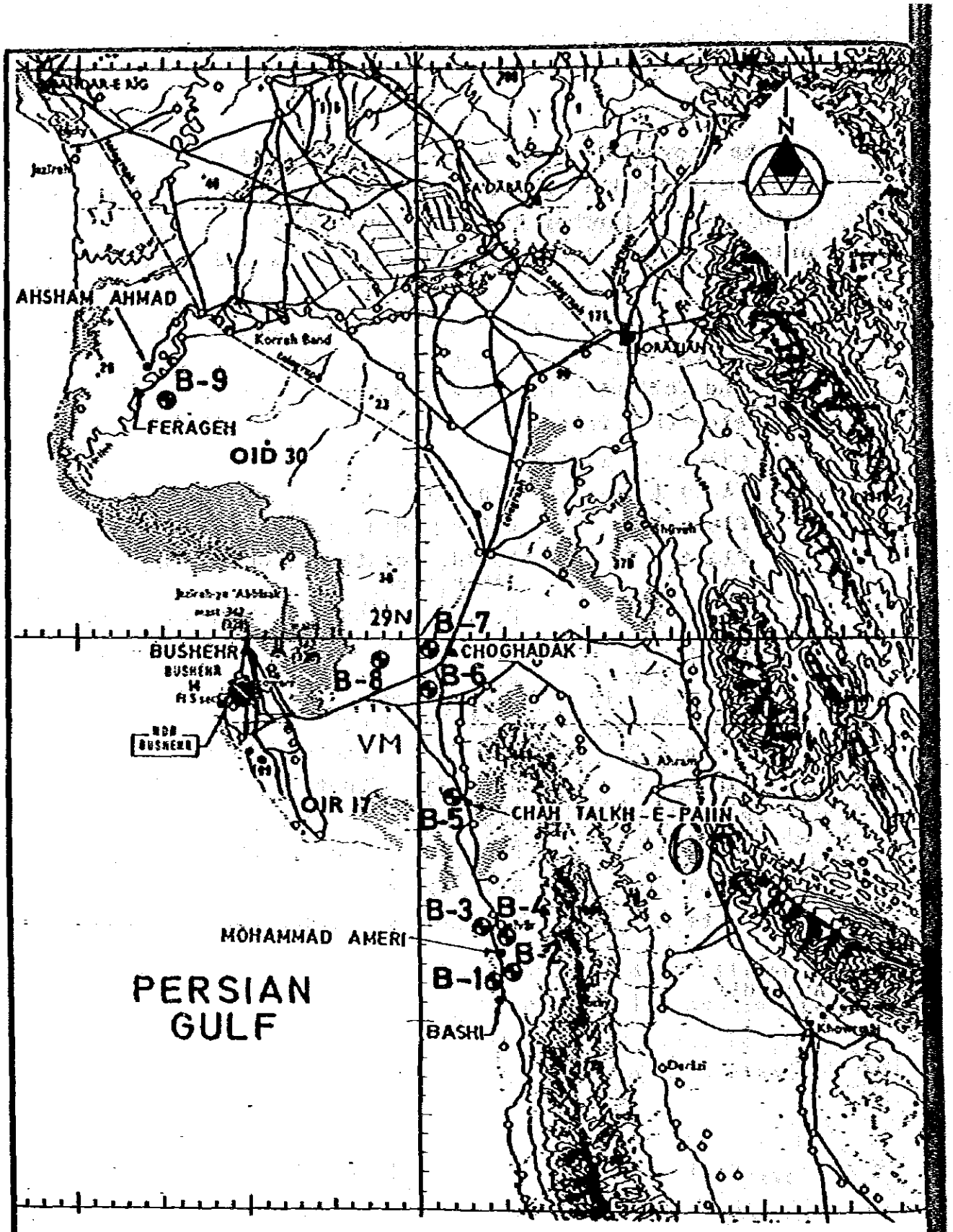
of the known fill and aggregate sources of the Bushehr area are located within short distances from Choghadak, it is our opinion that further detailed investigation should be primarily concentrated in Mohammad Ameri and Choghadak areas.

- * * * * * -

The following Plates and Appendix are attached and completed this report:

Plate 1	Vicinity Map
Plate 1-A	Boring Locations, Mohammad Ameri Area
Plate 1-B	Boring Locations, Choghadak/Chah Talkh Area
Plate 1-C	Boring Location, Helleh River Area
Plate 2-A	Site No. 1 Photographs
Plate 2-B	Site No. 2 Photographs
Plate 2-C	Site No. 3 Photographs
Plate 2-D	Site No. 4 Photographs
Plate 2-E	Site No. 5 Photographs
Plate 2-F	Site No. 6 Photographs
Plate 2-G	Site No. 7 Photographs
Plate 2-H	Site No. 8 Photographs
Plate 2-I	Site No. 9 Photographs

Appendix

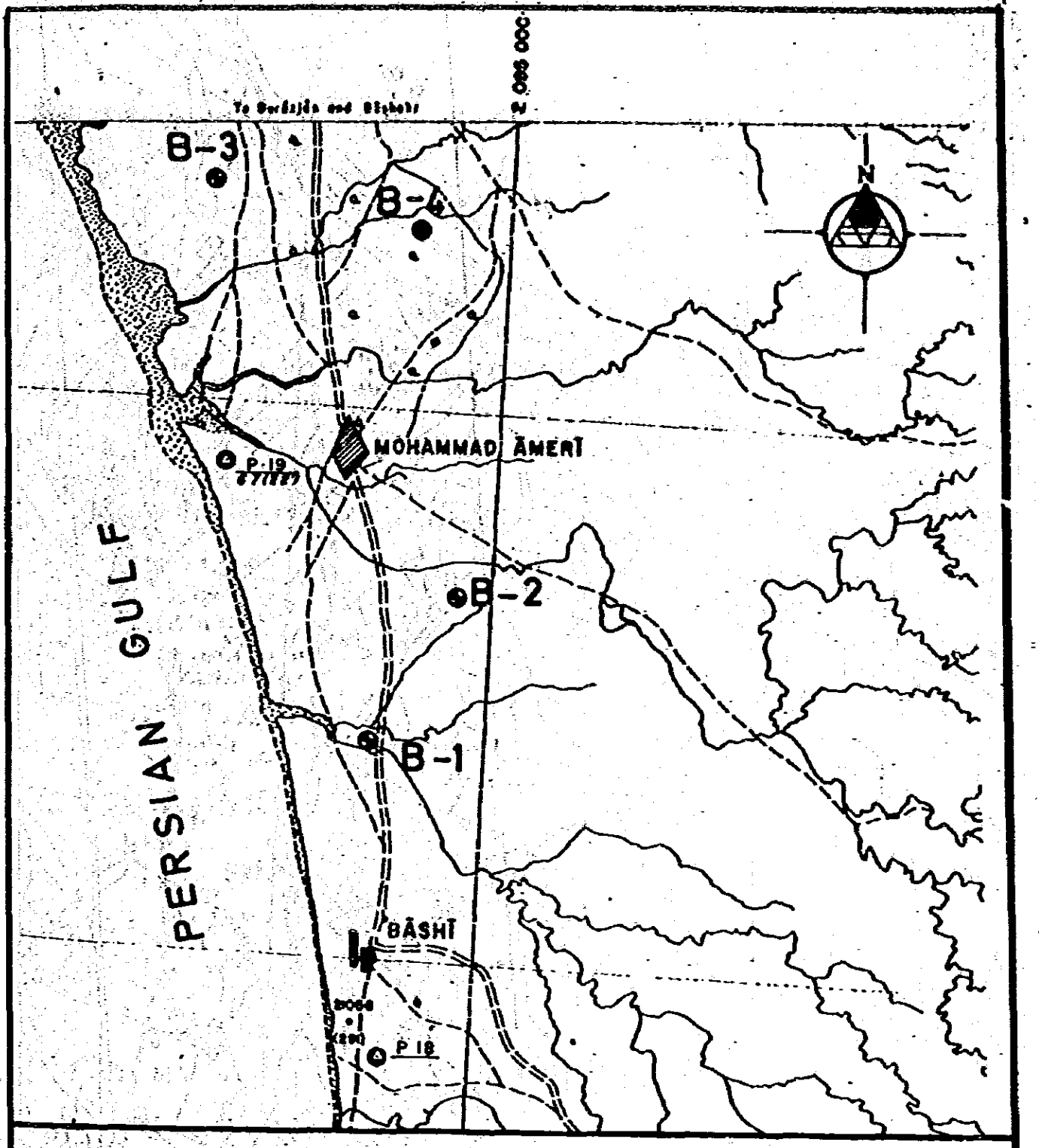


VICINITY MAP

SCALE 1:500,000

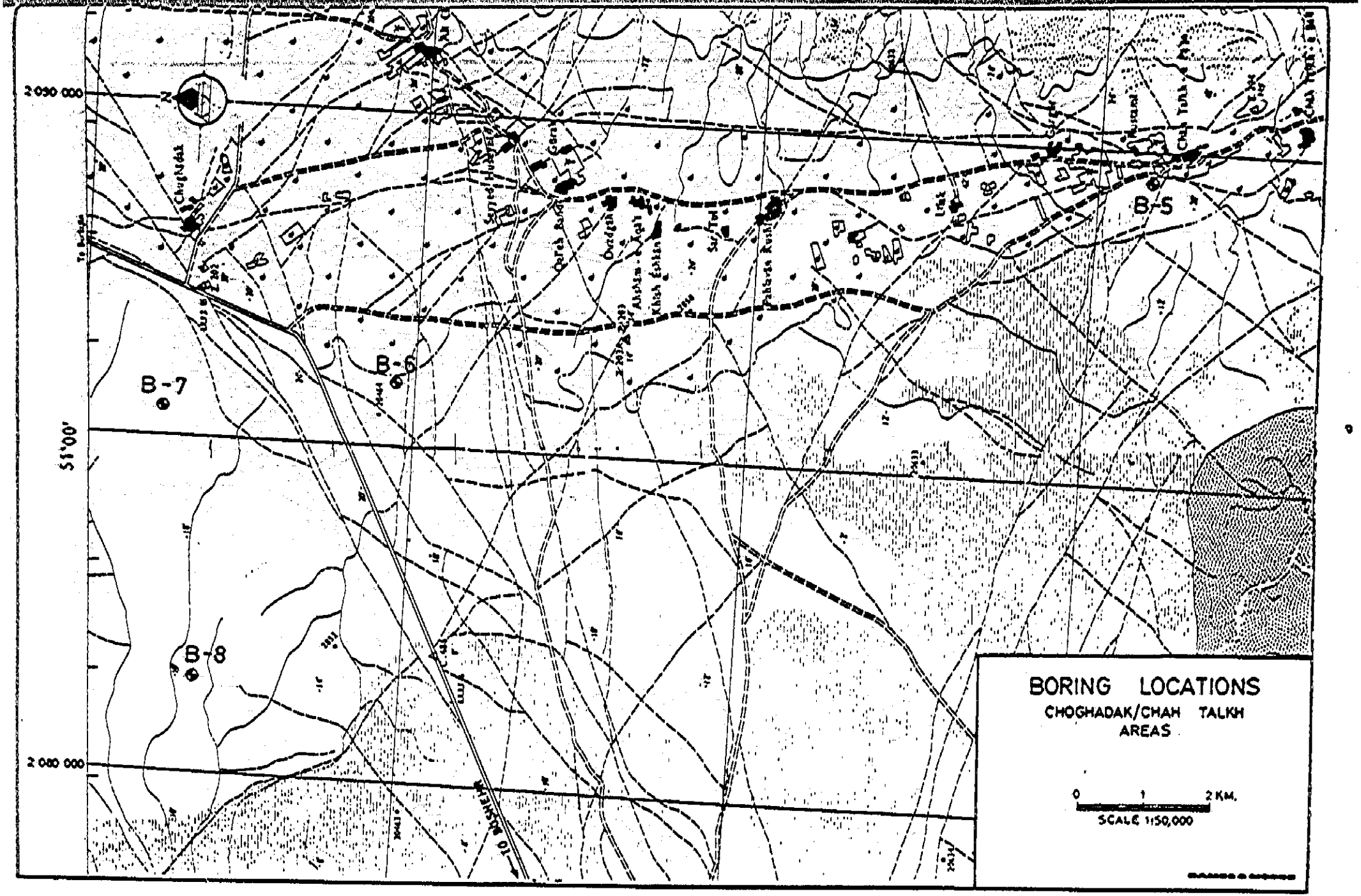
● BORING LOCATIONS

PLATE 1



BORING LOCATIONS
MOHAMMAD AMERI AREA

PLATE 1-A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B-7
B-8
BORING LOCATIONS
CHOGHADAK/CHAH TALKH
AREAS
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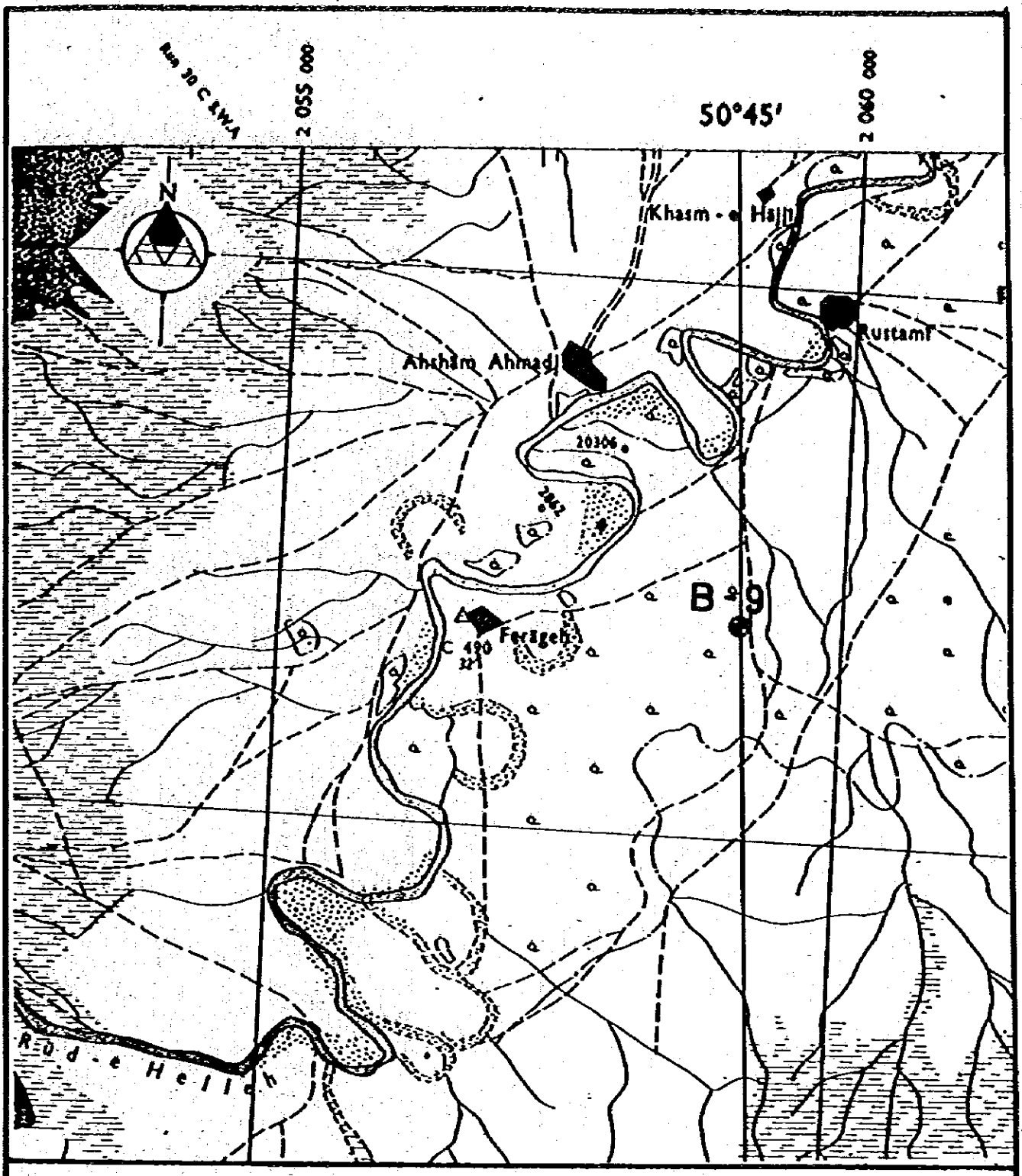

BORING LOCATIONS
HELLEH RIVER AREA

0 1 2 KM.

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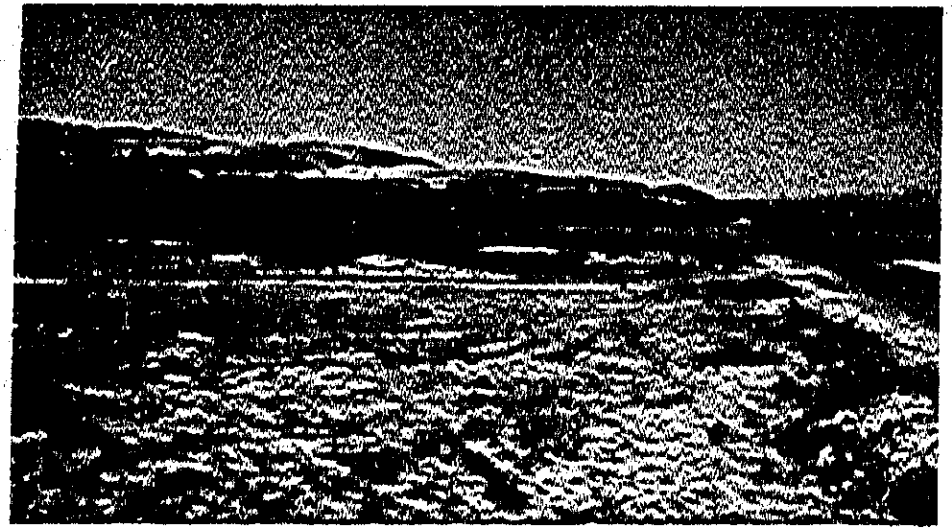
HAMES & MOORE

PLATE 1-C



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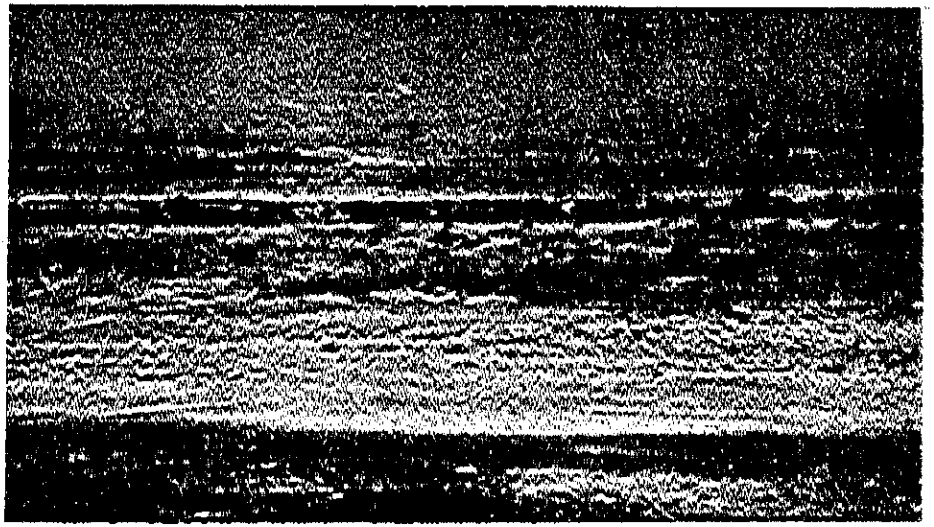

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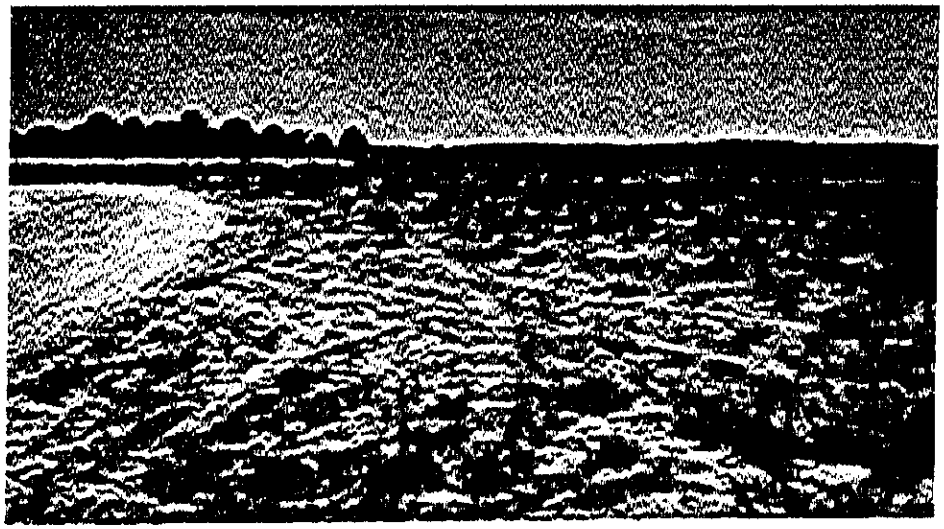

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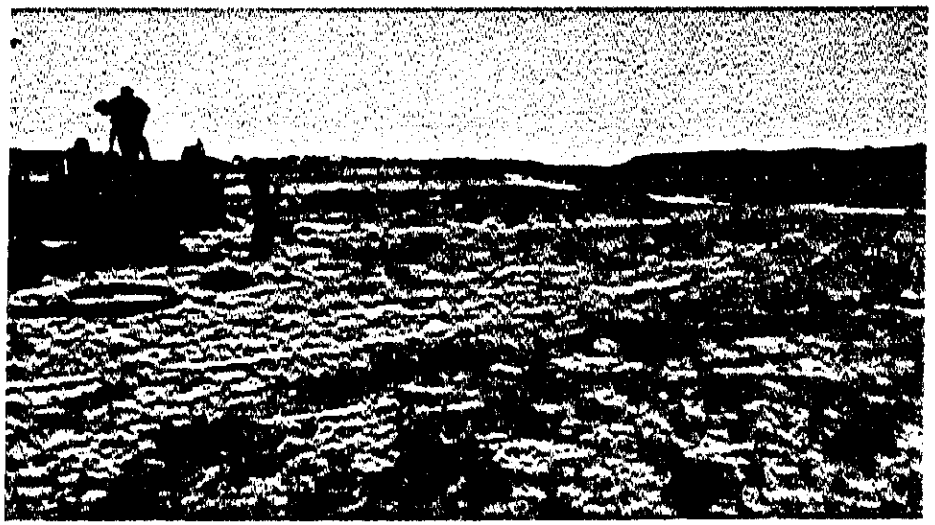
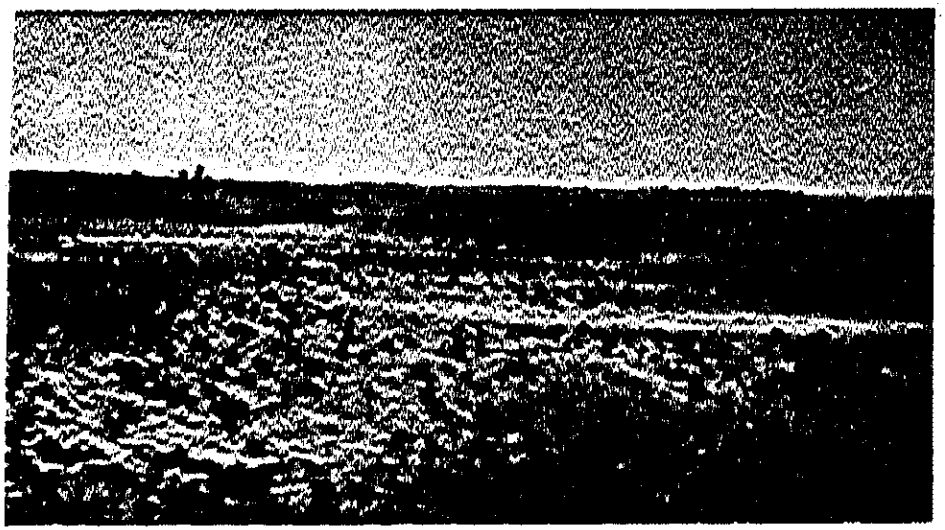


WEST

SITE NO. 1 PHOTOGRAPHS

PLATE 2A



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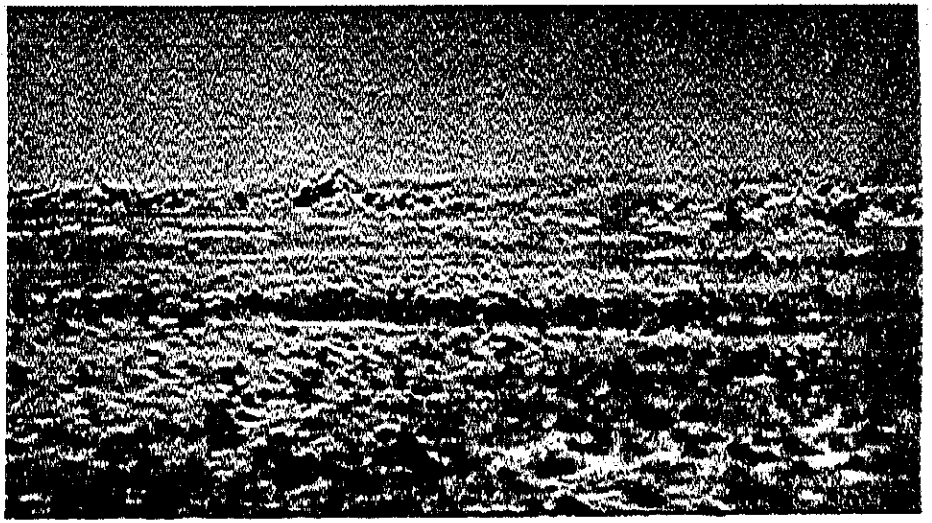

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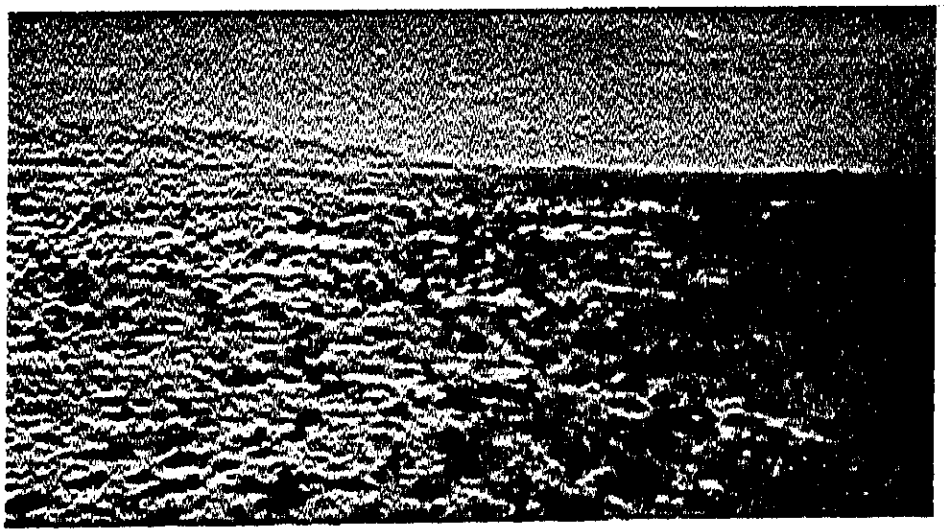

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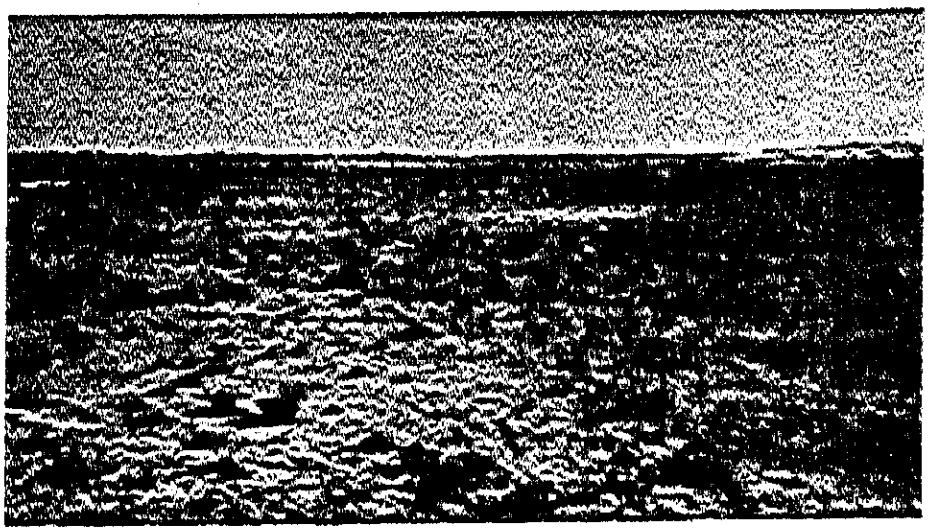

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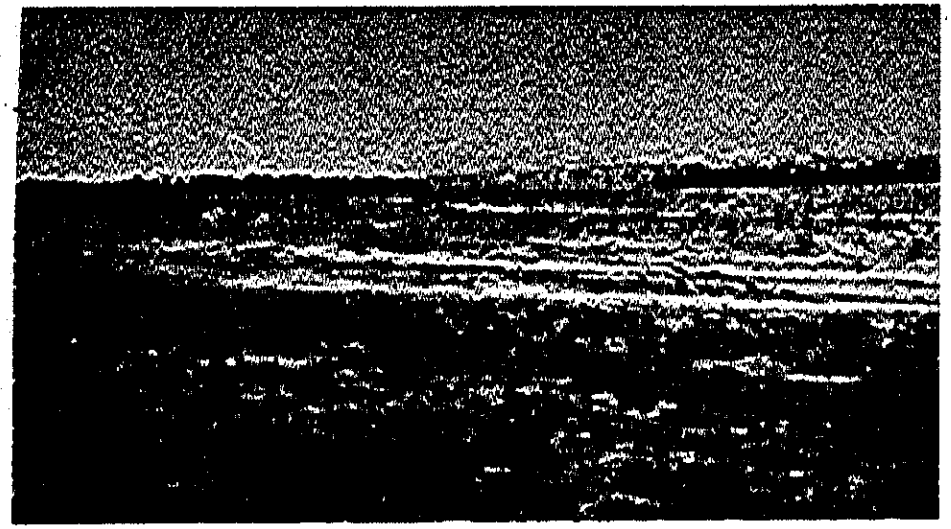
SITE NO. 2 PHOTOGRAPHS

PLATE 2B



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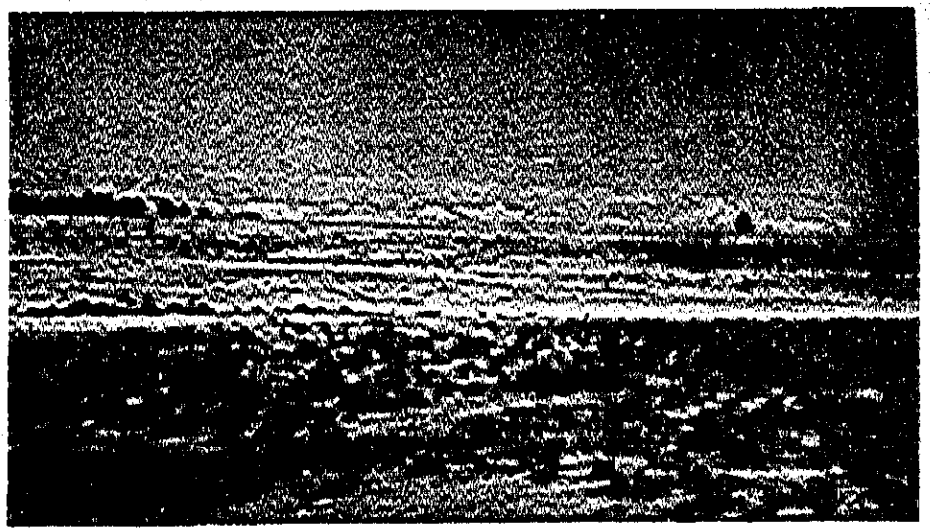

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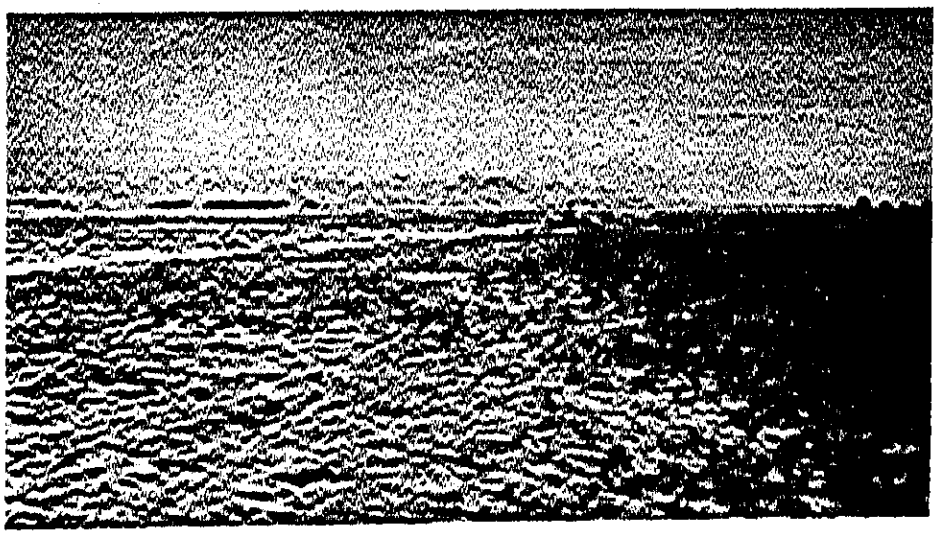

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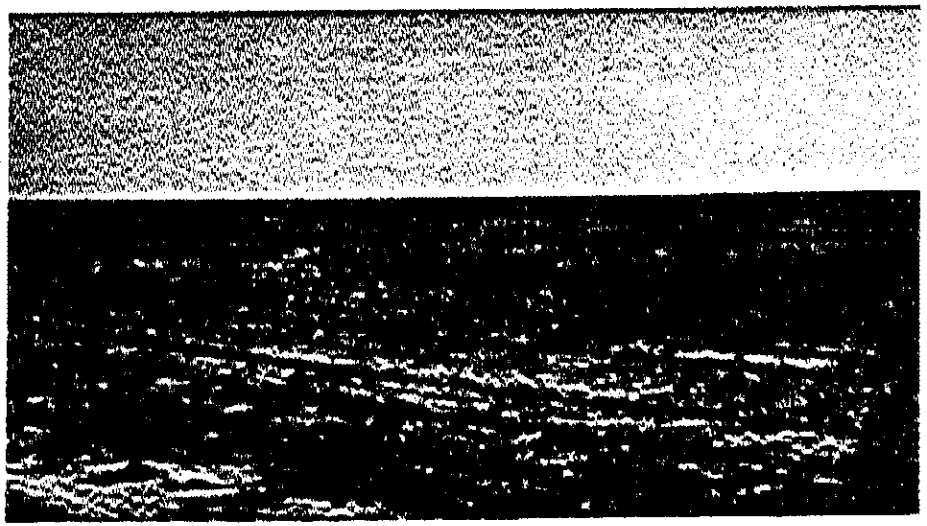

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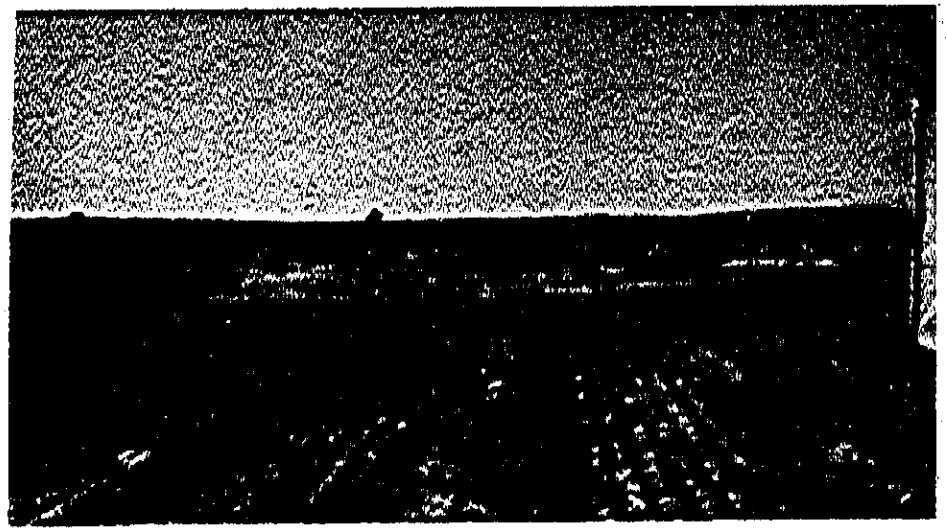
SITE NO.3 PHOTOGRAPHS

PLATE 2C



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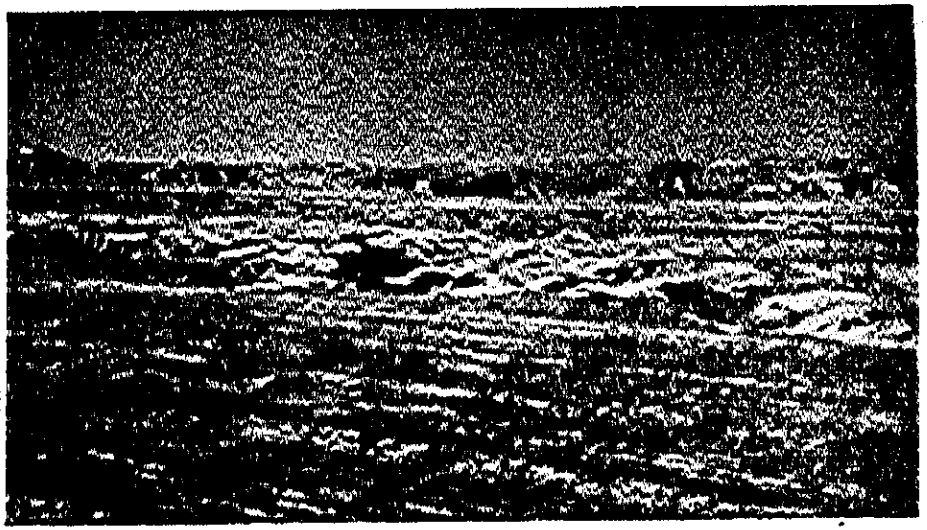

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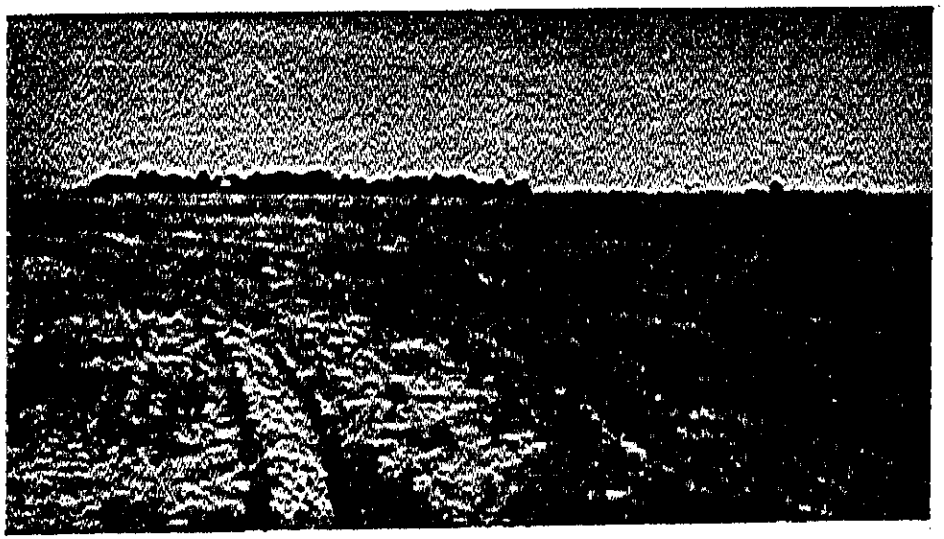

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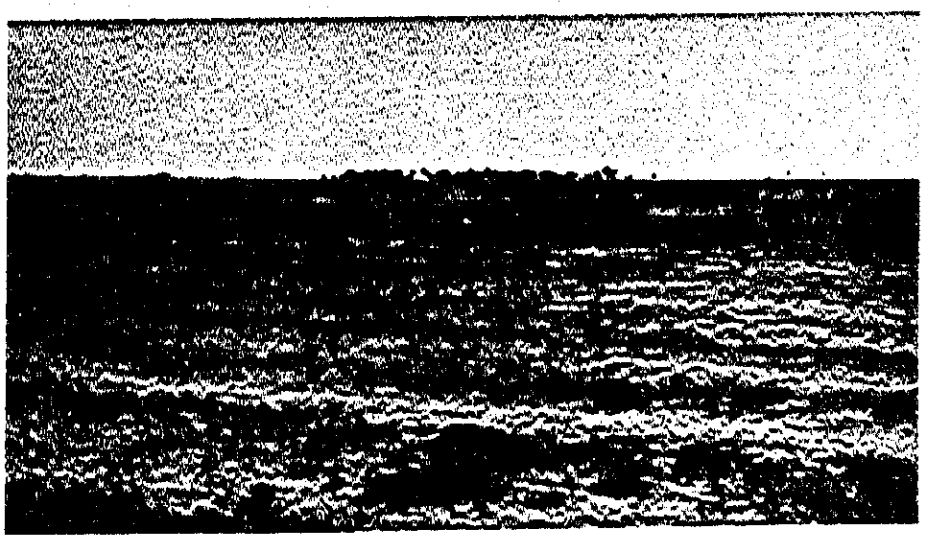

WEST

SITE NO. 4 PHOTOGRAPHS

PLATE 2D

EAST

WEST

SITE NO. 5 PHOTOGRAPHS

NORTH

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PLATE 2B

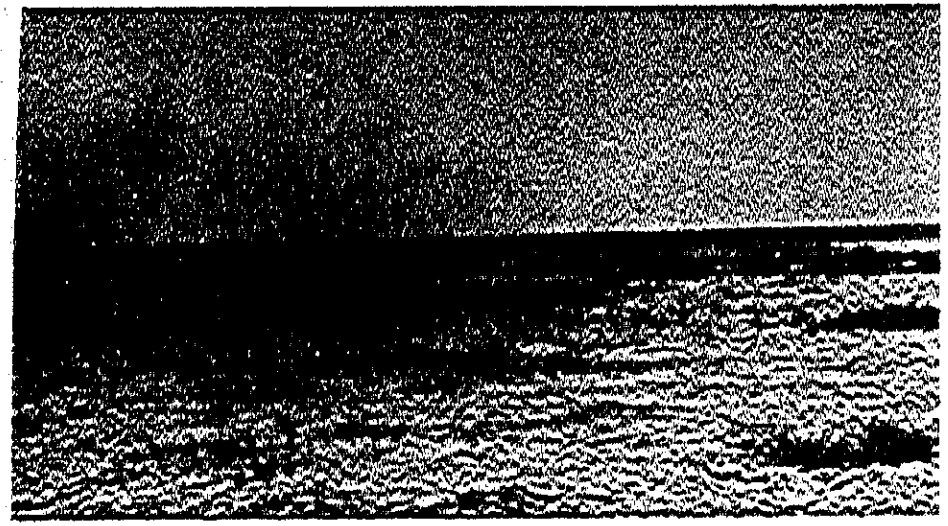
EAST

WEST

SITE NO. 6 PHOTOGRAPHS

NORTH

SOUTH



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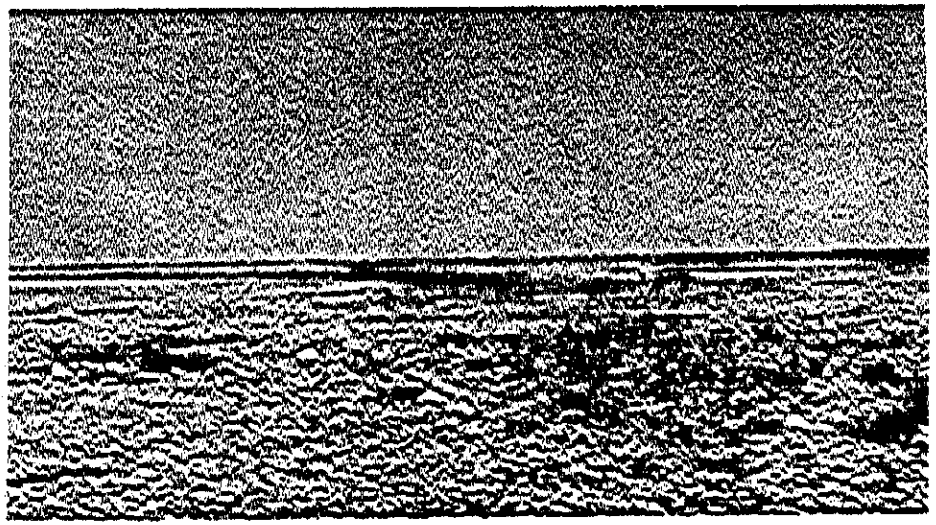

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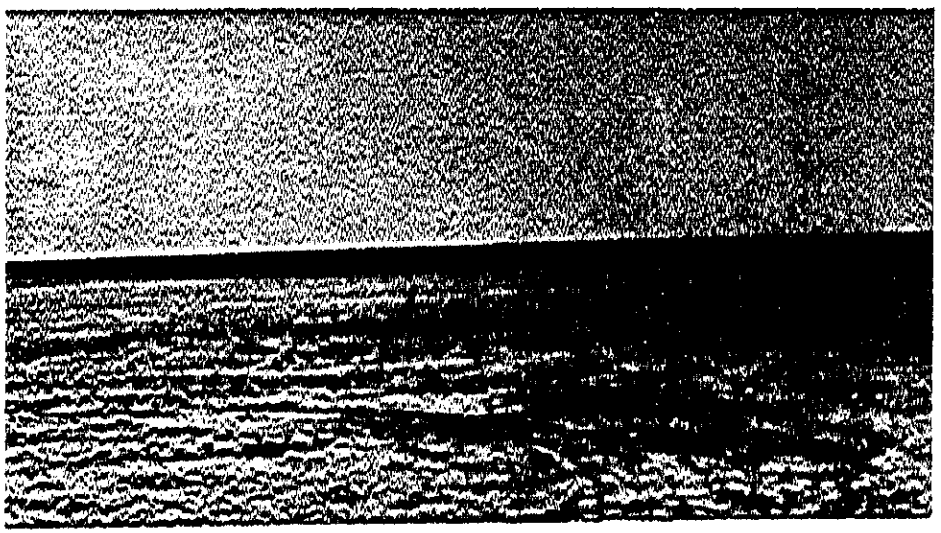

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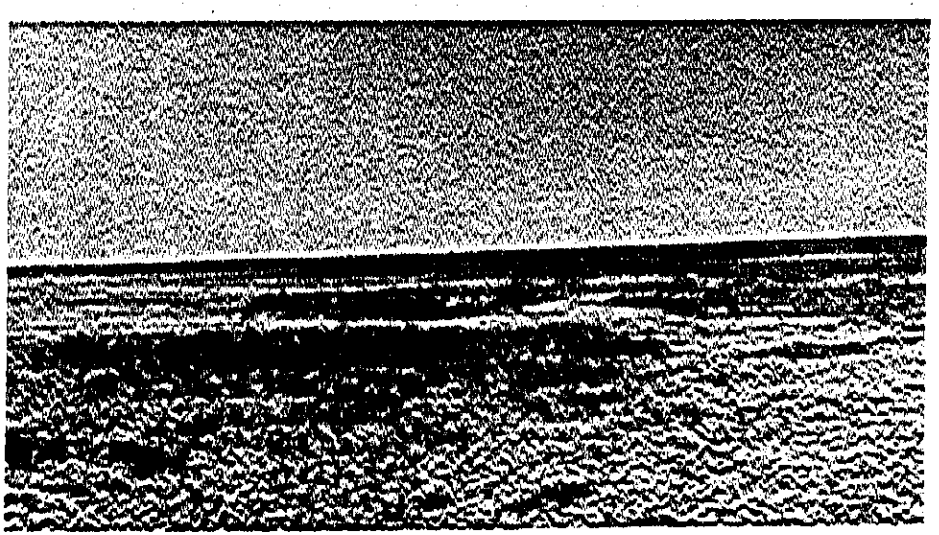

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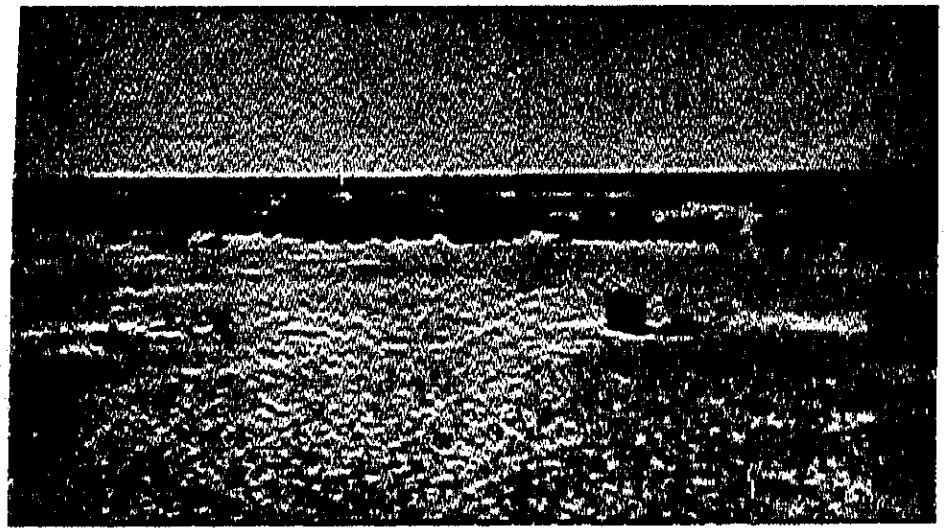
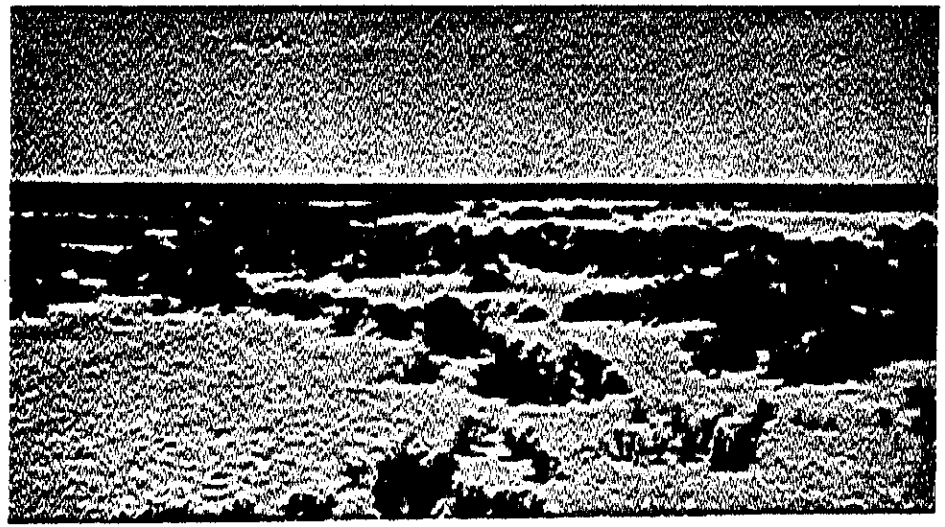
SITE NO. 7 PHOTOGRAPHS

PLATE 2G

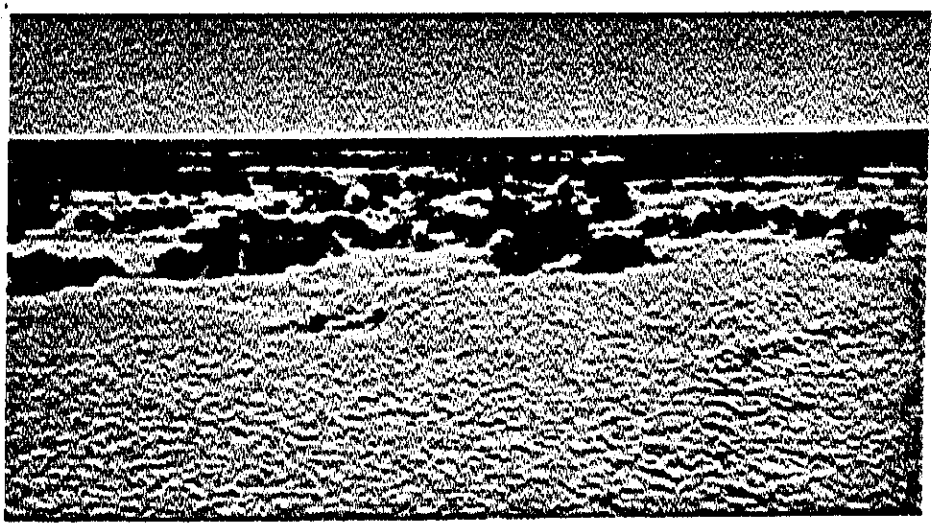


NORTH

EAST



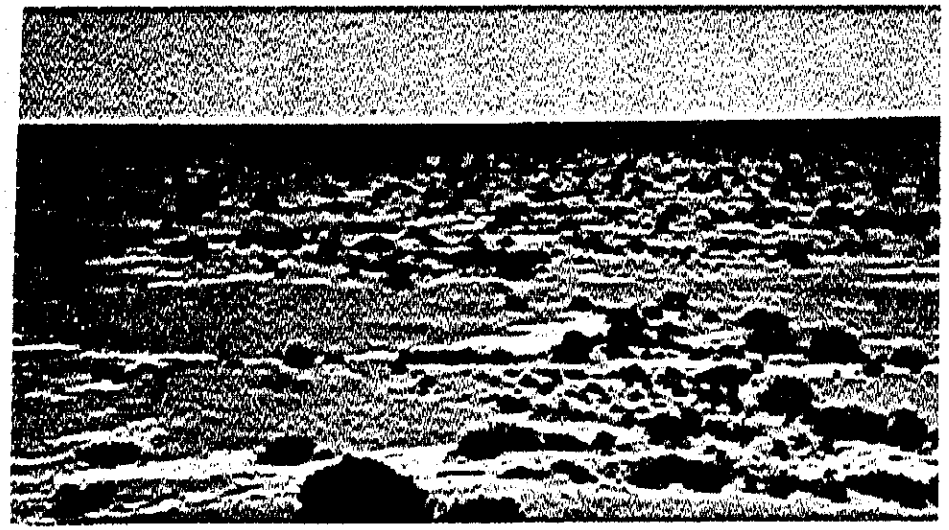
SOUTH



WEST

SITE NO. 8 PHOTOGRAPHS

PLATE 2H



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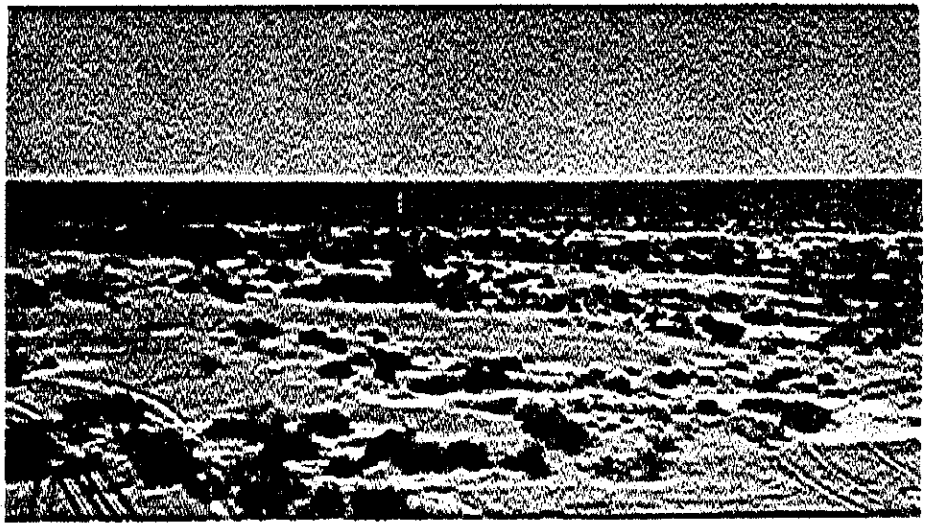
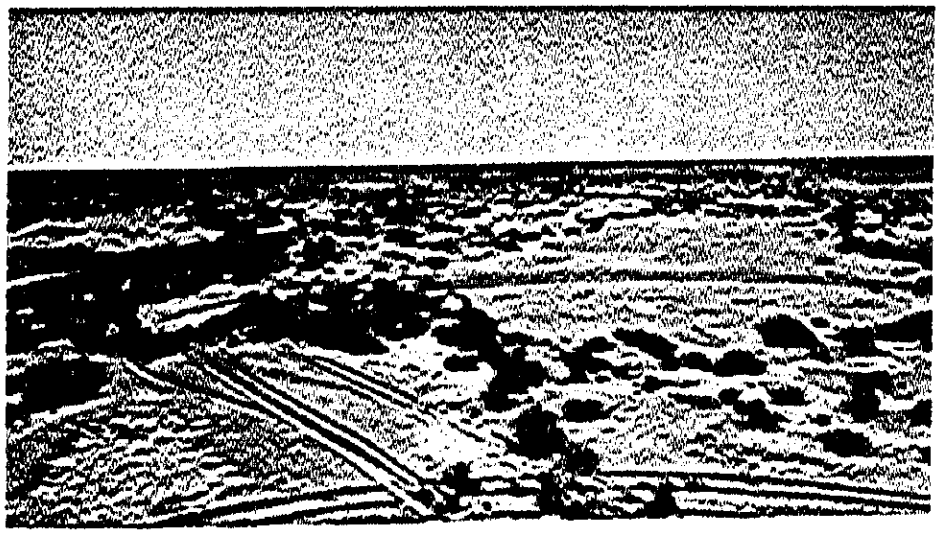
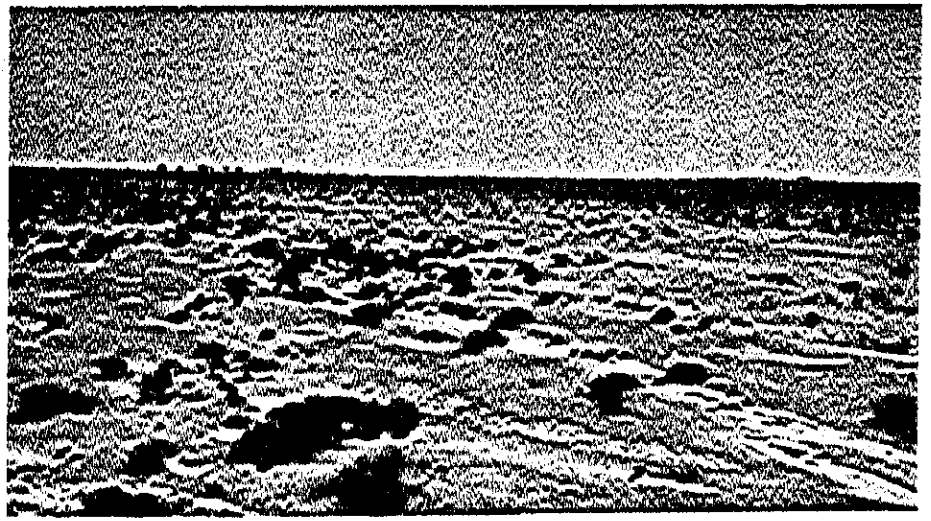


EAST



SOUTH



WEST

SITE NO. 9 PHOTOGRAPHS

PLATE 2I