

La transformation du paysage dans l'Antiquité de l'Arabie du sud

Techniques hydrauliques et construction

Christian Darles
Pierre Gentelle

13^e Rencontres Sabéennes
Paris, 4-6 juin 2009

Fondation Simone et Cino Del Duca

At Qaid
2/26/88
Shelton





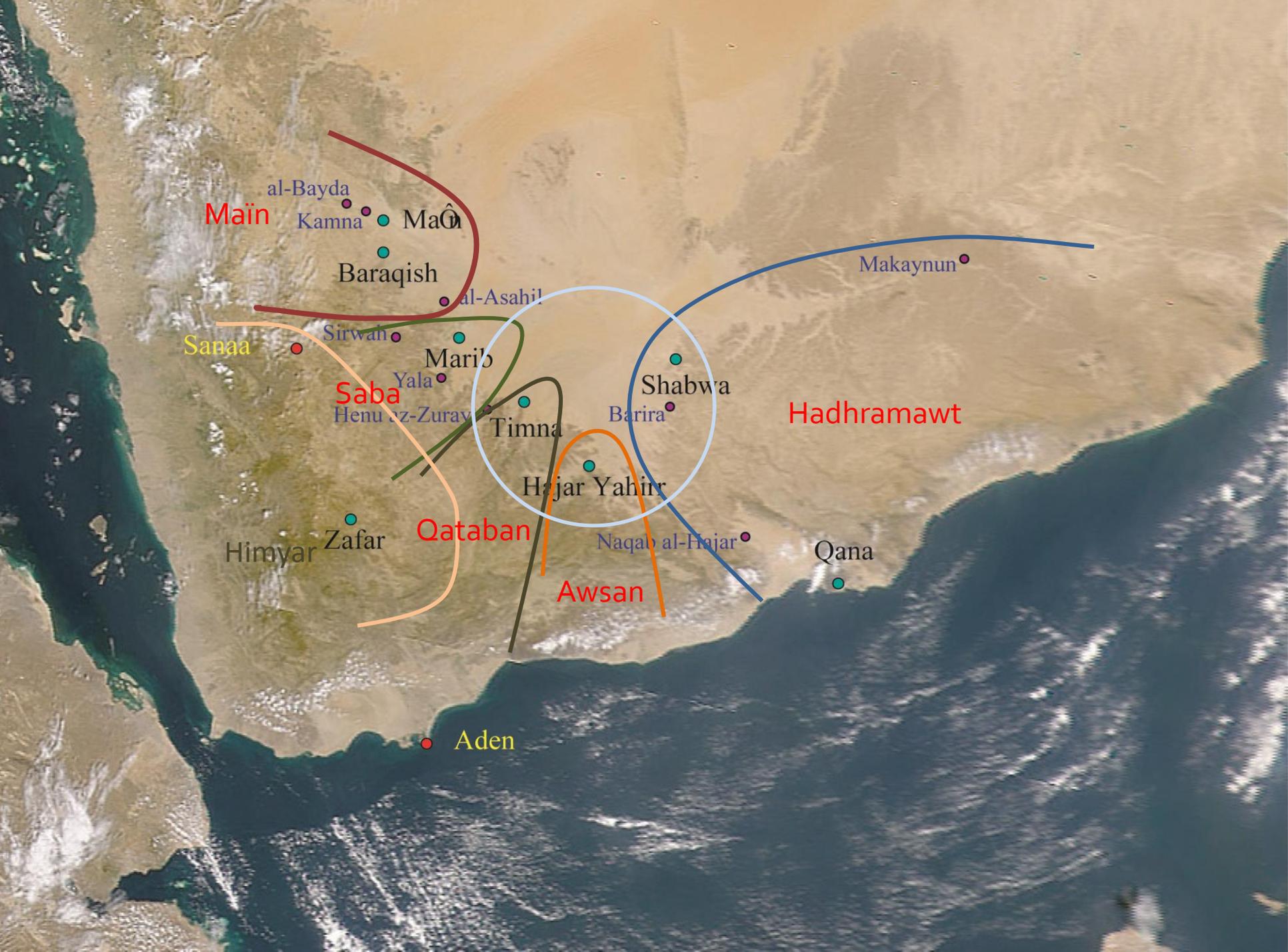
Les hommes et leur territoire

Petite échelle :

Des vallées étroites à fond plat

Grande échelle :

Des vastes ouvertures vers le désert



Main

al-Bayda

Kamna

Ma'ûn

Baraqish

al-Asahil

Makaynun

Sanaa

Sirwan

Marib

Saba

Yala

Henuz-Zuray

Shabwa

Barira

Hadhramawt

Timna

Hajar Yahir

Himyar

Zafar

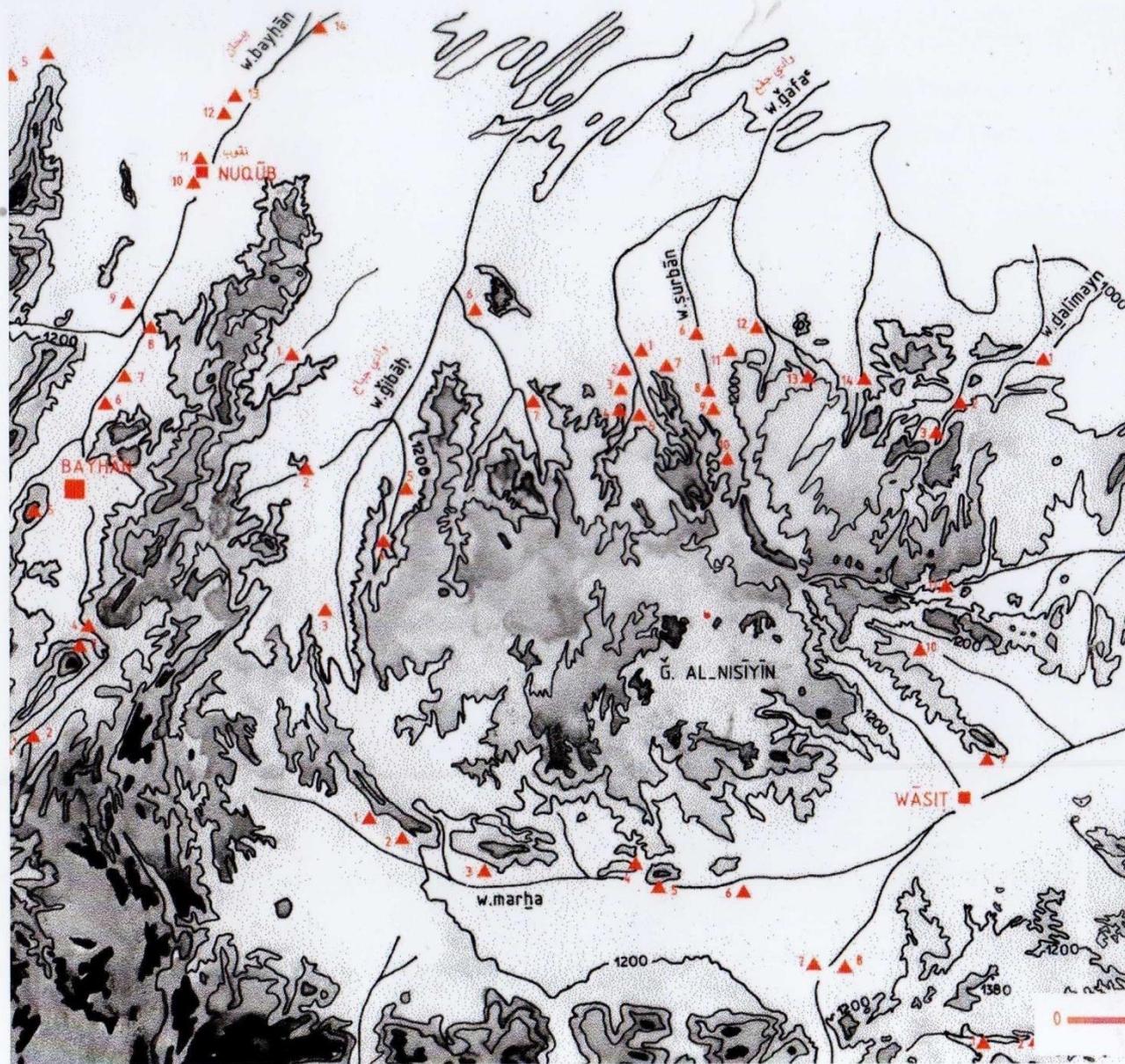
Qataban

Naqab al-Hajar

Qana

Awsan

Aden



- WĀDĪ BAYHĀN**
- 1 - Al-Baḍī
 - 2 - Ḡabal Al-'Abyaḍ
 - 3 - Ġirbat Di-Naṣr
 - 4 - Al-Haraḡa
 - 5 - Ḡabal Rayḍān
 - 6 - Ġudrā
 - 7 - Aš-Šiḡin
 - 8 - Haḡar Ibn Ḥumayḍ
 - 9 - Ḥuṣn al-Haḡar
 - 10 - Al-Huḡayra
 - 11 - Ad-Darb
 - 12 - Haḡar Kuḫlān
 - 13 - Haḡar Ibn 'Aqīl
 - 14 - Muḡannā

- وادي بيحان
- ١ - البديع
 - ٢ - جبل الأبيض
 - ٣ - خربة ذي نصر
 - ٤ - الحرجة
 - ٥ - جبل ريضان
 - ٦ - خدرات
 - ٧ - الشجين
 - ٨ - هجر بن حميد
 - ٩ - حصن الهجر
 - ١٠ - الهجرية
 - ١١ - الدرب
 - ١٢ - هجر كحلان
 - ١٣ - حيد بن عقيل
 - ١٤ - مغانع

- WĀDĪ ḠIBĀH**
- 1 - Haḡar aṣ-Ṣafrā
 - 2 - Haḡar Warīqa
 - 3 - Haḡar ad-Dimna
 - 4 - Haḡar Suḡqām
 - 5 - Haḡar 'Abd Allāh Ibn 'Aḡmad Ibn 'Aḡmad
 - 6 - Haḡar Wāla
 - 7 - Haḡar 'Arā

- وادي جباح
- ١ - هجر الصفراء
 - ٢ - هجر ورقية
 - ٣ - هجر الدمنة
 - ٤ - هجر سقام
 - ٥ - قبر عبد الله بن احمد بن احمد
 - ٦ - هجر والة
 - ٧ - هجر اره

- WĀDĪ ḠAFĀ**
- 1 - Haḡar al-Maḡla' a al-Sarḡī
 - 2 - Haḡar al-Maḡla' a al-Qibli
 - 3 - Haḡar 'Umm Yaḡmūm al-'Asfal
 - 4 - Haḡar 'Umm Yaḡmūm al-'Alā
 - 5 - Haḡar Lafāḡ
 - 6 - Haḡar Rizq
 - 7 - Am-Nuḡub
 - 8 - Ṣurḡān al-'Asfal
 - 9 - Ṣurḡān al-'Alā
 - 10 - Tariq Ḡaḡā
 - 11 - Rumūḡ
 - 12 - Haḡar 'Iṭṭayn
 - 13 - Ḥalīf 'Iṭṭayn
 - 14 - Haḡar Ṣuḡḡūb

- وادي جافع
- ١ - هجر الخصلة الشرقي
 - ٢ - هجر الخصلة القبلي
 - ٣ - أم يعموم السفلي
 - ٤ - أم يعموم العلوي
 - ٥ - هجر لفاع
 - ٦ - هجر رزق
 - ٧ - النغوب
 - ٨ - صربان السفلي
 - ٩ - صربان العلوي
 - ١٠ - طريق قضاة
 - ١١ - رومو
 - ١٢ - هجر ايتين
 - ١٣ - خليف ايتين
 - ١٤ - هجر شحوب

- WĀDĪ ḌALĪMĀYĀ**
- 1 - Haḡar Ḍalīmāyā
 - 2 - Ši'b as-Sāq
 - 3 - Ši'b as-Sāwwa
 - 4 - Ḥarīfān

- وادي ظلمين
- ١ - هجر ظلمين
 - ٢ - شميب الساق
 - ٣ - شميب الساه
 - ٤ - حرشفان

- WĀDĪ MARḤĀ**
- 1 - Haḡar Laḡiyya
 - 2 - Haḡar am-Barka
 - 3 - Haḡar Tālib
 - 4 - Qurūn al-Ḥutayt
 - 5 - Haḡar am-Nāb
 - 6 - Al-Ḥizma
 - 7 - Ad-Darb
 - 8 - Al-'Urāyḍ
 - 9 - Bīr Muraysā
 - 10 - Haḡar Ḥamūma
 - 11 - Haḡar Ruma
 - 12 - Al-Ḥarṣayn
 - 13 - Haḡar Yahir
 - 14 - Dāt al-Ḡār

- وادي مرخه
- ١ - هجر لاجيه
 - ٢ - هجر امبرك
 - ٣ - هجر طالب
 - ٤ - قرين الحيت
 - ٥ - هجر امباب
 - ٦ - المزبه
 - ٧ - الدرب
 - ٨ - العريض
 - ٩ - بئر مريصع
 - ١٠ - هجر حمومة
 - ١١ - هجر رومه
 - ١٢ - المرشين
 - ١٣ - هجر يهر
 - ١٤ - دات الجار



Djebel al-Nisîyîn



● Bī'r al Gafayiah

4.62 km

Pointeur 14°50'51.94" N 46°06'40.13" E

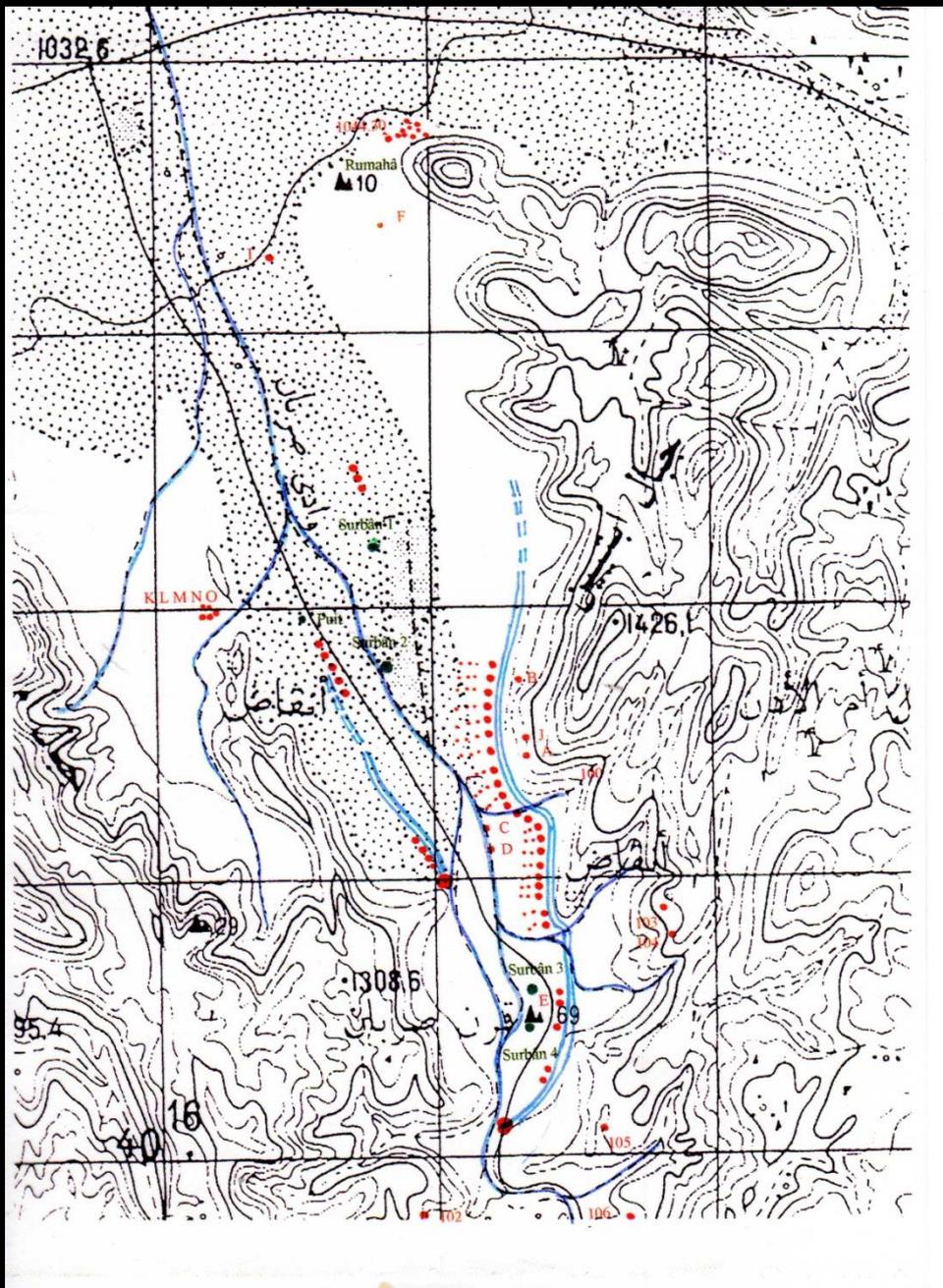
Image © 2007 DigitalGlobe
Image © 2007 TerraMetrics
© 2007 Europa Technologies

©2007 Google

Mise au point ||||| 100%

Altitude 15.99 km

Wādī Surban



Wādī Surban

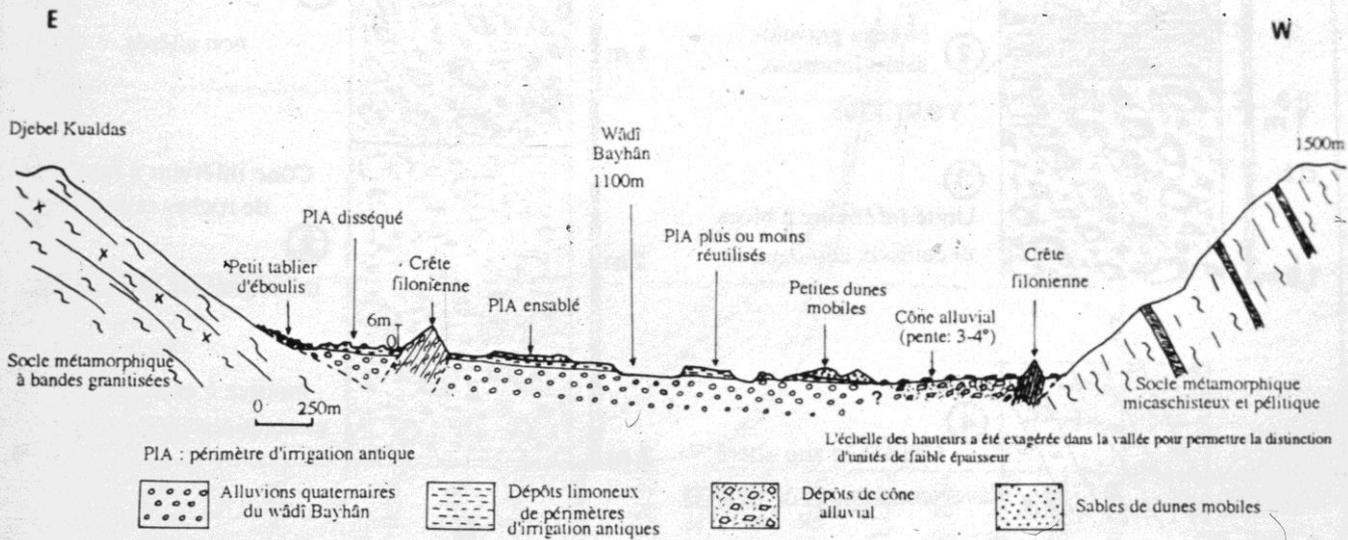


Fig. 10. – Coupe est-ouest de la vallée du wādī Bayhân (au nord de Bayhân al-Qasab).

Bayhan

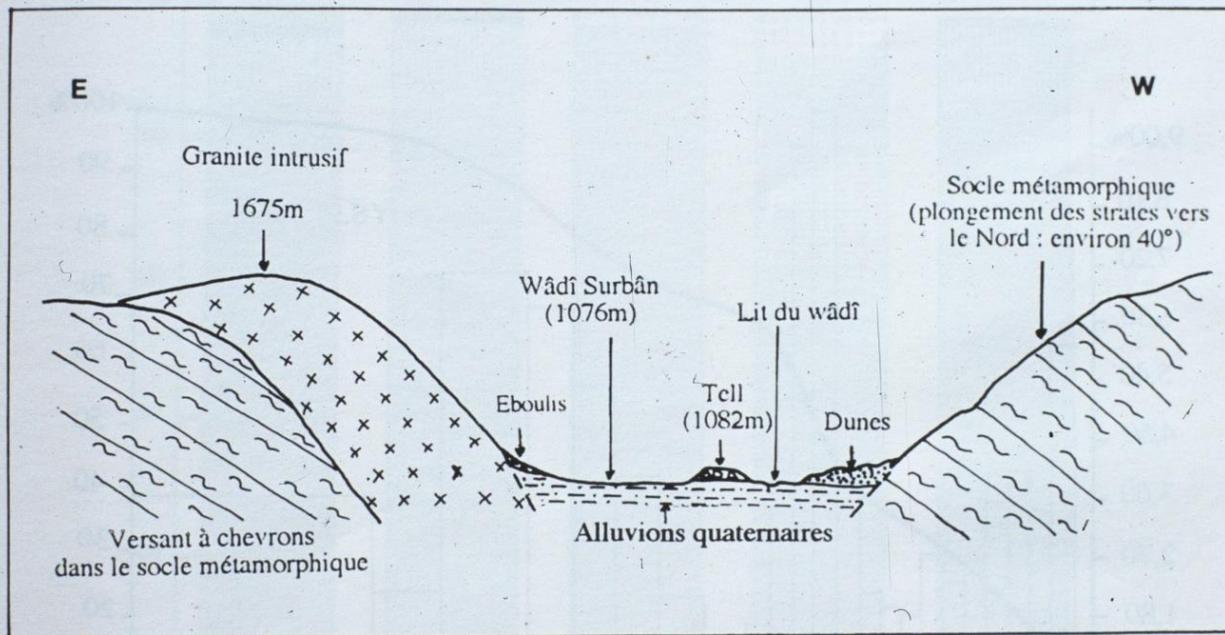
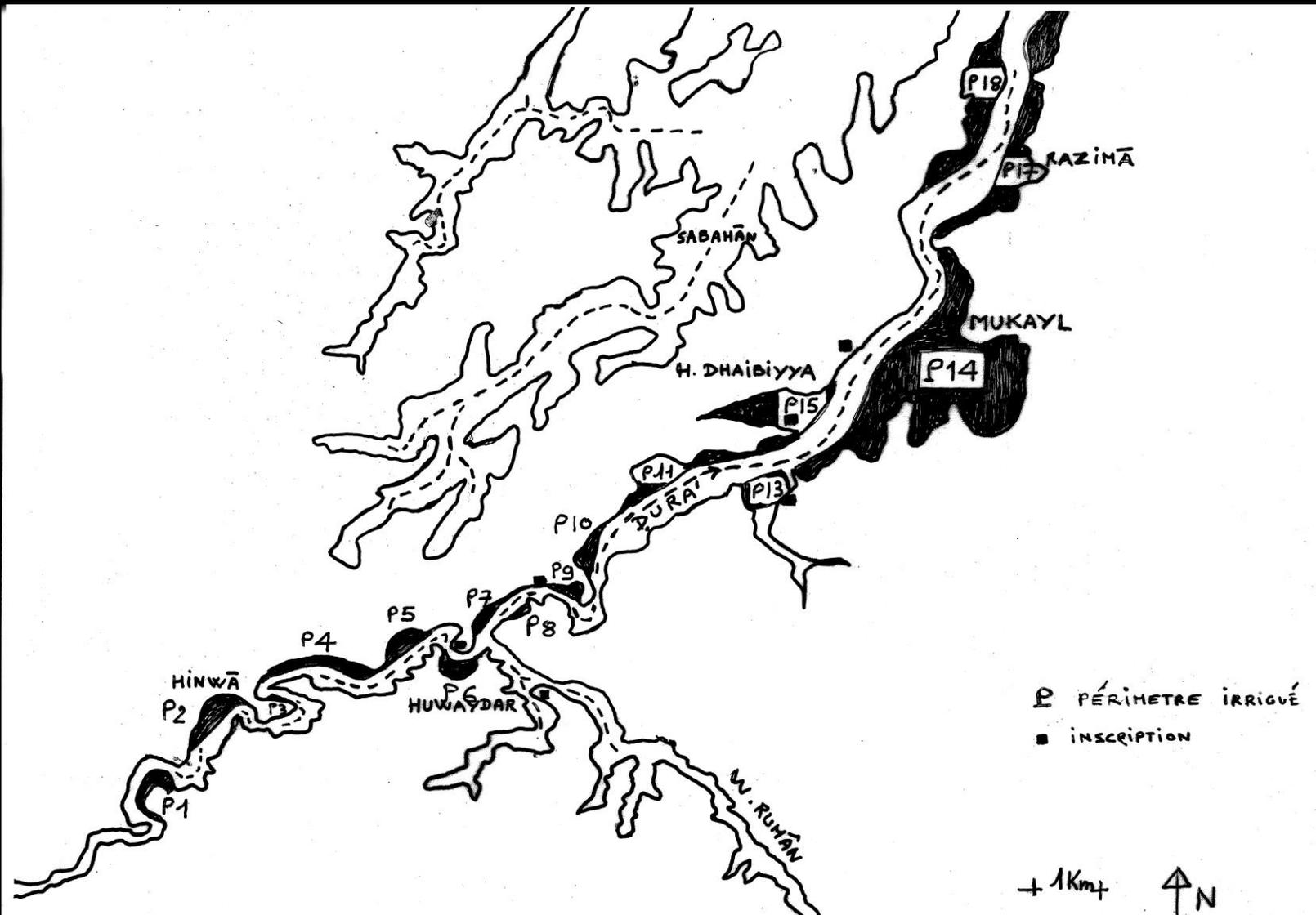
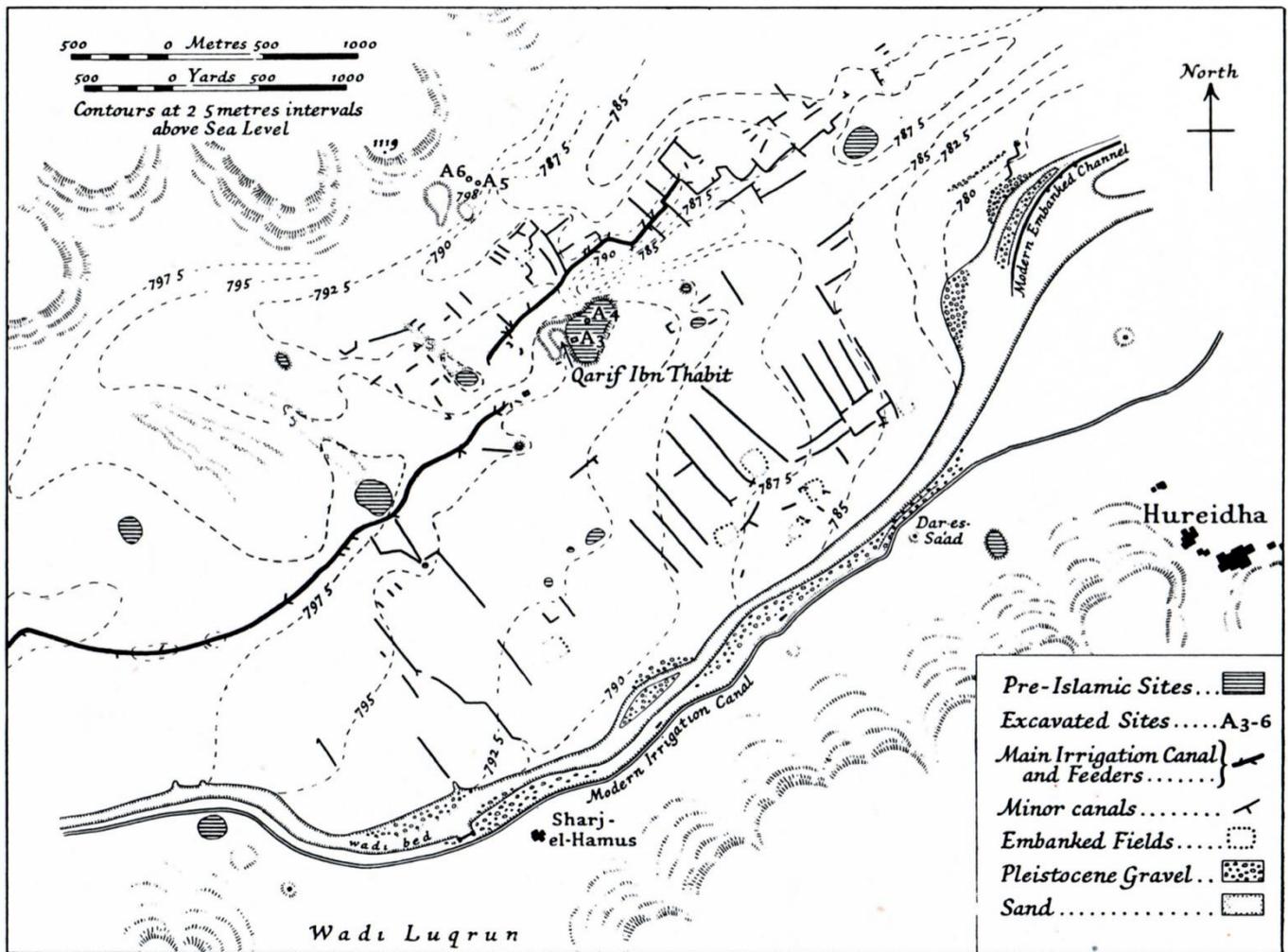


Fig. 11. – Coupe est-ouest du wādī Surbân au niveau du site 1.

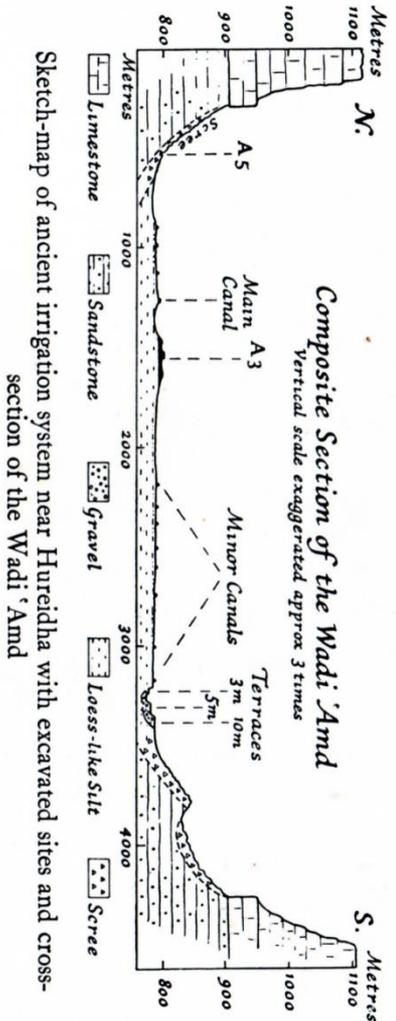
Surban



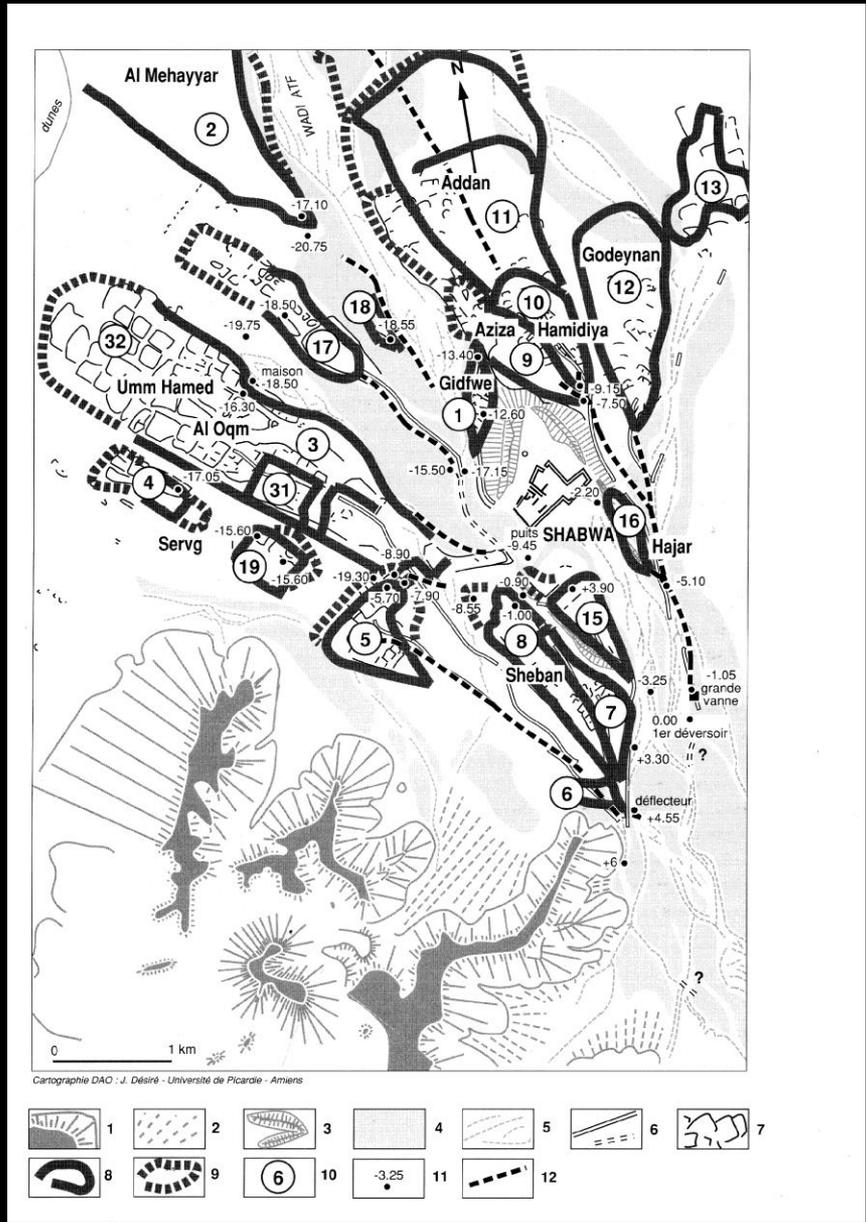
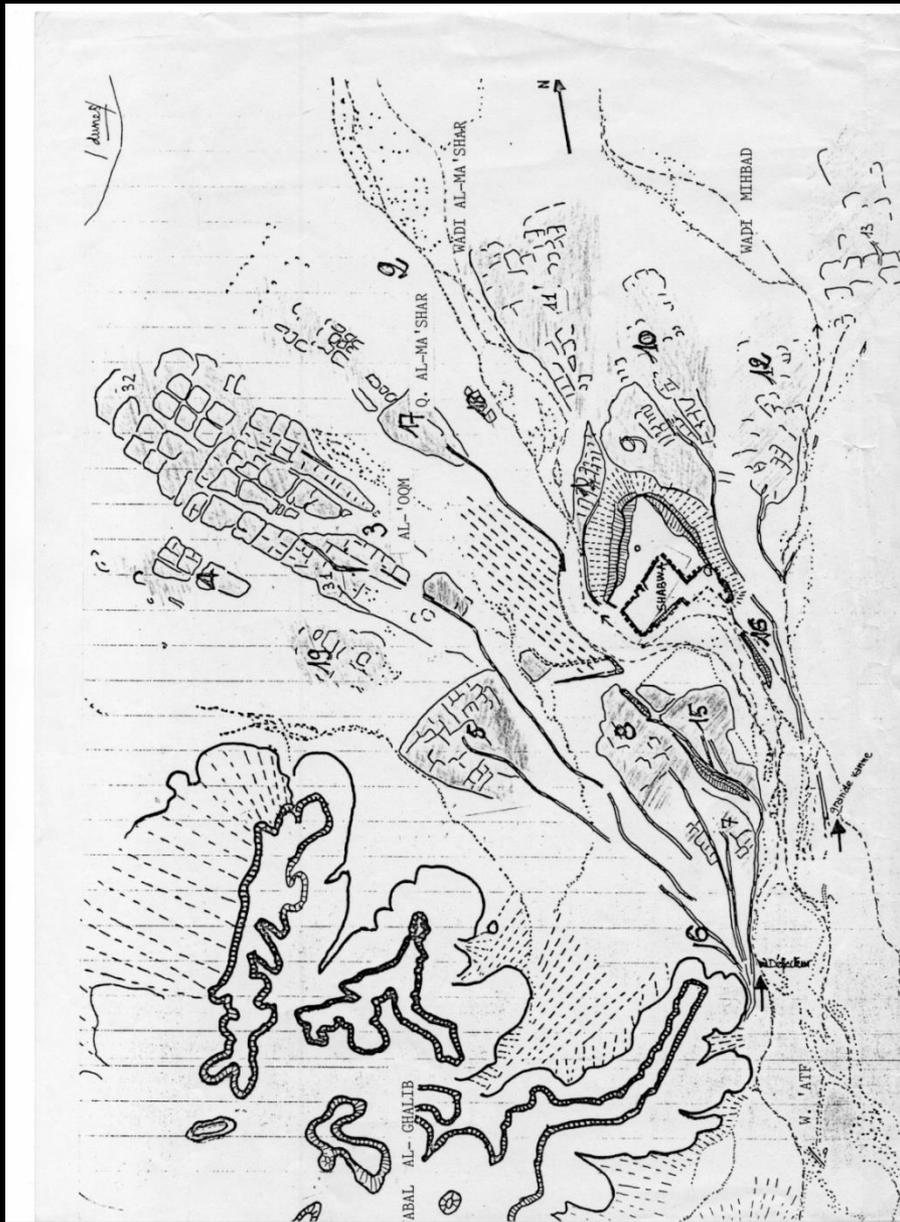
Wâdî Dura (Gentelle)



- Pre-Islamic Sites... [hatched box]
- Excavated Sites..... A3-6 [dotted box]
- Main Irrigation Canal and Feeders..... [thick line with arrows]
- Minor canals..... [thin line with arrows]
- Embanked Fields..... [dashed line]
- Pleistocene Gravel... [stippled box]
- Sand..... [dotted box]



Sketch-map of ancient irrigation system near Hureidha with excavated sites and cross-section of the Wadi 'Amd



Shabwa (Gentelle)

Un modèle et ses variantes

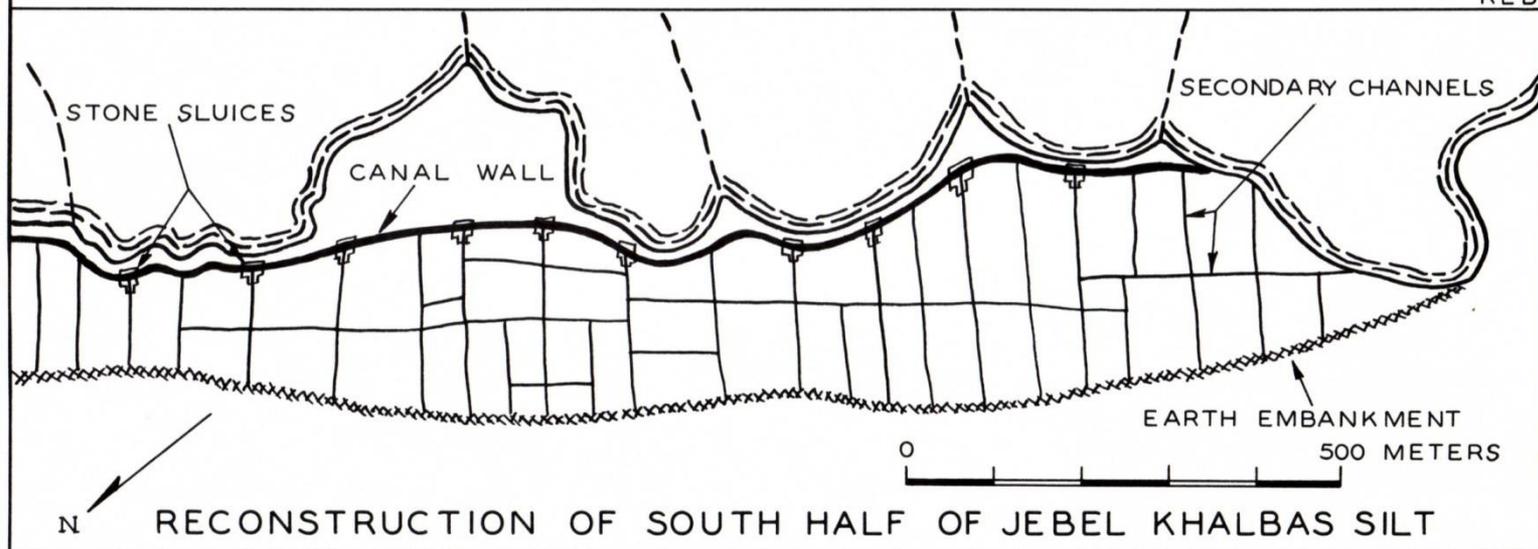
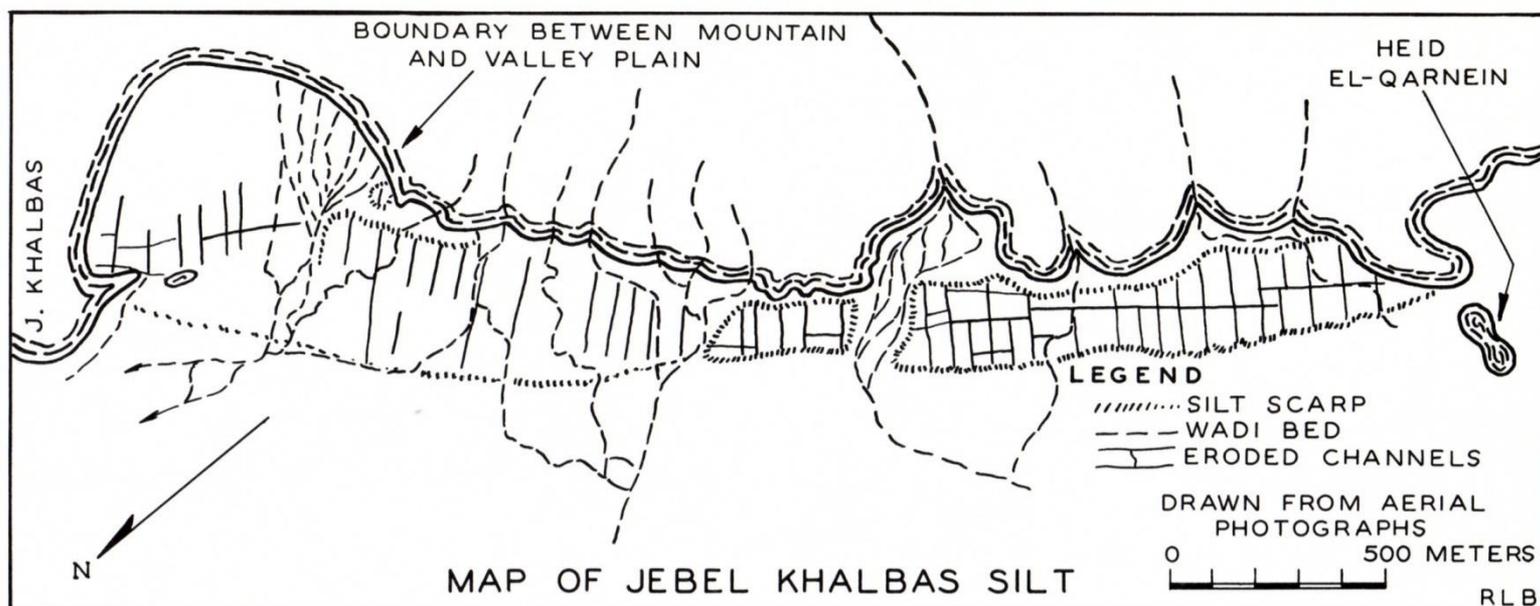
- La crue
- L'eau sauvage et l'eau pacifiée
- L'eau fait le champ
- La notion de réseau



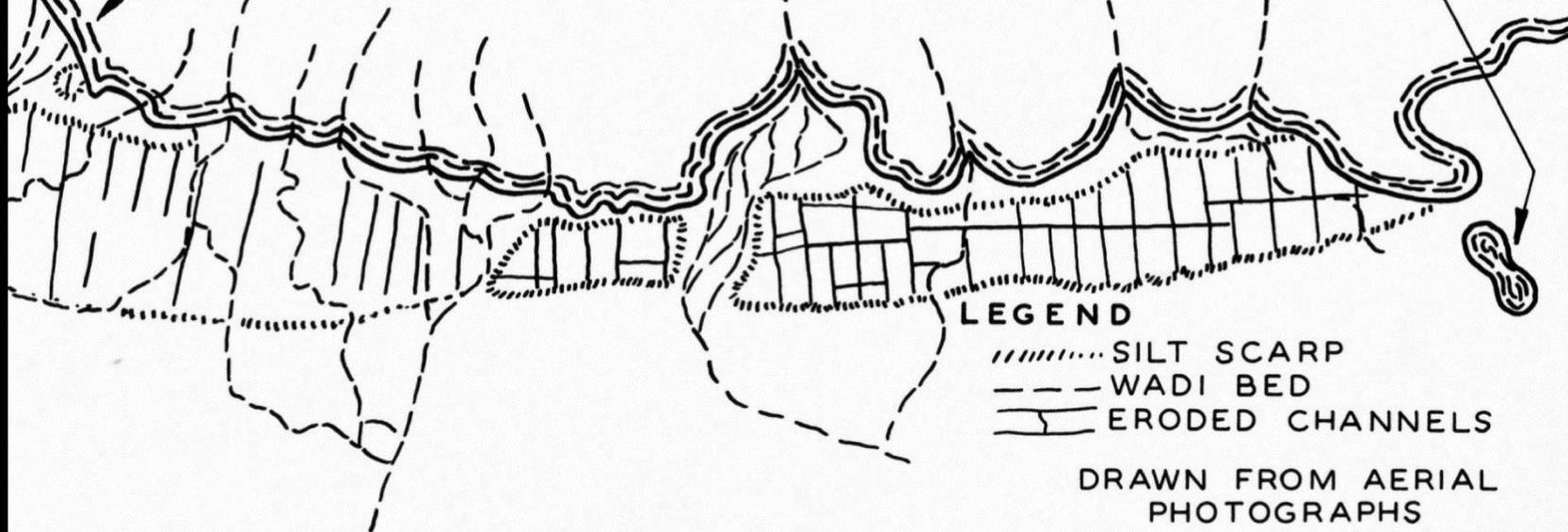
Shabwa





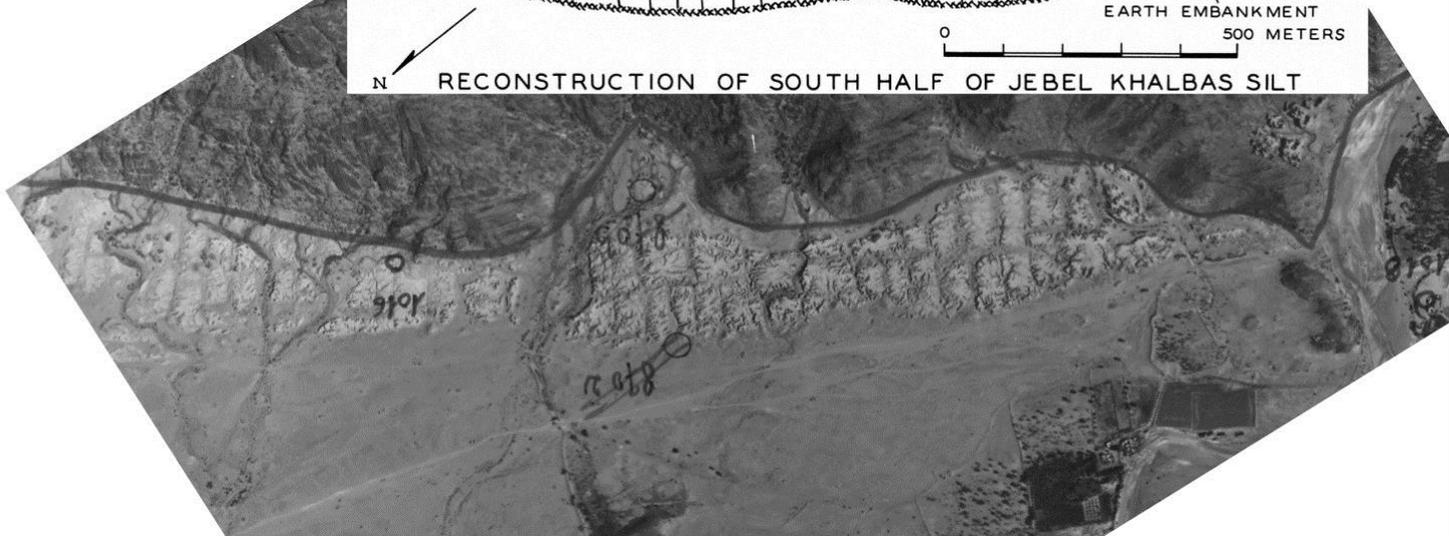
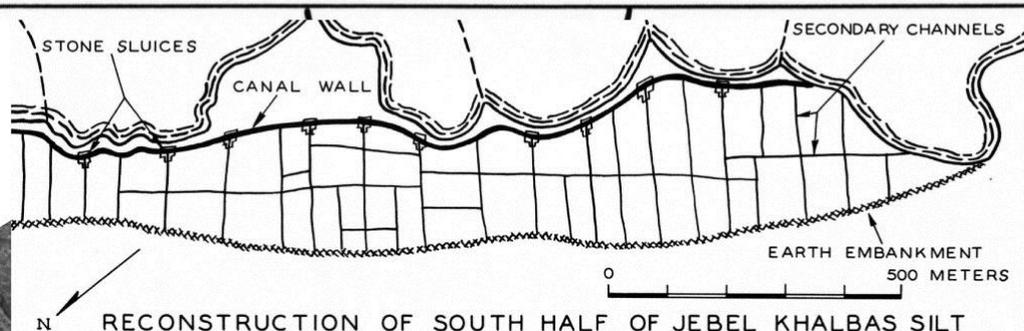


64. Map of Jebel Khalbas silt. The top is drawn from aerial photographs and the bottom is a reconstruction of the southern half. The runoff from the mountains collected behind an earthen wall about 10 m. from the mountain edge. The water was distributed from this canal by stone sluices placed at intervals in the earthen wall.



MAP OF JEBEL KHALBAS SILT

RLB



Capter

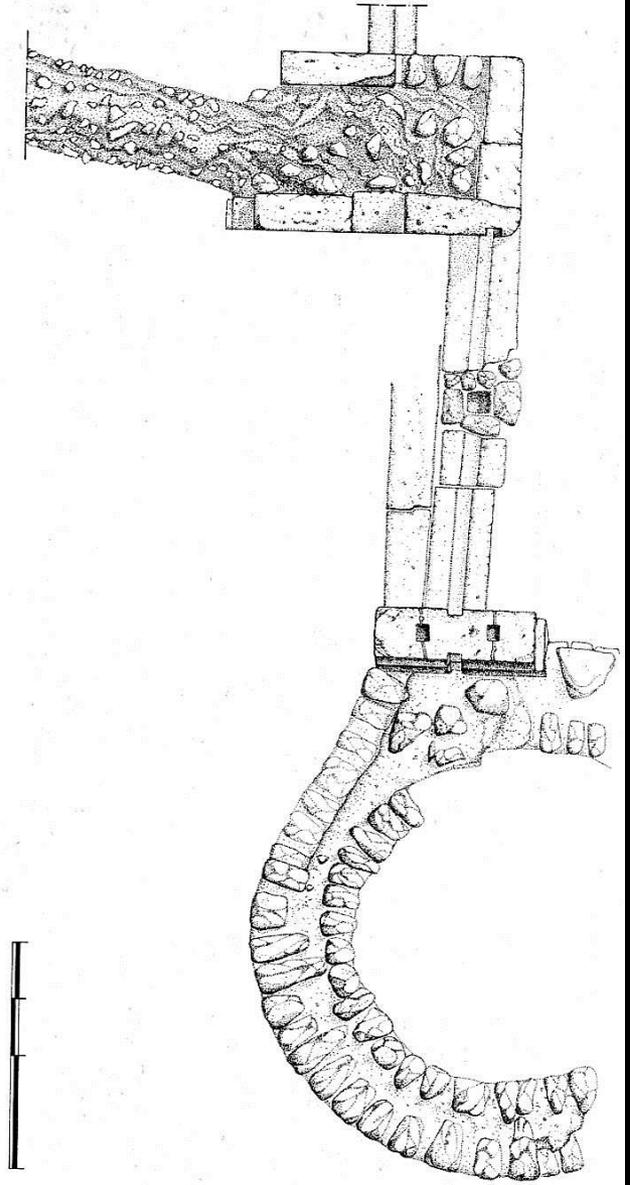
- Barrages déflecteurs
- Vannes d'entrée dans le réseau
- Consolidation des berges











Acheminer

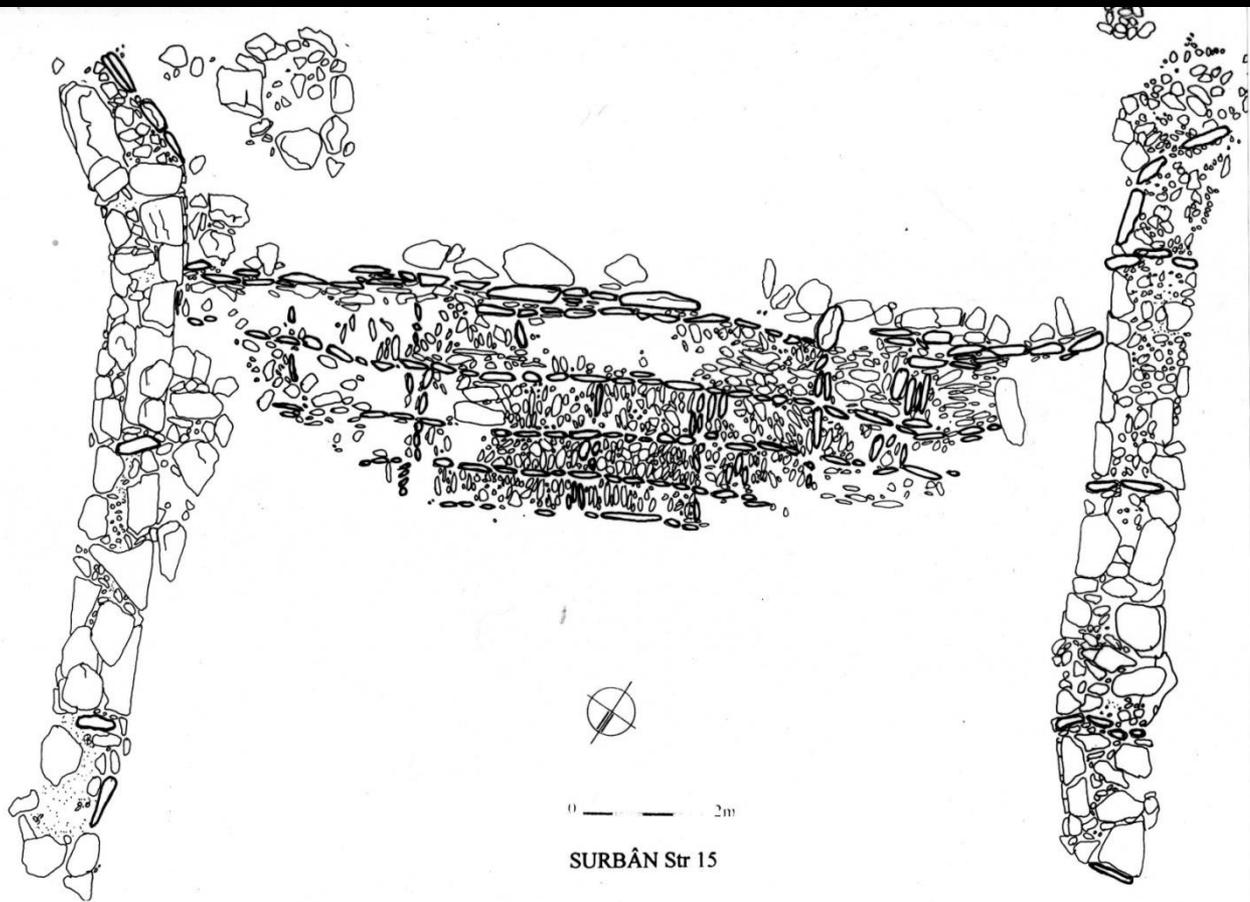
- Aqueducs
- Canaux
- Déversoirs
- Seuils



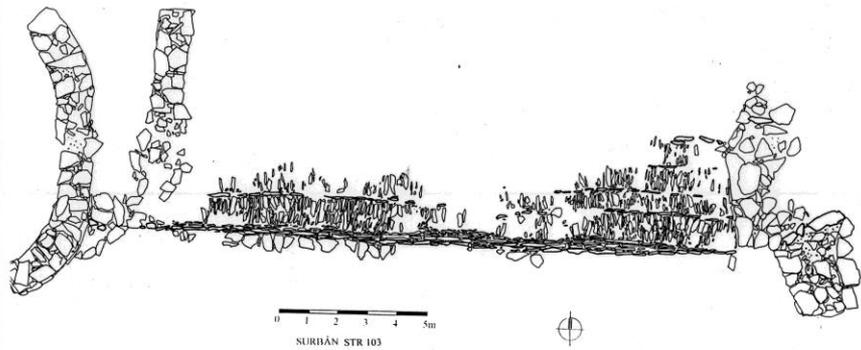


Fig. 10. – Mur d'aqueduc. Un long mur en pierre, le long du wâdî Surbân, photographié ici à 150 m en aval de la prise, isole l'aqueduc (à droite) du lit de crue. Il permet l'acheminement contrôlé de l'eau jusqu'aux ouvrages de l'aval.

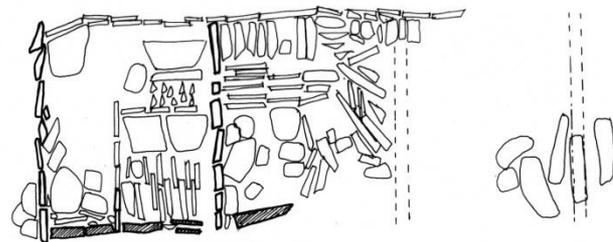




SURBÂN Str 15



SURBÁN STR 103

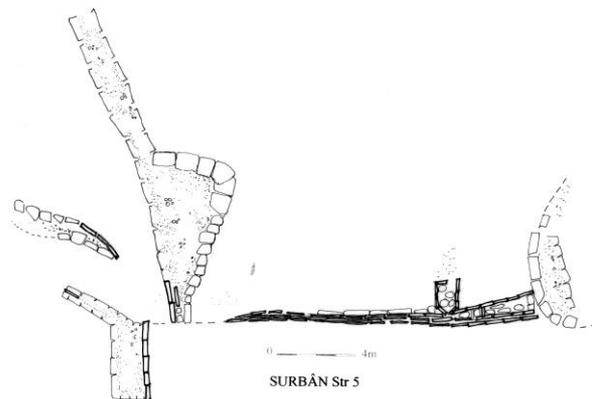


SURBÁN Str 11 A

0 ——— 2m



SURBÁN Str 9

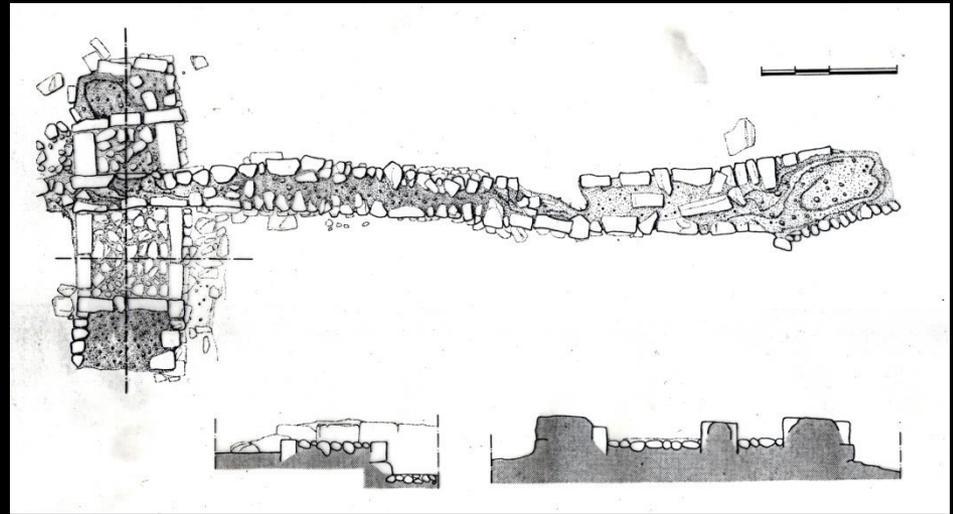
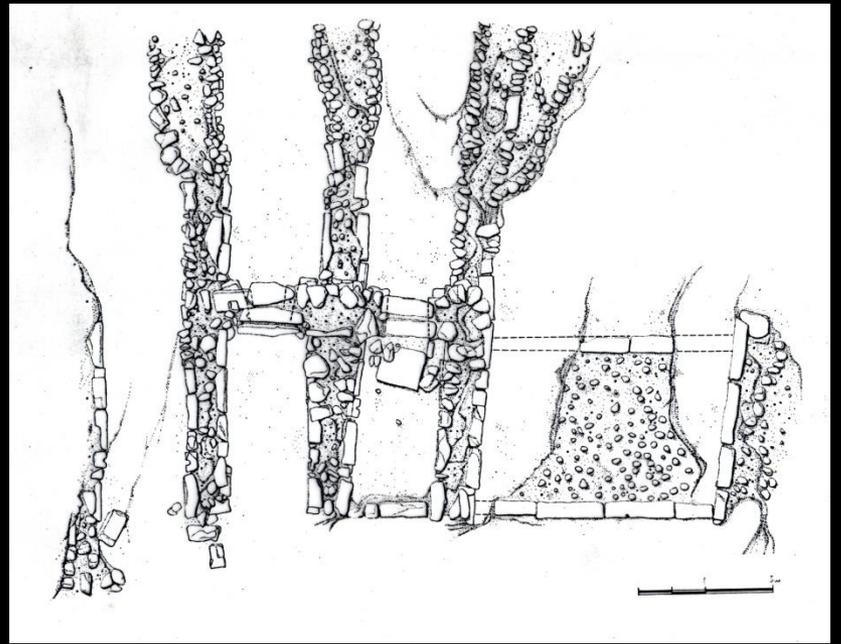


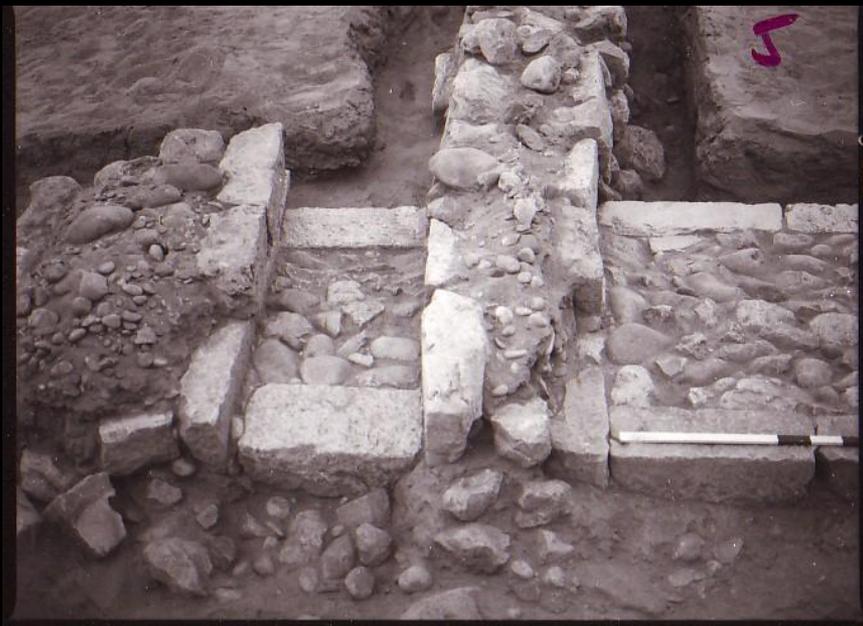
SURBÁN Str 5



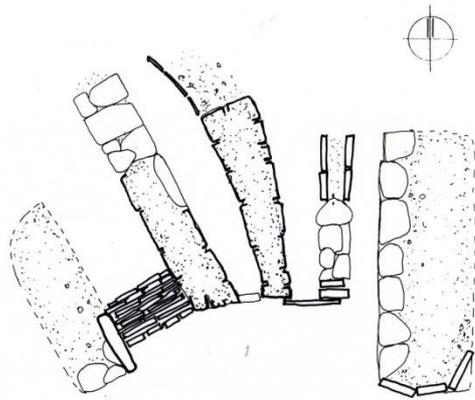
Distribuer

- Partiteurs
- Vannes d'entrée dans les champs



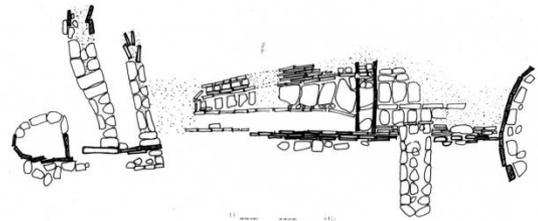




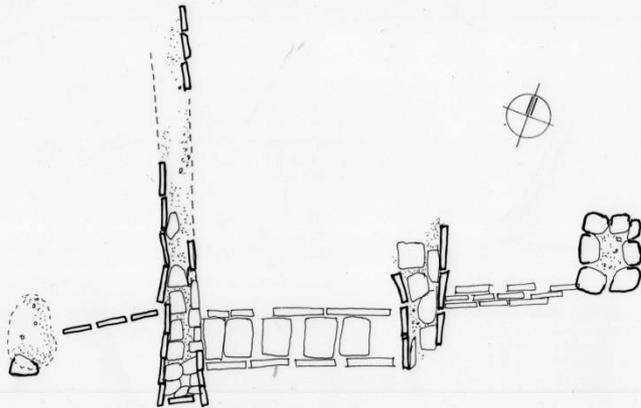


SURBÂN Str 8

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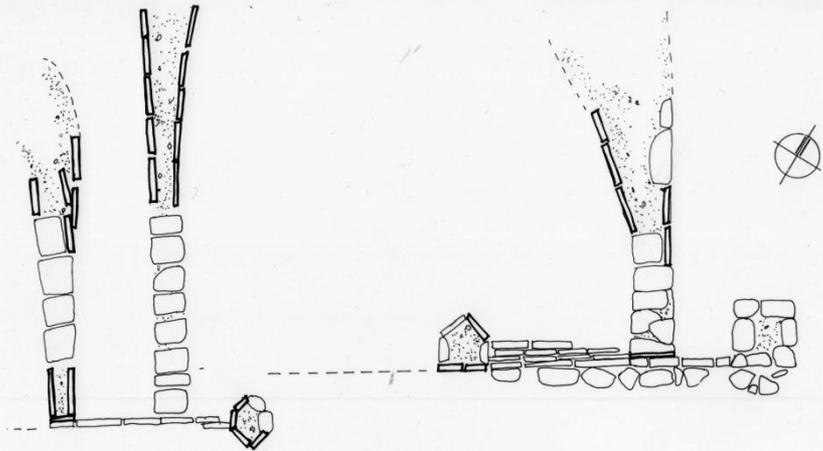


SURBÂN Str 11



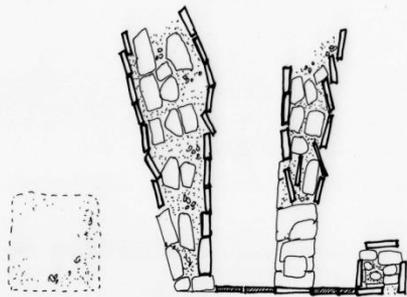
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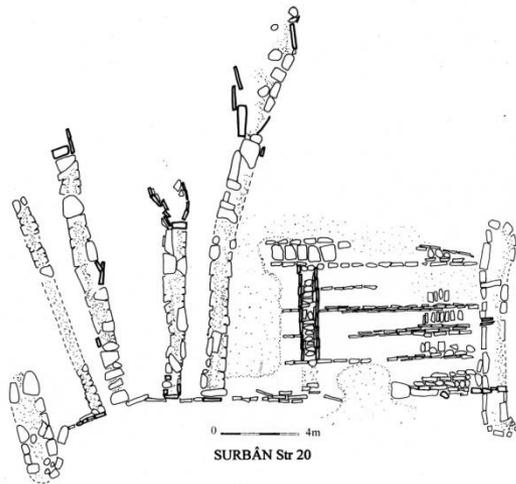
SURBÂN Str 13

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SURBÂN Str 14

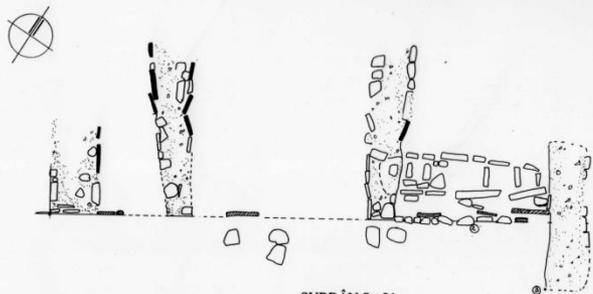
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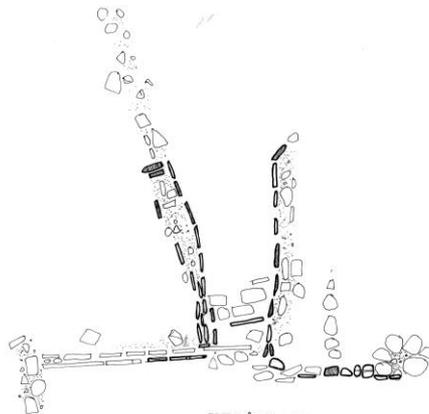
Str 20
Udr. Surbân.

1/2



SURBÂN Str 21

0 ——— 2m



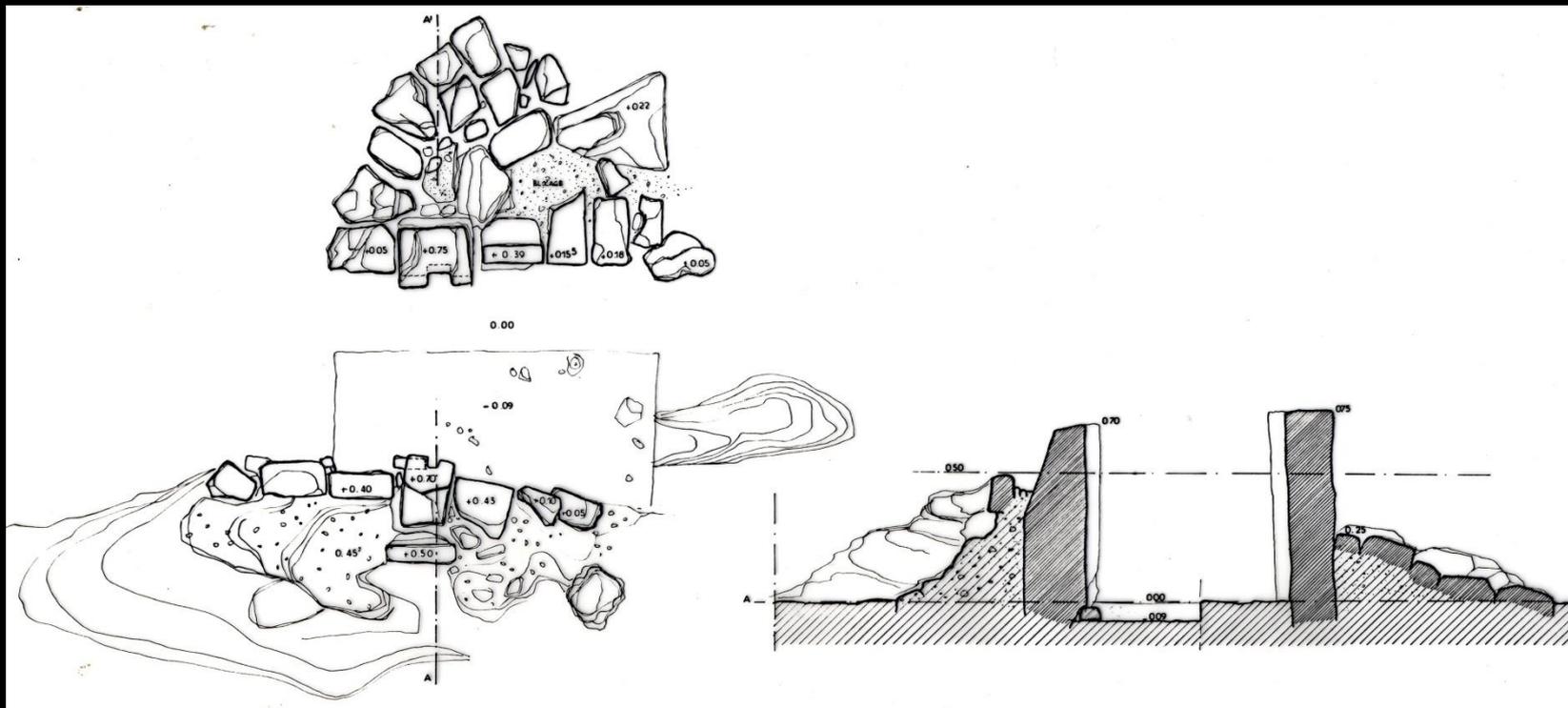
SURBÂN Str 107

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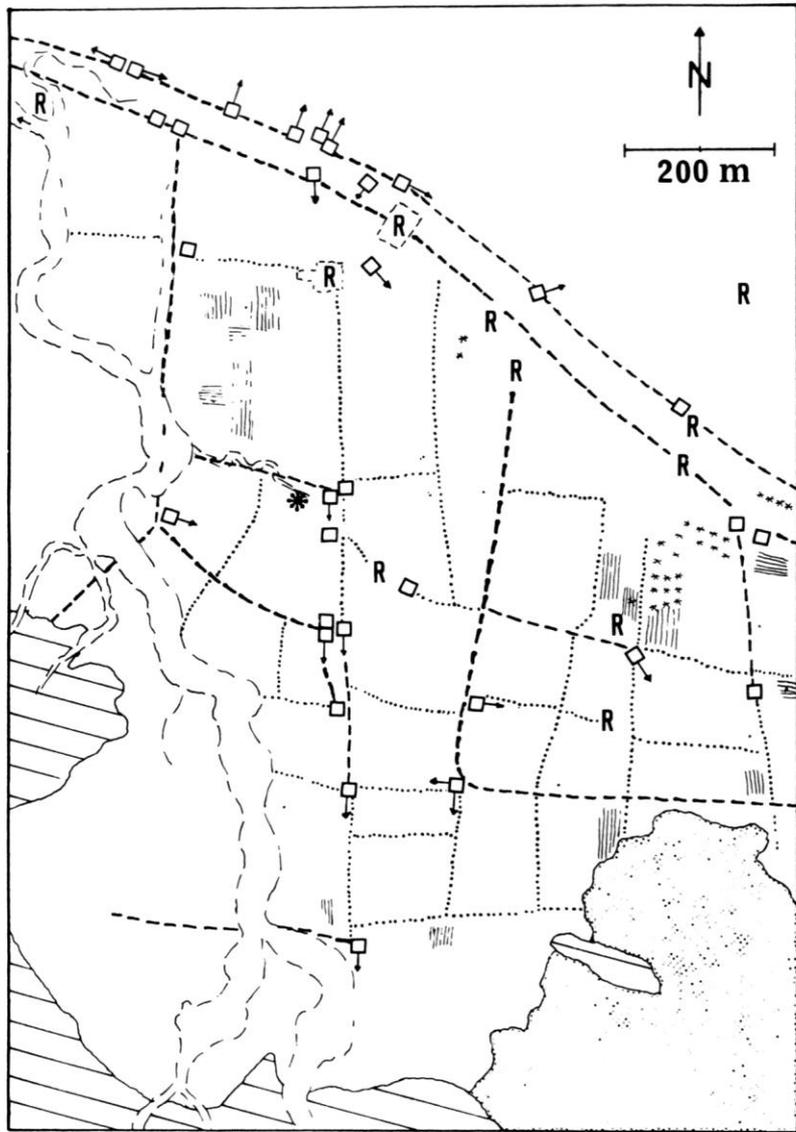


Dat el-Jar









- Sekundärkanal
- - - Tertiärkanal
- Feldwall
- R Ruine
- Verteiler/Durchlass (wenn bestimmbar mit Öffnungsrichtung)
- ||||| Pflugspuren (schematisch)
- Erdringe (schematisch)
- Erdstotzen (schematisch)
- * UZ-527
- Runse
- ▨ Kalk
- ▨ Dünen

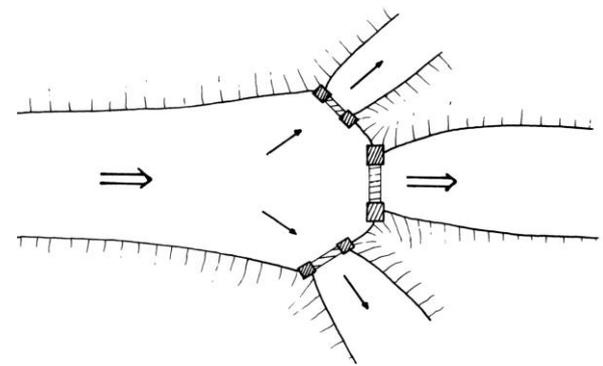
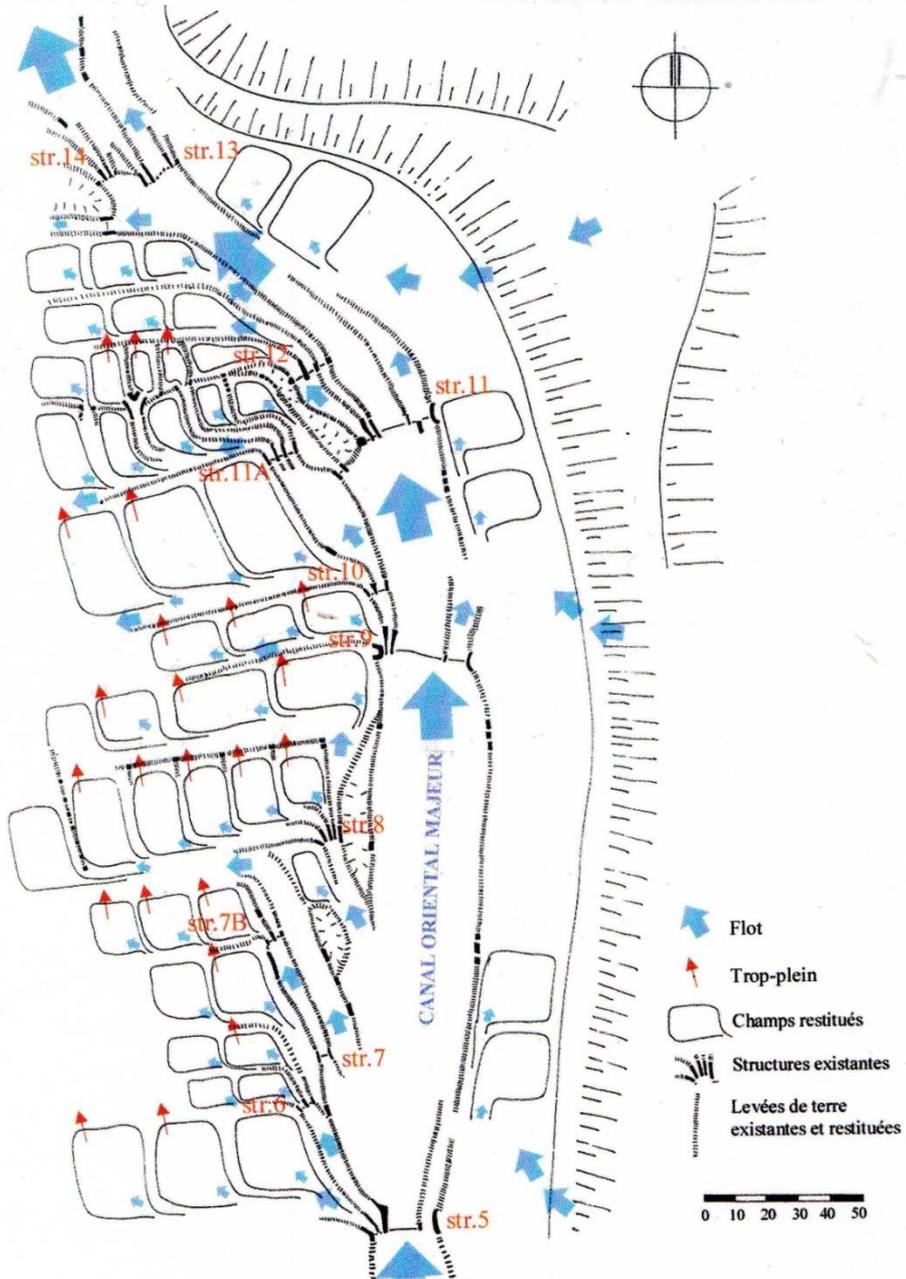


Abb. 28. Schemaskizze der Funktionsweise einer Gruppe von Wasserdistributoren am Südostrand der Qa' al-Hayyāl. Der mittlere Verteiler weist das tiefste Schwellenniveau auf und ist demnach der wichtigste.

Abb. 31. Detailkartierung der Oberflächenformen am Westrand der Südoase (genaue Lage vgl. Abb. 24). Sie zeigt deutlich das feine Netz aus Feldwällen und Kanälen, das die Oberfläche der antiken Oase strukturiert.

Marîb (Brunner)

FONCTIONNEMENT DU RESEAU D'IRRIGATION



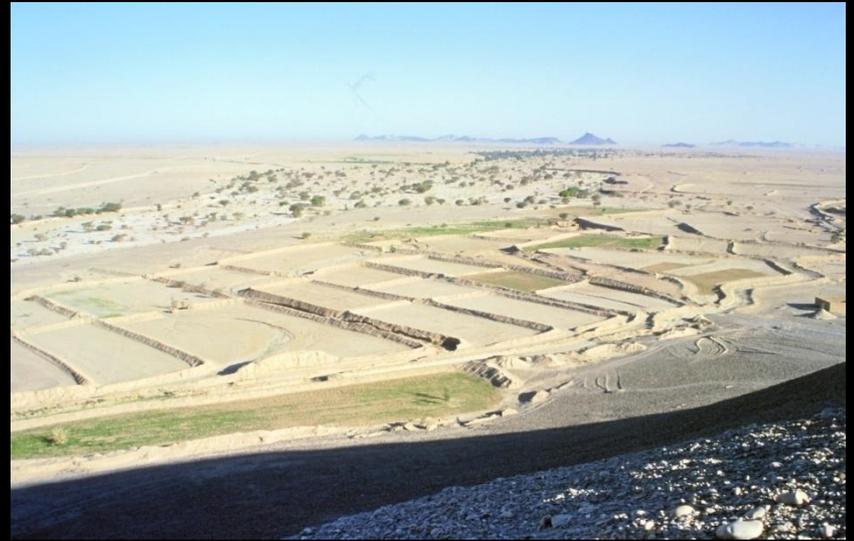
Surban

Les champs

Quadrangulaires ou en écaille de poisson

- Traces fossiles
- Erosion
- Remise en culture



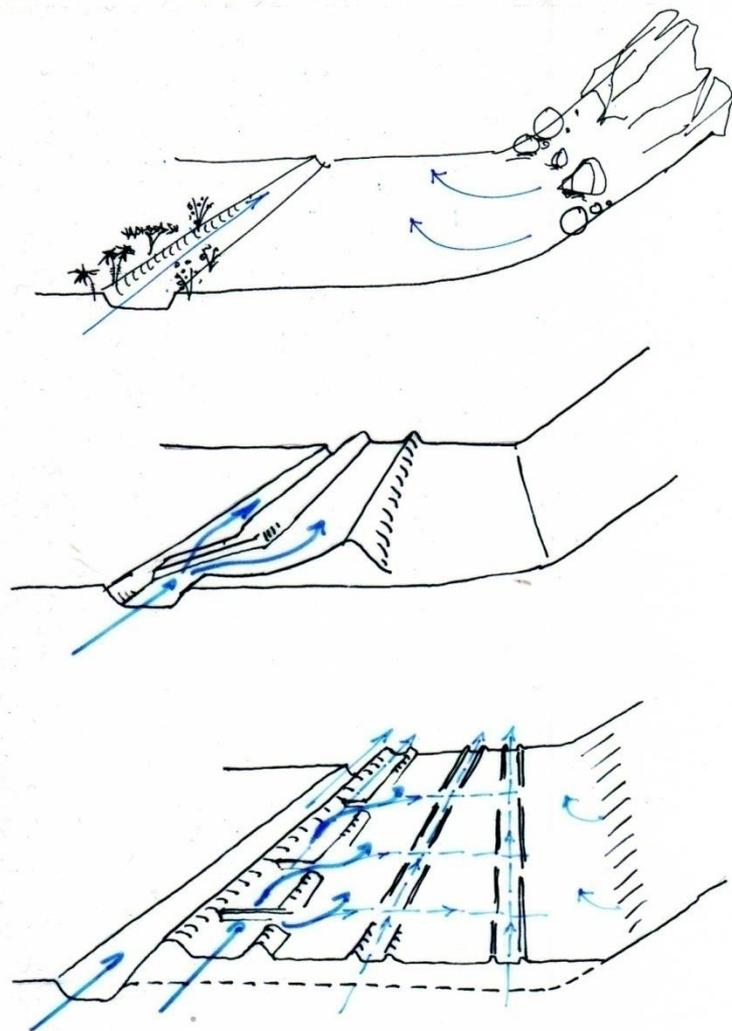
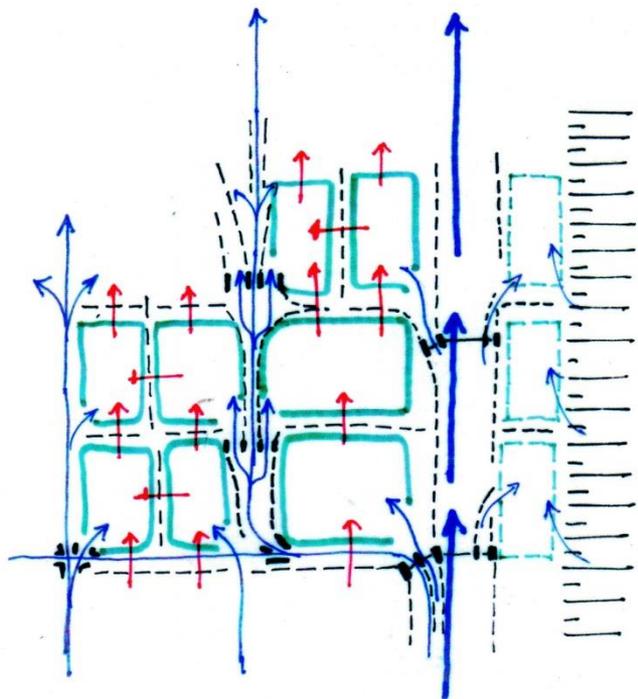


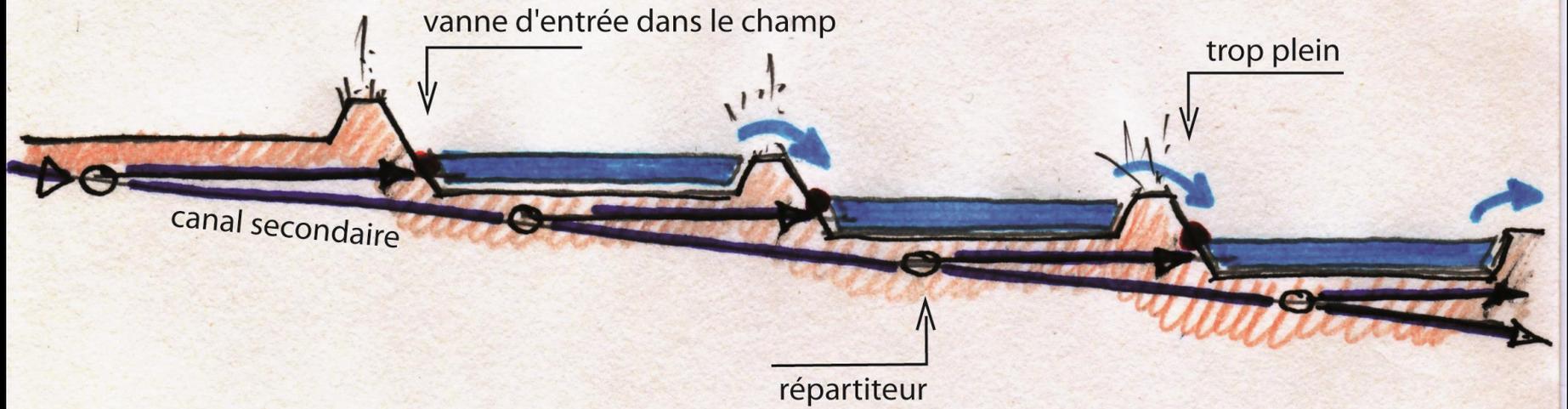


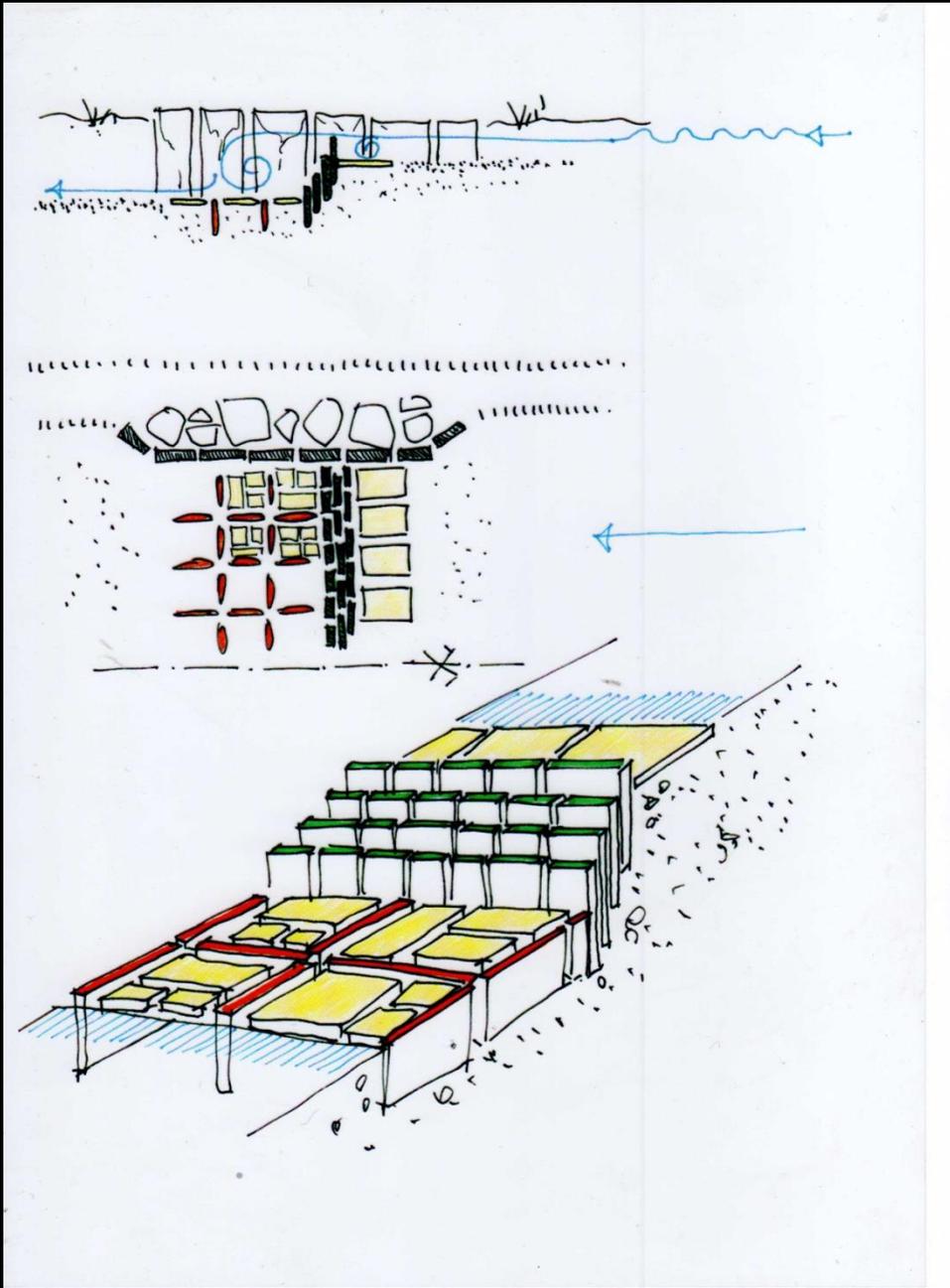


Réguler

- Calmer le flot
- Mesurer son débit
- Le laisser continuer
- Permettre les trop pleins









Perdurer:

Des centaines d'années d'entretien et
d'utilisation

Contrôler l'accumulation des alluvions

Rehausser le niveau de l'eau

vanne d'entrée du champ

partiteur

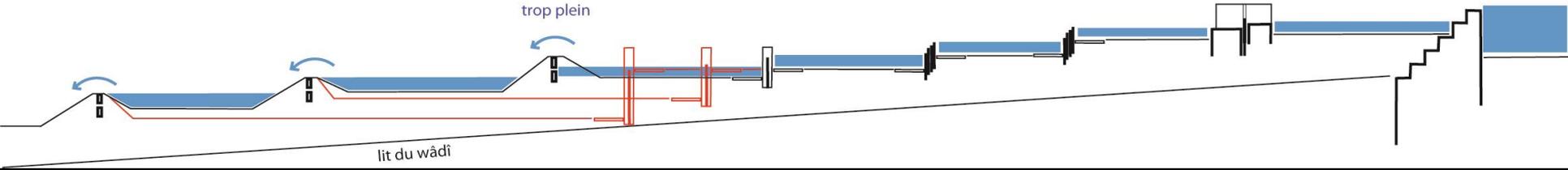
seuils

vanne du réseau

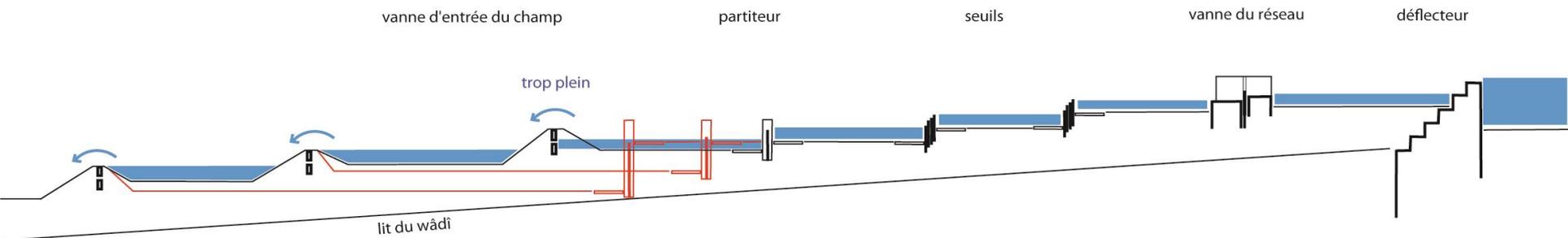
défecteur

trop plein

lit du wâdi



Quand le champ est surélevé par l'accumulation des alluvions :!



Il faut protéger le périmètre irrigué de la crue et du wâdi

1- on récurve les champs

2- on remonte les vannes d'entrée et les planches du répartiteur

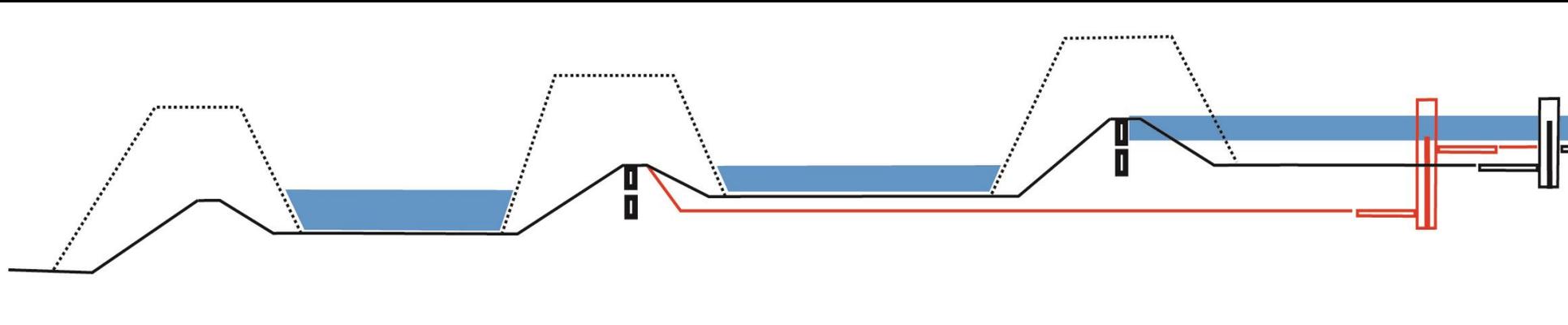
3- on remonte les partiteurs

4- on rehausse les seuils

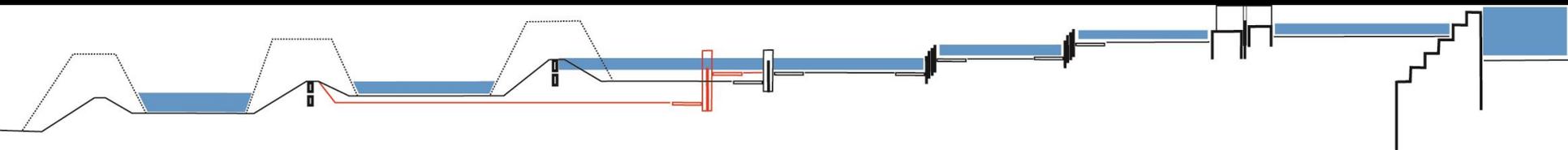
5- on rehausse la vanne générale

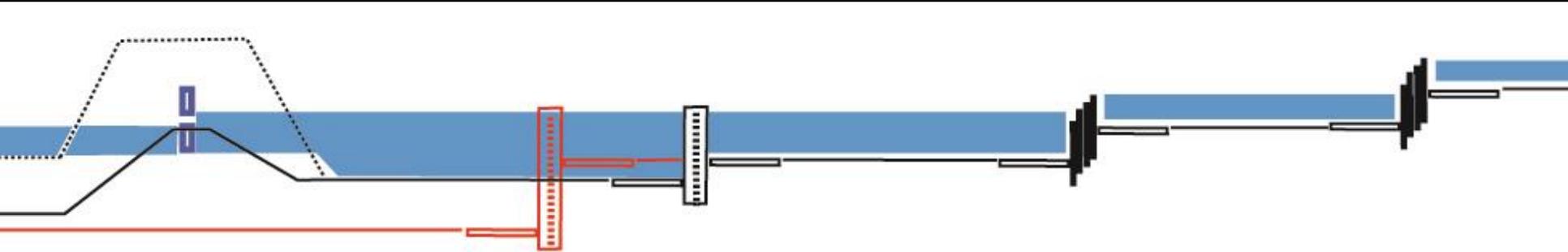
6- on reconstruit le barrage déflecteur

7- on déplace le déflecteur en amont

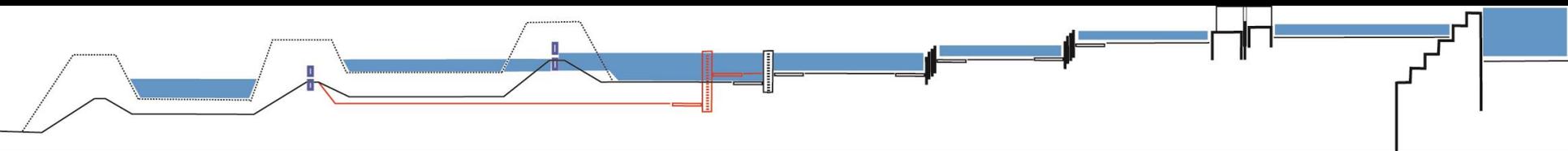


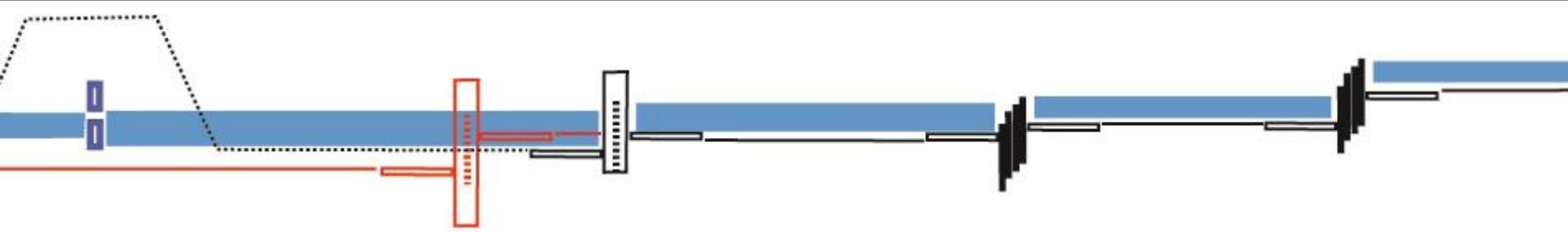
1- on récurve les champs



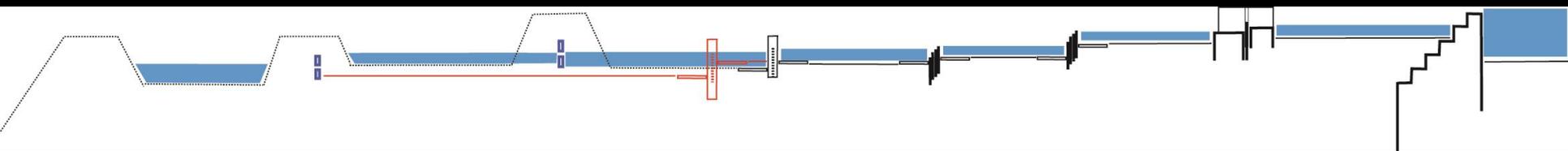


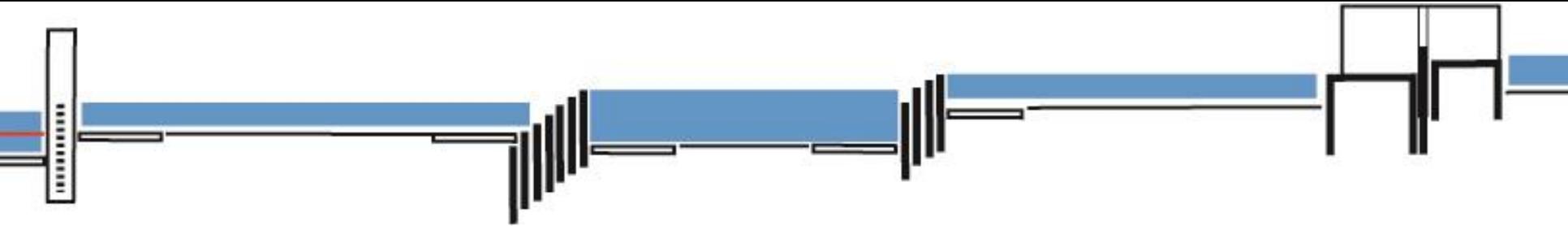
2- on remonte les vannes d'entrée et les planches du répartiteur



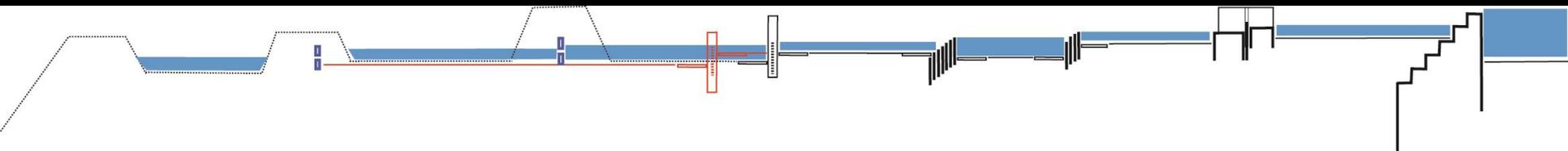


3- on remonte les partiteurs





4-on rehausse les seuils



-en fait toute l'opération d'entretien est issue de la gestion du champ, en aval....

...et de la présence permanente d'un habitat sur site...

MERCI