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**KASUR TANNERY POLLUTION CONTROL PROJECT**  
**DP/PAK/93/006**  
**KASUR - PAKISTAN**

**TECHNICAL SUPPORT IN ESTABLISHMENT OF A COMMON**  
**EFFLUENT TREATMENT PLANT (CETP) AND RELATED DISPOSAL**  
**SYSTEM AT THE KASUR TANNERY, PAKISTAN**

**FINAL REPORT**

**Prepared by TEH-PROJEKT HIDRO, Rijeka, Croatia**  
**CONTRACT No. 97/008**

**Project Manager**  
**Mr. F. Schmel, Agro-based Industries Branch**



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION  
VIENNA - AUSTRIA

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## EXPLANATORY NOTES

<b>R</b>	Raw Hides or Skins
<b>WB</b>	Wet-Blue
<b>F</b>	Finished
<b>BOD<sub>5</sub></b>	5 days Biochemical Oxygen Demand
<b>COD</b>	Chemical Oxygen Demand
<b>SS</b>	Suspended Solids
<b>TDS</b>	Total Dissolved Solids
<b>DS</b>	Dry Solids
<b>CEPTP</b>	Common Effluent Pre- (or Primary) Treatment Plant
<b>CMETP</b>	Common Municipal Effluent Treatment Plant
<b>SP</b>	Stagnant pool
<b>BSO</b>	UNIDO Back-stopping Officer (Mr. F. Schmel)
<b>CTA</b>	Chief Technical Advisor
<b>TOR</b>	Term of Reference
<b>TES</b>	Techno-Economic Study
<b>TD</b>	Tender Documents
<b>JFM</b>	Joint Formulation Mission (February 1993)
<b>PD</b>	Project Document (January 1997)
<b>EIS</b>	Environmental Impact Statement
<b>EIA</b>	Environmental Impact Assessment
<b>KEIP</b>	Kasur Environmental Improvement Project

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<b>KTPCP</b>	Kasur Tannery Pollution Control Project
<b>NEQSMLIE</b>	National Environmental Quality Standards for Municipal and Liquid Industrial Effluents
<b>EPA</b>	Environment Protection Agency - Punjab, Lahore
<b>HP&amp;EP</b>	Housing, Physical and Environmental Planning
<b>WASA</b>	Water and Sanitation Authority
<b>FTC</b>	Facility cum Training Centre
<b>TAD</b>	Tanners Association Dingarh - Kasur
<b>STA</b>	Small Tanners Association - Kasur
<b>KTWMA</b>	Kasur Tannery Waste Management Authority
<b>TEH-team</b>	TEH-PROJEKT HIDRO, Rijeka, Croatia Team (Subcontractor)
<b>PCM-team</b>	Process Management Consulting International (Pvt) Ltd (charged for the KTWMA organisation)
<b>IN CONSULT</b>	Selected consulting company for the preparation of the detailed design and other construction documents for CEPTP and the geodetic survey, including the ongoing works
<b>Rs</b>	Pakistani Rupees (US\$ 1.00 = approx. Rs 48 - 50, January 1999)
<b>1 cusec</b>	approx. 28 l/sec (approx. 101.9 m <sup>3</sup> /h)
<b>1 kanal</b>	5445 square feet
<b>1 acre</b>	8 kanals (approx. 4047 m <sup>2</sup> )
<b>1 ha</b>	approx. 2.5 acres
<b>1 marla</b>	272.25 square feet

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**FINAL REPORT  
CONTRACT No. 97/008**

**TEH-PROJEKT HIDRO TEAM**

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**DRAWINGS:**

- 1. LAND OFFICE MAP OF PROBABLE CEPTP SITE  
(in Urdu language), not to scale**

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## SUMMARY

TEH-PROJEKT HIDRO as UNIDO Subcontractor visited Kasur Pakistan for the Second (and the last in the actual contract) field mission from 22.01. to 28.01.1999, presented the prepared documentation (Study, conceptual design and tentative Tender documents for Kasur Tanneries CEPTP, CEPTP sludge dewatering, drying and permanent disposal and Laboratory equipment and chemicals), checked the actual status of KTPCP and discussed actions to be taken.

During this visit, TEH team explained again to all concerning parts (tanners and tanneries associations, KTWMA, recently selected consulting company IN CONSULT, local UNIDO representatives) the treatment concept accepted during the JFM in February 1993. This concept was the base for the preparation of the revised Study and the Tender documents through this actual contract. Special attention was given to the problem of the CEPTP sludge dewatering, drying and permanent disposal. All questions initiated by consulting company IN CONSULT concerning the conceptual design and tentative tender documents were answered.

The activities on the filed were also checked.

As stated, practically any concrete activities were observed between the first and second filed mission.

In meantime from the first field mission, waiting for the selection of the consultant, the KTWMA was occupied practically only with the organisational problems, and the preparation of the activities.

Unfortunately, during the commissioning of the activities between the old and new management of the KTWMA, practically all the documentation prepared by TEH-PROJEKT through the first contract, and still valid as conceptual and tentative tender documentation for all activities on the annexed construction, except for the CEPTP for which a new documentation were prepared (subject of this actual contract), were disappeared. Without this documentation it is not possible to check the as-built constructions and continue the activities.

Now, when the consultant is selected and his activities began, the intensification of the activities should be awaited.

The selected consulting company IN CONSULT already began the activities, especially on the geodetic survey of the area selected for the CEPTP construction and the structures and the installation already constructed.

In the Final report we repeated all the documentation prepared by TEH-PROJEKT through the first contract, additional jobs and also through this second contract.



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## 1. INTRODUCTION

The UNIDO Subcontractor (TEH-PROJEKT, Croatia) prepared TES and Tender Documents for the revised Kasur Tannery Pollution Control Project (KTPCP) in September 1997.

As per TOR, TEH-PROJEKT awaited the comments on this documentation and invitation to the field to present this documentation, discuss the probable comments and agree on the finalisation of the documentation.

Due to the organisational problems, and the expectation of the selection of the consulting company for the continuation of the activities on the KTPCP, TEH-PROJEKT was finally invited to the field in January 1999.

TEH-PROJEKT HIDRO visited Kasur Pakistan for the Second (and the last in the actual contract) field mission from 22.01. to 28.01.1999, presented the prepared documentation (Study, conceptual design and tentative Tender documents for Kasur Tanneries CEPTP, CEPTP sludge dewatering, drying and permanent disposal and Laboratory equipment and chemicals), checked the actual status of KTPCP and discussed actions to be taken.

To facilitate the activities on the KTPCP and to instruct the new persons and consulting company which were not got to know with the previous activities we will repeated in the Final report all the documentation prepared by TEH-PROJEKT and its experts through the first contract, additional jobs and also through this second contract.

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## 2. SECOND FIELD MISSION

As per TOR, TEH-PROJEKT's task on the second field mission was to present the documentation for Kasur tanneries CEPTP, discuss the probable comments and agree on the finalisation of the documentation.

The visit of TEH team was organised by KTWMA (tentative Schedules are presented in the Annex 2.).

TEH team explained again to all concerning parts (tanners and tanneries associations, KTWMA, recently selected consulting company IN CONSULT and local UNIDO representatives) the treatment concept accepted during the JFM in February 1993. This concept was the base for the preparation of the revised Study and the Tender documents through this actual contract.

The selected consulting company IN CONSULT prepared the list of the questions named "PREPARATION OF CONSTRUCTION DOCUMENTATION FOR THE CENTRAL EFFLUENT PRE-TREATMENT PLANT (CEPTP), UNIDO CONTRACT NO. 98/215" (annex 3.) and also put verbally many other additional queries.

All question initiated by consulting company IN CONSULT concerning the conceptual design and tentative tender documents were answered.

The tanners and tanneries associations representatives repeated their questions concerning the CEPTP sludge dewatering, drying and permanent disposal, initiated previously in TAD's letter dated 05.07.1998. Because this problem and its history was not clear to all concerning parts, the detailed explanation was given (see Annex 5.).

The activities on the filed were also checked.

Practically any concrete activities were observed between the first and second filed mission.

During the first field mission an detailed inventory on the ongoing works were made and some concrete activities suggested and agreed, as for example:

- installation of the water meter in each tannery
- re-check of each tannery on the installed capacity and production and the preparation of a computer database and recapitulative tables
- re-check the actual effluent volume and characteristics by direct measuring of the existed effluent streams
- construct in-house pre-treatment in each tannery
- define the Dingarh effluent pumping station location
- survey the constructed canalisation system and annexed area and prepared the as-built drawings
- construct the Younus Nagar canalisation system and pumping station

- 
- finish the works on the "Final Outfall" (manual cleaning screen, non-return cover at the end of pipeline, ventilation of the manholes, channel crossings (bridges), etc.)
  - finish the construction of the peripheral channel for storm water along SP-1 and SP-2.
  - survey geodetically all the executed works and prepare as-built drawings
  - make detailed design for all works
  - survey geodetically and mark the selected CEPTP site

Although not in the actual TEH's contract it was also necessary to continue the activities on:

- solid waste disposal including all necessary equipment for the solid waste handling and transport
- chrome recovery plant
- construction of the road and the bridge between the CEPTP and CEPTP sludge (and probably also solid wastes) disposal site

In meantime from the first field mission, waiting for the selection of the consultant, the KTWMA was occupied practically only with the organisational problems, and the preparation of the activities.

Unfortunately, during the commissioning of the activities between the old and new management of the KTWMA, practically all the documentation prepared by TEH-PROJEKT through the first contract, and still valid as conceptual and tentative tender documentation for all activities on the annexed construction, except for the CEPTP for which a new documentation were prepared (subject of this actual contract), were disappeared. Without this documentation it is not possible to check the as-build constructions and continue the activities.

Now, when the consultant is selected and his activities began, the intensification of the activities should be awaited.

The selected consulting company IN CONSULT already began the activities, especially on the geodetic survey of the area selected for the CEPTP construction and the structures and the installation already constructed.

The realised visit schedules, the participants and the discussion, findings and conclusions during the second filed mission are presented in the "MINUTES OF TECHNICAL MEETINGS OF TECHNICAL TEAM OF TEH PROJEKT WITH REPRESENTATIVES OF IN CONSULT, TAD, STA, UNIDO AND KTWMA HELD FROM 22.01.99 TILL 28.01.99" (Annex 4.). The problem on the CEPTP sludge dewatering, drying and permanent disposal was elaborated in the separate document prepared by Mr. Bosnic (Annex 5.)

Immediately after the return from the second field mission, TEH PROJEKT brief BSO Mr. Schmel on the activities and conclusion during the mission (Annex 6.)

Together with Draft Final Report, UNIDO provided the Final version of the tentative Tender documents.

### 3. FINAL REPORT

Although the actual contract cover only the activities on the revised documentation for the Kasur tanneries CEPTP, according the conclusions on the JFM held 1993, and the new prepared Project documents and TOR, to understand the complete Kasur Tannery Pollution Control Project (KTPCP) this Final report will recapitulate all TEH PROJEKT's activities including first contract, additional jobs and this actual contract.

The list of all documents prepared by TEH-PROJEKT and its experts is presented in the Annex 6.

General concept and the actual status of the whole KTPCP is as follows:

#### 3.1. Dingarh Tannery Effluents (not the subject of actual contract; elaborated in TES, and Tender Documents dated 1991/1992)

Effluents from Dingarh cluster should be collected in an interceptor along the river R. Nullah and pumped into the "Pucca drain". **The R. Nullah will be free from heavily polluted tannery effluents and its water (owing to surprisingly fast self-purification) will be usable for irrigation with hardly any health hazard.**

**Details are elaborated in Annex 4 of TES, dated June 1992 and Tender No. 1, dated July 1992!**

Detailed design of this system and/or as built drawings were never prepared.

Due to the doubt on the actual tanneries capacity and effluent quantity it was suggested to recheck the data, although it will not be easy to make the change, because the pumps and some other equipment are purchased.

The majority of the suggested effluent collection system is constructed. The last part, e.g. the connection to the Dingarh pumping station should be constructed when this pumping station will be constructed. Site for Dingarh pumping station is not yet selected and marked (land map drawing annexed).

The majority part of the concrete channel for the pressure pipeline is also constructed and it is necessary to connect it with Dingarh pumping station when this pumping station will be constructed. Some details concerning the crossing with other infrastructures and complete channel covering are not finished.

None decision concerning the material of pressure pipeline and mode of construction is still done.

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### **3.2. "Pucca Drain" (not the subject of actual contract; elaborated in TES, and Tender Documents dated 1991/1992)**

It was suggested to extend the existed "pucca drain" to the beginning of the Kot Moulvi A. Qadir cluster and make arrangements for the overflow of the rain water as well as for the connection to the treatment plant near the stagnant pool No. 2. All tannery effluents should be connected to it.

**Details are elaborated in Annex 5 of TES, dated June 1992 and Tender No. 2, dated July 1992!**

Detailed design of this system and/or as built drawings were never prepared.

Some of the secondary collectors were not connected to the Pucca Drain. On some places it seems that the connections will maybe not be possible, because the bottom level of the Pucca Drain seems to be higher than the bottom of the existed secondary collectors.

Actually, the effluent flow from the Pucca Drain is deviated to the stagnant pools.

### **3.3. Younus Nagar Tannery Effluents (not the subject of actual contract; elaborated in TES, and Tender Documents dated 1991/1992)**

The effluent from Younus Nagar cluster should be collected to the pumping station and lifted into the "Pucca drain".

**Details are elaborated in Annex 6 of TES, dated June 1992 and Tender No. 3, dated July 1992!**

Detailed design of this system and/or as built drawings were never prepared.

Due to the doubt on the actual tanneries capacity and effluent quantity it was suggested to recheck the data, although it will not be easy to make the change, because the pumps and some other equipment are purchased.

The majority of the suggested main effluent collection system is constructed. The last part, e.g. the connection to the Younus Nagar pumping station should be constructed when this pumping station will be constructed. On some places it seems that the connection of the existing tanneries will not be possible, because the bottom level of the constructed Younus Nagar collector seems to be higher than the level of neighbouring tanneries.

Some civil works on the pumping station are done, but it was not possible to verify, because the construction documentation was not available.

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### **3.4. Final Outfall and evacuation of the "Stagnant pools" (not the subject of actual contract; elaborated in TES, and Tender Documents dated 1991/1992)**

In the absence of a suitable water recipient **there was no economically and environmentally acceptable temporary, "interim" solution.** Instead, evacuation is part of an overall, comprehensive programme for drainage and treatment of the sanitary and tannery waste waters from the three clusters.

**The only feasible solution was to construct an intercepting channel along the stagnant pool No. 1 to protect it from the storm water and to extend it to the Pandoki Outfall. Simultaneously the tannery effluents inflow should be cut off. They should be pre-treated prior to discharge.**

This channel named the Final Outfall will not only collect rain water but also the tannery effluents **after treatment at the CEPTP.**

Owing to the high evaporation rate in Kasur (ca 1500 mm/year), the water in the ponds will evaporate within 1 year and the area will be ready for reclamation. The town planning for this area should start immediately and all the relevant data about the effluent drainage should be prepared, so they can be taken into account for the final designs of the final municipal effluent treatment plant.

**Details are elaborated in Annex 7 of TES, dated June 1992 and Tender No. 4, dated July 1992!**

Detailed design of this system and/or as built drawings were never prepared.

The final part (close pipeline) of "Final Outfall" is constructed. Some details suggested in Mr. Brusic's Technical report - Field Mission of the Consultant in Civil Engineering, dated 08 July 1996, are not realised (installation of manual cleaning screens at the end of the open section, non-return cover at the end of the pipeline (inlet in the Pandoki channel) ventilation of the manholes etc.). The first part (open channel) of the "Final Outfall" is not finished. Approx. 140 m should be constructed. Practically non channel crossing (bridges) are constructed. Only some provisory crossings (bridges) exist or somewhere the constructed channel is filled-up with the earth. The crossing of the "Final Outfall" with Rohi Nullah is constructed, except one of three pipeline. The crossing of the "Final Outfall" with Tolwahwala is constructed.

Storm water peripheral channel along SP-1 is constructed, except some 200 m, which will not be constructed, considered by KTWMA as not necessary.

Storm water peripheral channel along SP-2 is excavated, but only 150 m of channel is constructed.

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### **3.5. In-house Arrangements (not the subject of actual contract; elaborated in TES dated 1991/1992)**

It was suggested that the coarse screens and simple grit/grease chambers should be installed in each tannery to protect the drainage from clogging with coarse, settling and floating materials.

Flow meters for process water should be installed to control the water consumption and indirectly the effluent volume.

**Details are elaborated in Annex 1 of TES, dated June 1992; Tender documents were not prepared, because the concrete specification for the each tannery was never prepared and this activities should be done by each tannery!**

Practically non activities in the construction of in-house pre-treatments. Only some tanneries has correct in-house pre-treatment as representative examples.

Although it was decided that the water-meters will be purchased from Minerva Trading Corporations and the UNIDO money was available, this activities was not done.

### **3.6. Chrome recovery (not the subject of actual contract; elaborated in TES, and Tender Documents dated 1991/1992)**

It was suggested that cleaner production methods, recycling, utilisation of wastes as by-products etc should be introduced wherever possible.

**In particular a semi-industrial chrome recovery and a by-products processing pilot plant is recommended to be installed for demonstration and adaptation of the full recovery from spent tanning liquors.**

**Details are elaborated in Annex 1 of TES, dated 1991/1992 and Tender No. 7, dated July 1992!**

Detailed design of this system was never prepared.

Practically non activities in the construction of the chrome recovery plant.

### **3.7. Common Effluent Pre-treatment Plant (CEPTP) and CEPTP sludge disposal**

Among several alternatives elaborated in great detail (please refer to the TES, dated 1991/1992, the Annexes 8, 9 & 10), from the list of possible technical options, **it was recommended to adopt a simple, reliable, cost efficient system** (please refer to the TES, dated 1991/1992, Annex 16). Due to the conclusions of JFM (February 1993) a revised concept of the CEPTP was suggested (see FINAL REPORT ON ADDITIONAL SERVICES UNDER EARLIER CONTRACT No. 91/106, prepared by TEH-PROJEKT HIDRO Rijeka, May 1993).

**This actual contract cover the conceptual design and tentative tender documents for this revised alternative which consisting of the following:**

- coarse manual screening
- automatic fine screening
- flow and quality equalisation with 1 day (24 hours) retention time (mixed and aerated by floating aerators)
- primary settling (without chemicals),
- lagooning in the natural lagoons at the available area (with only approx. 15 % of the necessary lagooning time,
- (probable) sludge conditioning with the lime
- hydraulical liquid sludge transport and sludge thickening, dewatering, drying and permanent disposal in separate lagoons (after destroyed railway bridge) with the return of supernatant back to the CEPTP
- disposition of pre-treated effluent by Final Outfall and Pandoki Channel to Sutlej River

**This concept was selected because hardly any chemicals are used (lime only), and the energy requirements are low!**

**The recommended system will be able to remove almost all the sulphides and chromium (95-98 %) as well as more than 95 % of the suspended solids and 60 % of BOD<sub>5</sub> load. The problem of the pollutants (especially dissolved salts) which will remain in the effluent will be considerably decreased by dilution on the way towards and in the final recipient (Sutlej river) itself, so that no serious harm can be expected.**

**The laboratory equipment and chemicals should be also included in the new documentation for CEPTP.**

The sub-alternatives with chemical treatment and the aeration of the effluent treatment lagoons were also elaborated, but only as the Study (preparation of the tentative tender documents was not our task in this contract).



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After the first field mission and the submission of the Report on the first field mission, TEH PROJEKT prepared the revised TES (including conceptual design) of this alternative and tentative Tender documents.

This documents were sent to all concerning parts at the field, and TEH PROJEKT was invited for Second field mission to present its documentation and give all necessary comments and answers to local counterparts and selected consulting company to be able to continue the activities.

The report of this Second field mission is presented in the previous chapter.

After the signature of the contract and from the TEH PROJEKT's second field mission, the selected consulting company IN CONSULT is responsible for the detailed engineering design and the preparation of construction documents.

The crucial problem for any other activities on the detailed design, tender documentation and the CEPTP construction is **that the CEPTP location is not still completely surveyed and marked on the field.**

### **3.8. Tannery Solid Waste Disposal (not the subject of actual contract; elaborated in TES, and Tender Documents dated 1991/1992)**

Although out of the scope of the actual contract, the problem of the tanneries solid wastes collection, transport and disposal will be also mentioned to complete the activities on the KTPCP.

The solid wastes from the tannery production processes should be collected and reused to the largest extent possible.

However, investigations on the optimum solution for its disposal should continue, more specifically, it should be established whether and to what extent it could be applied on the agricultural areas.

**It should be noted that the amount of both usable (to be converted into by-products) and unusable solid wastes from leather processing to be transported and/or dumped will be approximately 55 - 110 t/day.**

In the future the possibility of common disposal or/and processing together with the other municipal solid wastes should be examined.

**Details as per old alternative were elaborated in Annex 13 of TES, dated 1991/1992 and Tender No. 9, dated July 1992, and this documentation is not more valid.**

The JFM suggested to dispose the tannery solid wastes on the old railway track in the prolongation of the CEPTP site (after the destroyed railway bridge).

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The tanners and tanneries associations requested the re-investigation of the location of the disposal site for solid wastes, suggested by JFM, to keep this (limited) area only for the CEPTP sludge disposal and it is necessary to make the final decision on this problem.

For the design of the solid wastes disposal and for the tender documents for its construction a separate experts and sub-contractor were selected. Their job should include the design for the necessary equipment for the solid wastes collection transport and handling.

### **3.9. Approach roads to permanent CEPTP sludge disposal site and to the solid wastes disposal site**

Due to the change in the conception of the CEPTP sludge disposal and the location and shape of the disposal site for the tanneries solid wastes, it is necessary to made the new documentation (design, specification and tender document) for the construction of approach roads.

The conception of the roads design depend on the final selection of the location for the tanneries solid wastes disposal site.

The conception of the reconstruction of the destroyed railway bridge between the CEPTP location and the location of the permanent CEPTP disposal site depend also on the location of the tanneries solid wastes disposal site.

If all available area after destroyed railway bridge will be reserved only for the CEPTP sludge disposal (as asked by tanners and tanneries associations), the road and the bridge should be construction only for the intermittent traffic of the small vehicles for the inspection and maintenance of the CEPTP sludge disposal installations, and if this road and the bridge should be also used for the solid waste transport (as actually planned) they should be constructed for the permanent traffic of the heavy vehicles.

If a new location for the tanneries solid wastes will be selected, the approach road included all necessary infrastructures should be constructed according the selected location.

It is not yet clear who will be responsible for this activities.

### **3.10. Vehicles (not the subject of actual contract; elaborated in TES, and Tender Documents dated 1991/1992)**

For the correct functioning of the KTPCP it is necessary to have a different vehicles .

**Details as per old alternative were elaborated in different Annexes of TES, dated June 1992 and Tender No. 8, dated July 1992, and this documentation is not more valid.**

Due to the of changes in the conception and the location of tannery solid waste and CEPTP sludge disposal and due to the partially purchased vehicles it is necessary to prepare a new specification

The new specification of vehicles should be prepared by KTWMA and solid wastes consultant.

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## 4. CONCLUSIONS AND RECOMMENDATIONS

According to the activities and the documentation prepared through the first contract and additional activities, presentation of the conceptual Study and tentative Tender documents for the revised alternative (actual contract) and the discussion with all concerned parties in this project (tanners and tanneries associations, KTWMA, UNIDO Pakistan, selected consultant IN CONSULT) and the findings during the second (the last in actual contract) field mission, the Subcontractor (TEH-PROJEKT) has the following conclusions and recommendations:

1. Through first contract, additional activities and the actual contract TEH PROJEKT and its experts gave all necessary basic information and documentation (conceptual designs and tentative tenders) for the realisation of the KTPCP.
2. KTWMA and contracted consulting company IN CONSULT (for CEPTP and geodetic survey of ongoing works, but not for all activities yet) are responsible for the detailed engineering design and the preparation of construction documents for all contracted activities.
3. All the doubts concerning the increase of the tanneries installed capacity and actual production and effluent volume, appeared after the fixation of the basic data for the CEPTP, should be once more checked. Because it is practically not possible to change the capacity of the planned CEPTP, it will be necessary to limit the capacity of the tanneries and the effluent volume to the designed CEPTP capacity (12700 m<sup>3</sup>/d), as it was promised by local authorities.
4. Especially, it is necessary to recheck the estimated effluent volumes to the effluent pumping stations on the effluent collection system. According to the findings, either the effluent volume should be limited to the designed volume, or the pumping stations should be reconstructed (although possible, because these are still not constructed, it is not recommended, because the main equipment is still purchased).
5. It is necessary to survey geodetically all ongoing works, prepare as-build drawings and detailed constructive drawings (for the works which are not finished) and finish all these works (effluent collection systems, final outfall, storm water collection system along the SPs, installation of the water meters in the tanneries, in-house pre-treatments, etc.).
6. It is necessary to answer the questions initiated by tanners and tanneries associations concerning the future CEPTP sludge disposal and the location of the solid wastes disposal site. Although this can be considered as conceptual question, the answer to this question is indispensable for the continuation of the activities on the solid wastes disposal and the design and construction of the approach roads including infrastructures

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(bridge), not only for the solid wastes disposal, but also for the connection of the CEPTP site and the site for permanent CEPTP sludge disposal.

7. As the most important and crucial problem for the CEPTP and CEPTP sludge disposal construction it is necessary to know finally the exact sites location and dimensions and to mark the sites on the field.
8. The chrome recovery plant should be constructed to decrease the content of the chromium in the effluent and to make the tanning more economic, by using the recovered chrome.
9. The activities on the Tanneries Solid Wastes Disposal should be continued.
10. Due to the of changes in the conception and the location of tannery solid waste and CEPTP sludge disposal and due to the partially purchased vehicles, the new specification of vehicles should be also prepared by KTWMA and solid wastes consultant.
11. The activities on the approach roads, including the infrastructures (bridge), between the CEPTP and CEPTP sludge disposal and for the tanneries solid wastes transport site should be cleared and continued.

**ANNEX 1.**

**TERMS OF REFERENCE**

**Terms of Reference**  
for the subcontract  
**Technical Support in the Designing the**  
**Central Effluent Treatment Plant (CETP)**  
**for Tanneries in Kasur**

## 1. Background

The town of Kasur is located about 55 km southeast of Lahore, in the province of Punjab, near the Indian border, where the river Sutlej enters Pakistan. Since antiquity Kasur has been known as a centre of trade, commerce and culture. The town is located in a NW-SE ridge, surrounded by a flat landscape. The low permeability of the top soil characterizes the land. Wind erosion and water logging deteriorates soil qualities and reduces land areas suited for agriculture. Farming relies on irrigation, using ground water and private tube wells. Intensive irrigation has changed the soil structure. Waterlogging and high salinity decreases the productivity of the agriculture sector. A *Salinity Control and Reclamation Programme (SCARP)* consisting of 12 wells and the drainage channel Pandoki Outfall were constructed to overcome these disadvantages. However, only one of these wells is currently in operation. The municipal boundary covers an area of about 2,335 acres, surrounded by agricultural land (wheat, grums, maize, rice and cotton). Mainly due to tannery effluent water, large land areas are presently under water, constituting the so-called stagnant lakes or pools, for which the town has become famous during the last few years as one of the most heavily polluted in Pakistan.

The Kasur district covers a gross area of 981,702 acres of which 705,224 acres are classified as cultivable land. Under irrigated agriculture conditions, the soil is very productive. Rice, sugar cane, cotton, various fodder, maize and vegetables are the main crops in summer (kharif), while wheat is the only dominant crop in winter (rabbi). A former river, Rohi Nallah, meanders through the town. Natural effluent has been cut off and today the water in the river consists of the domestic sewage from the town and some of the waste water from the tanning industry. The river bed is also the dumping site for garbage and other solid waste. Farmers along the river use the mixed sewage for irrigation, watering buffaloes and washing clothes.

According to the last (1981) census, the number of inhabitants was about 155,500; for 1995 it is estimated to be about 280,000. The textile industry is the largest industry in Kasur in terms of employment, followed by the tanning industry. These industries dominate the town, with most of the population directly or indirectly depending on them.

Tanning has a long standing tradition in Kasur. Initially, rather primitive tanneries, in which all operations were carried out manually, and in which tree bark for tanning proper was used, had apparently been established in the Dingarh area on the bank of the Rohi Nallah. Subsequently, tanneries started spreading over a wider area south of the river and Kot Molvi, Abdul Qadir, Niaz Nagar and Younus Nagar agglomerations were gradually developed. With its 170 tanneries, Kasur is the biggest tanning concentration in number in the country.

According to data provided by the TANNERIES ASSOCIATION DINGARH, Kasur, the average daily input of all tanneries in Kasur is estimated to be over 180 tons of wet salted weight, comprising some 8,000 hides (cattle, buffaloes) and between 12,000 and 15,000 skins (sheep and goats) per day. The small-scale units mainly produce hides and/or skins up to the wet-blue stage only, as they do not have the facilities for finishing leather. They sell the semi-processed leather to tanneries in Karachi, Sialkot and other places, where the leather is finished for various end uses. Some small and medium-sized tanneries also produce vegetable tanned leather for sole leather and for other purposes.

The conventional pattern has been well preserved: except 3-5 larger and mechanized tanneries with a more or less industrial way of production, the other tanneries are small, family-owned units, employing up to ten workers. Traditional family-owned tanneries typical of Kasur are very basic. Most operations are still carried out with very limited use of machines and equipment. Sulphide supported unhairing by pulping for hides and by painting for skins are commonly used in liming. Chrome tanning has, to a great extent, replaced the slow vegetable tanning process, but the ancient bag-tanning method can still be seen. Some tanners still prepare their own chrome liquors from dichromate under poorly controlled conditions. Due to the unavailability of water supply, encouraged by its economic incentives, all the tanneries are presently using the underground water for their tanning activities.

Most medium-sized tanneries finish their chrome-tanned leather using only water-based coatings and hand-spraying techniques. The largest tannery has fully automated spraying units (two) for finishing the leathers produced and several other larger tanneries are also in the process of installing automated spraying units.

In contrast to the export oriented tanners of the Korangi industrial zone of Karachi, who operate large, well-equipped factories, Kasur has remained a hide processing centre, mostly catering to the needs of the local, low-price bracket leather footwear manufacturers. Profit margins are low and their access to capital and potential for modernization is limited. Many will find it difficult to survive in the increasingly competitive environment.

In view of its proximity to the large market of Lahore and the availability of leather and cheap labor in Kasur, it is somewhat surprising that no downstream manufacturing units (footwear, leather goods) have been established in Kasur; they remain within the Lahore area.

Sanitary conditions both within and outside tanneries are poor by any standard: few units are kept tidy. However, possibly due to the UNDP/UNIDO preparatory assistance project, an increasing awareness of the negative impact of tannery operations on the environment has been created among members of the tanning community. Little attention is given to occupational health standards, protection from exposure to harmful chemicals and to safety at the work place.

The well organized TANNERIES ASSOCIATION DINGARH, Kasur is the main driving force behind endeavors to catch up with more advanced tanners in the country and, in particular, to resolve the problems of treatment and discharge of tannery effluent which, sooner or later, is bound to paralyze the tanning operations in Kasur.

The three tannery clusters discharge 9,000 m<sup>3</sup> of heavily polluted tannery waste water per day. About 2,500 m<sup>3</sup> of the above tannery effluent together with domestic sewage is discharged into the Rohi Nallah. This is used for irrigation in the down stream parts of Rohi Nallah. The remaining amount is discharged to the stagnant pools permanently covering an area of 327 acres and another 311 acres during the monsoon period. The chemically polluted water affects the growth of crops, plants and crop yields; outputs from animals and their health; as well as induced social problems in the area.

A total of 100-150 tons/day of solid tannery waste and 150-200 tons/day of solid domestic waste is disposed of by casual dumping at various places, including the Rohi Nallah. Water supplies from hand pumps and tube wells, and foodstuffs produced in the area are contaminated with dissolved solids, especially sodium chloride and sulfides. The *Environmental Impact Assessment (ELA)* report made in February 1993, attributes the groundwater contamination to the tannery effluent, waste water and stagnant pools.

Improper use and handling of chemicals has rendered workers and residents to hazardous exposure. Respiratory disorders, skin infection related diseases, diarrhea/dysentery and typhoid are the most serious illnesses among the community, population etc. Currently 50,000 to 60,000 people are exposed to the environmentally polluted conditions. Most of the tanneries are small and their owners have limited knowledge of simple methods and ways of improving their tanning process and working situation.



The following is the amount of the tannery pollution load discharged into the environment (per annum): 4,000 tones of BOD, 11,000 tones of COD, 10,000 tones of solids in suspension in waste water and effluent; 160 tones of Chromium and 400 tones of Sulphide (calculated on the basis of 13,000 m<sup>3</sup>/day and 300 days per year). It should be noted that although being a primary treatment type, the proposed treatment plant is expected to eliminate 65% of the BOD, 55% of the COD, 95% of the suspended solids, 95% of the chromium and 98% of the sulphide.

The HOUSING, PHYSICAL AND ENVIRONMENTAL PLANNING DEPARTMENT (HP&EP) of the GOVERNMENT OF PUNJAB is administratively responsible for provincial policies and programmes in the area of environmental planning and the enforcement of standards, including the provision of water and sanitation services. HP&EP, acting through the KASUR DEVELOPMENT AUTHORITY (KDA), established the KASUR TANNERY WASTE MANAGEMENT AGENCY (KTWMA) which is the national counterpart organization responsible for implementing the UNIDO project and later for operating the complex tannery effluent treatment system comprising chrome recovery units, channels and pump stations, the *Central Effluent Treatment Plant (CETP)* and activities related to the solid waste handling. KTWMA will delegate the direct responsibility for the promotion of in-house tannery technology improvements, operation improvements and the chrome recovery and by-products pilot plant to the KASUR TANNERY ASSOCIATION (KTA). In its capacity as national executing agency, HP&EP has appointed the *National Project Director (NPD)*, who is responsible for overall project development and liaison with concerned government agencies and UNDP/UNIDO. In his work he will, during project life, be assisted by the *Assistant National Project Director (ANPD)* financed from the UNIDO technical assistance project budget.

Detailed designs and outline tender documents have been prepared in the techno-economic study of the preparatory assistance phase. These need some modifications as a result of the change in the solid waste disposal site, including changes in the built-up area of the tannery clusters necessitating some minor changes in the lay-out of pumping stations. Hence, a final design review is required early on during project implementation before tenders can be called. Technical assistance in the form of UNIDO consultants and subcontractor services is provided for in the project.

Contracts for civil works would be given by KDA/KTWMA through local competitive bidding. In order to speed up the implementation of the project and to avoid significant price increases, the civil works have been split into five smaller packages: drainage in tannery clusters, solid waste site plus lagoons, treatment structures, pump houses in clusters and the final outfall.

The physical implementation of major civil works contracts related to the sewage system commenced early 1996 and should be completed by mid 1997. A detailed work-plan coordinating efforts of local and international parties involved in the project implementation has also been prepared for Phase I.

UNIDO provides technical backstopping support services related to introducing low waste technologies including chrome recovery and by-products, technical evaluation of equipment and training. Its services, in particular, do *not* include the overall project management and all construction works except *guidance* in the initial review and introducing minor modifications of designs made during the project preparatory assistance.

## 2. Project Objective

The overall objective of the project is to control the indiscriminate discharge of potentially harmful solid waste and heavily polluted waste water and improve the working conditions in Kasur, thereby ensuring an environmentally sustainable social and economic development of the area. The present Phase I of the project is focusing on building infrastructure for transporting effluent from tanneries to a *Central Effluent Treatment Plant (CETP)* and subsequently to transfer the treated effluent to the Sutlej river, introducing cleaner technology in local tanneries and handling solid waste. Phase II of the project will concentrate on constructing and starting up the CETP operation, establishing an effluent treatment laboratory and improving working conditions in the tanneries.

### 3. Responsibilities of the Contractor

The project deals with constructing sewers, pumping stations, treatment plants, purchasing and installing heavy equipment, assisting the agency to manage the same, collecting data on wet and solid discharges and on health parameters, training staff in administrative, financial and technical matters. The assignment will cover the following fields:

- 3.1 Reappraise the volume and pollution loads from existing and planned tanneries, other industrial activities and occupants connected to the CETP waste water collection network, taking further extensions of tanning activities in Kasur and the expected impact of introducing cleaner technology in the existing tanneries into consideration.
- 3.2 Verify estimated characteristics and volume of sludge resulting from primary treatment, including solid waste produced by local tanners.
- 3.3 Review the design documentation of CETP prepared during the preparatory phase of the present project, define changes needed due to technical development, volume and characteristics of the effluent produced, land allocated for the CETP etc.
- 3.4 Revise the design documentation for the CETP including drawings, process flowchart(s) and related technical description(s), list and specification of equipment to be imported and those to be produced locally, recommend potential suppliers, estimate the volume and costs of civil works required for the establishment of the plant, indicate detailed documents to be prepared for construction work.
- 3.5 Revise estimates of operation costs and depreciation of the CETP and solid waste management plant.
- 3.6 Assist KDA, KTWMA, NPD/ANPD and UNIDO field staff in preparing tender documents and carrying out technical evaluation of bids for CETP construction work.
- 3.7 Recommend a time schedule for constructing, test running and starting up the CETP as Phase II of the present project.

### 4. Field of Expertise Required

Reputable consulting firm with engineering and institutional development background. Prior experience in Pakistan or other South Asian countries is a prerequisite.

**Expert in the tannery effluent treatment - team leader (two months)**

Mechanical or civil engineer with a proven track record in the tanning industry with extensive experience in designing, installing and/or running effluent treatment plants and a profound knowledge of constructing sewage systems.

**Civil engineer (two months)**

Well qualified engineer experienced in designing, organizing and quality assessment of constructing tannery effluent treatment plants.

**Support staff (three months)**

Engineers and craftsmen to prepare plant design documentation, secretaries and interpreters if required.

## 5. General Time Schedule

The final time schedule and a detailed work-plan will be prepared as soon as the Contractor has been selected. The time schedule will be annexed to the contract and will form an integral part of the same. The following *tentative* programme, subject to modifications, is applicable for contract negotiations.

5.1	Briefing the Contractor's team leader in Vienna	March 1997
5.2	Finalization of the work-plan	March 1997
5.3	Appraisal of effluent load and future developments, evaluation of the CETP design documentation prepared in the preparatory assistance phase	May 1997
5.4	Preparation of revised documentation of the CETP	July 1997
5.5	Recommendation and work-plan for establishing the CETP	August 1997

### Reports as follows

--	after field survey, including proposals	May 1996
--	design documentation on CETP	July 1997
--	draft final report	August 1997
--	final report	September 1997

**ANNEX 2.**

**SCHEDULES OF TECHNICAL MEETINGS WITH TEH PROJEKT  
TEAM ABOUT CONCEPTUAL DESIGN OF CEPTP**

BRUSIC

Fax No: 042/650185

OFFICE OF THE PROJECT MANAGER  
KASUR TANNERY WASTE MANAGEMENT AGENCY  
TEHSIL ROAD, KASUR, PAKISTAN  
Phone No: 0492-763675 Fax NO: 0492-763678

To:  
See distribution

Subject : Schedules of Technical Meetings with THE PROJEKT Team  
About Conceptual design of CEPTP

This is in continuation of our letter No. KTP/PM-07/432 dated 18-01-1999 about the subject. M/s Bosnic and Brusic of THE PROJEKT will be available at Kasur/Lahore from 22-01-1999 till 28.01.1999 to present and clarify their conceptual design of CEPTP to representatives of Tanners, detailed engineering consultants M/s In-Consult and UNIDO/KTWMA project management team. Schedule of meetings/presentations is as under:

- 22.01 + 1. Presentation by THE PROJEKT TEAM, on 22-01-1999 AT 3:00 PM AT Ambassador Hotel, Lahore
- 23.01 + 2. Presentation by In-Consult team on 23-01-99 at 9:00AM (Venue will be decided later)
- ~~24.01~~ → 24.01.99. **NEDEVA**
- 25.01 3. Visit to CEPTP site at Kasur on 25-01-99. Review of survey report by In-Consult. No of Facultative Lagoons to be reviewed
- 26.01 4. Tanners observations about conceptual design on CEPTP of 26-01-99 at 10:00AM (Venue will be decided later)
- 27.01 5. Discussions and finalisation of observations about Conceptual design of CEPTP in detailed engineering on January 27 and 28. Venue to be decided later.
- 28.01

Distribution

- 1. M/s Bosnic and Brusic, Ambassador Hotel, Lahore
- 2. Mian Shafiq Passari, Chairman Standing Committee, ETP, Kasur
- 3. President, TAD, Kasur
- 4. President, STA, Kasur
- 5. Mr Ibrahim Saeed, UNIDO, P.C. Lahore
- 6. Mr Iqbal P. Sheikh, IN-Consult, Lahore

*[Signature]*  
Project Manager  
KTWMA, KASUR

**ANNEX 3.**

**PREPARATION OF CONSTRUCTION DOCUMENTATION FOR THE  
CENTRAL EFFLUENT PRE-TREATMENT PLANT (CEPT), UNIDO  
CONTRACT NO. 98/215**

PREPARATION OF CONSTRUCTION DOCUMENTATION FOR  
THE CENTRAL EFFLUENT PRE-TREATMENT PLANT (CEPT)  
UNIDO CONTRACT NO. 98/215

Points to be discussed with TEH representative

**A. PROCESS**

1. What is the chemical reaction responsible for the decrease in Chromium content from 25 to 2 ppm?

*officially resistant enough. Reaction based on economical calculations.*

2. What is the type of stainless steel recommended (304 or 316)? Locally SS 304 (18/8) is readily available and its repair, maintenance would be easy.

The pump sizes do not match with the flow rates. For example, the maximum flow rate at screen level is  $13000 \text{ m}^3/12 \text{ hr}$ , but the average flow rate for equalised effluent is  $6300 \text{ m}^3$  per 12 hours and the pumps recommended have a flow rate of  $300 \text{ m}^3$  per hour (page 11, T&S) and  $350 \times 2 = 700 \text{ m}^3$  per hour at page 171 of tender document. This will require 24 hours pumping instead of 12 hours. Have we taken into an account any safety factor for flow rates?

4. Due to this difference in flow rates the level of water in equalisation tanks will vary and the hold up period will also decrease, in case pumping is done for over 12 hours.

The process water turbine is designed for 500 liter / minute flow rate, what are the process water requirements. What about a smaller pump and an overhead tank to meet the requirements with motors to develop the pressure?

6. For lime addition can we use hydrated lime powder and add it directly to sludge pumping tank. We may use a hopper and feeder system for powder. Feeder motor may be linked to automatic slurry feed valve.

7. Route of 125mm sludge pipelines after the bridge? *(As per layout)*

8. In case of intermittent pumping of sludge, possibility of choking of lines. *(Clarified)*

9. How to open the choked line. Possibility of fresh water pressure pipe line. *(Clarified)*

10. The design calculations provided in the volume are a summary of the design calculations done for the project, which only provides the final sizing of structures. Detailed calculations if available will be helpful in detailed design.

11. What are the criteria for selecting submersible pumps? As these pumps shall be imported, there will be problem in their maintenance in the long run. Platform mounted pumps may be a better solution. ( )

12. Can we have some more information about aeration turbines and settling tank equipment? As specifications of this type of equipment is not readily available in the local market.



## B. CIVIL/STRUCTURE

*pumping line* (D) flats  
? Block  
3rd fl. 6-C

1. ✓ Generally a fibre glass protective coating is applied on concrete surface for its protection, such as equalization tanks or settling tanks, what are T.H.H recommendations in this case?
2. ✓ What are the fire fighting design criteria? Use of the local standards shall be preferred?
3. ✓ The water supply/fire water systems does not have a ground or roof storage tank which could be utilized as the minimum emergency reserve for fighting.
4. ✓ What is the system designed for removal of sludge from aeration lagoons, How this sludge will be removed and disposed off and where? (*Clarified*)
5. ✓ The lagoons are to be lined with 300 mm of rammed clay. Have we identified the borrow pits of clay of desired specifications in the area. How about the use of geo membrane? (*Atent*)
6. ✓ Settling pattern of sludge in permanent sludge lagoon. How to control un-even settling along 80 meter and how to collect effluent in this case?
7. ✓ Access Road: Gravel road could be replaced with brick paved roads, which are a common practice in Pakistan. The kind of vehicle traffic loading expected for this road is required.
8. ✓ Do we anticipate any seepage problem? Has it been accounted for in the design?

*w.r.t ground water contamination* 8 5m

## C. CHEMICAL ANALYSIS

1. What is degree of accuracy required for chemical analysis? As it is not a research lab, delicate equipment might be replaced with kits or cheaper / rugged equipment.

## D. ELECTRICAL

1. A room is to be built at boundary line to install 11kV VCB for metering purposes. No place is designated for such room.
2. High voltage cable route is to be shown to lay HT cable from WAPDA room to high voltage Switch Board Room.
3. 35mm<sup>2</sup> ACSR (Al-Fe) conductor is not a standard WAPDA Conductor. A WAPDA Standard conductor will be used for overhead line system.
4. 11kV overhead line will be constructed on PC' poles and not on Lattice Steel Structures.
5. Younus Nagar Pumping Station is proposed to be fed through Distribution Broad RO 1 by making use of 4c, 35mm<sup>2</sup> underground cable. Distance may not permit this exercise
6. Fuel storage arrangement for GEN SETS is not shown



7. Nothing is mentioned about earthing of Neutral of Transformer and GEN SETS.
8. HV Board suggests to connect 630 kVA transformers through a combination of Load Break Switch and Low Oil Circuit Breakers simultaneously.
9. Secondaries of both the Transformers are shown to be operated in parallel.
10. How the power supply to the pumping station of sludge supernatant pumps at sludge lagoons shall be managed at a distance of nearly 1.5km from the control building.
11. Is it required to bring an express feeder for the plant
12. Fire Alarm System is not provided.

**ANNEX 4.**

**MINUTES OF TECHNICAL MEETINGS OF TECHNICAL TEAM OF  
TEH PROJEKT WITH REPRESENTATIVES OF IN CONSULT, TAD,  
STA, UNIDO AND KTWMA HELD FROM 22.01.99 TILL 28.01.99**

## **Minutes of Technical Meetings of Technical Team of TEH PROJEKT with Representatives of In-Consult, TAD,STA UNIDO and KTWMA Held from 22.01.99 till 28.01.99**

M/s Brusic and Bosnic of TEH PROJEKT HIDRO, are in Lahore to present and clarify the Techno-Economic study and Tender documentations of the accepted alternative proposal for Kasur Tanneries Pollution Control Project No. DP/PK/93/006 . The technical team of TEH PROJEKT is scheduled to stay in Pakistan from 22.01.99 till 28.01.99 to have detailed technical discussions about their conceptual design of CEPTP and other related facilities with detailed engineering consultants, M/s IN-Consult, representatives of TAD/STA, UNIDO and KTWMA.

### **22.01.99 (First day)**

1. Meetings were held at Ambassador Hotel, Lahore from 15.00 hours till 18.00 hours. List of participants is attached as annexure – I
2. Dr Siddiqi, Project Manager, KTWMA welcomed the participants and stated that conceptual design of TEH PROJEKT, to be reviewed jointly by all the participants. M/s In-consult will be responsible for the detail engineering design and preparation of construction documents and as such they are required to obtain any clarification which they consider necessary to proceed with their work and deliver the reports as per agreed schedule.
3. Mr Bosnic of TEH PROJEKT explained in detail the basis of conceptual design of CEPTP and other related facilities
4. Major limitations in conceptual design were:
  - Insufficient of Land for building adequate number of lagoons for achieving optimum results for pollution control.
  - Use of chemicals and mechanical aerators not allowed due to high operating cost
5. Mian Shafique Passari suggested that present proposed site for solid waste disposal be shifted to Kesargarh site and the available site may be used for sludge disposal, which will increase its operating life.

### **23-10-99 (Second day)**

Meetings held at Ambassador hotel, Lahore from 8:30 hrs till 16:00hrs.  
List of participants is attached as annexure -II

1. Mr Sheikh of M/s In-Consult, briefed the participants the background and working of In-Consult.
2. In-Consult team circulated a list of questions (attachment-I) about conceptual design of CEPTP, which were responded by M/s Brusic and Bosnic of TEH PROJEKT and detailed discussions took place among the participants
3. It was clearly stated by M/s Brusic and Bosnic that present visit by them is the final visit about conceptual design of CEPTP and other related facilities and from now onward, M/s In-Consult will take over the responsibility of the project for detailed engineering and other jobs as outlined in their contract with UNIDO.
4. Apprehensions were shown about the performance of CEPTP. Mr Saleem Malik of KTWMA stated that conceptual design of CEPTP is not a standard design because the BOD loading in the aerated lagoons is 13 times higher than recommended BOD loading and detention time is 3 times less than the standards. Due to these deficiencies in the design, there is a possibility of mal functioning of facultative lagoons and creation of excessive odor which will foul the environment badly.

To this, Mr Bosnic stated that due to shortage of land for lagoons and funds for chemical treatment, and electricity for mechanical aeration, it was not possible to design a best pollution control system. However, Mr Bosnic stated that proposed design for CEPTP will perform as stated in their Techno-Economic study made in September 1997. As per study, the following performance will be achieved.

		<b>Raw Effluent</b>	<b>Overall effluent</b>	
SS	mg/l	2700	150	(95 %)
BOD	//	1200	445	(65 %)
COD	//	3100	1600	(55 %)
S <sup>-2</sup>	//	70	2	(98 %)
Cr <sup>+3</sup>	//	25	1	(96 %)
TDS	//	6500	6400	(0 %)
Cl <sup>-</sup>	//	3200	3200	(0 %)
So <sub>4</sub> <sup>-2</sup>	//	1000	1000	(0 %)
pH		8 - 10	7 - 8	

5. About all electrical queries, it was agreed that WAPDA standards and local by laws for fire fighting etc., will be used by In-Consult, in the detailed engineering .
6. About specifications of material to be used in the manufacture of equipment, Mr Bosnic recommended to use stainless steel for long life and low maintenance. Mr Bosnic also suggested to compare prices of equipment made of SS material with MS material especially for pipelines and pumps etc. and it was agreed that M/s In-Consult will undertake this study under the present contract.
7. Mr Bosnic stated that list of equipment recommended by TEH PROJEKT, is based on their experience. Specifications of the equipment should be reviewed by In-Consult and may be discussed with TEH team by 28-01-99.
8. In-Consult team asked Mr Bosnic for details of design criteria and assumptions used in conceptual design of CEPTP and other related facilities. Mr Bosnic stated that In-Consult should review all calculations and may discuss with TEH team by 28-01-99.
9. IN-Consult team presented the geodetic survey of the site of CEPTP and sludge disposal. A joint site visit to the project area was agreed to be under taken on 25.01.99.
10. Mr Bosnic stressed the need of using clay with 100 % impermeability for lining the lagoons. He further stressed to use standard procedures of clay lining. With proper clay lining, no leakage is expected from the lagoons. However, the availability of good quality clay in the area was to be studied. Economics of clay lining with other options may also be studied by In-Consult.
11. Mian Shafique Passari presented a map showing abandoned railway track with additional land being acquired for CEPTP and sludge disposal sites. He further stated that upto 110 m wide land is available for setting up the pollution control system. He requested to adjust size of lagoons according to available land.
12. It was stated by TEH, that the drawings for conceptual design were manually made and thus were not available on CAD.

**25-01-99**  
**(Fourth day)**

Mr Brusnic of TEH PROJEKT visited KTWMA office in Kasur. Mr Bosnic could not come to Kasur due to indisposition.

Mr Iqbal Sheikh of In-Consult along with PM, DPM and Sr. Engineer of KTWMA participated the discussions. Civil Engineer and other members of In-Consult could not attend the meeting.

1. Collection of supernatant of sludge through Fish bone pipe was discussed. Apprehensions were shown about safety of operator during manual closing of Fish bone openings with increase in sludge level. In-Consult should adopt safety measures during detailed design. In opinion of KTWMA, better design would have been a floating lever.
2. Construction site of Younus Nagar pumping station was visited and construction progress reviewed.
3. Final out-fall was also inspected. It was found that waste water flowing through 54 inches R. C. C. sewer and entering Pondoki Drain, consisted of a mixture of tanneries effluent and municipal waste .
4. Mr Brusic along with PM, DPM and S. E. of KTWMA visited Mian Shafique Passari is office in Niaz Nagar and met President and other Office bearers of TAD and STA and had discussions about Kasur Tanneries Pollution Control Project.

**26-01-99**  
**(Fifth day)**

M/s Bosnic and Brusic visited In-Consult site office at Kasur and had detailed discussions with Mr Iqbal P. Sheikh and Dr Naecm-ul Zaman of In-Consult. Main points of discussion are as under:

1. It was agreed that the supply of electricity for Younus Nagar pumping station may be arranged from nearby grid station. Emergency diesel generator for Y. N. pump station is only for operation of one pump.
2. As per TAD (Mian Shafique ), the effluent quantity to be collected/pumped by Y. N. pumping station has increased and needs to be rechecked.
3. TEH team suggested to recheck the specifications of all equipment already reached at site and should be compared with TEH specifications.
4. TEH team stressed that it is necessary to recheck the calculations of required discharge pressure of the sludge pump to meet the actual size and material of the pipe and as per actual site levels.
5. The design of the pipeline geometry was discussed. It was stressed by TEH team to consider the following points during detailed engineering

- Correct Slopes

- Correct pipe layout design. The pipes may be located in the center of lagoons as specified by TEH or it may be on one side of the lagoon.
- Avoid any pockets in pipe layout to avoid accumulation of sludge and or air.

6. Selection of pipeline material was reviewed. It was again recommended to use SS material. However, other materials like PEHD, PVC, M.S. etc. may also be considered as cheaper material provided, it meets the process requirement.
7. For streamlining the procurement of material/equipment, TEH team agreed to In-consult suggestion to divide the equipment into different groups. For example, all pumps to be procured under one group. All equipment to be procured under 9 groups.
8. TEH team highlighted to include furnitures for laboratory and other offices in the design of control and administrative buildings.
9. TEH team suggested that size of lagoons may be adjusted to utlise all available land. Main criteria of designing lagoon is to maintain 1.5 m working depth with free board 0.5 m. Length to width ratio should be maintained at 3:1.
10. In-Consult will continue working on the design of solid waste management and approach road to the area at present site. Any change in the present site may be communicated to In-Consult at the earliest.
11. Report "Selection of Equipment for Laboratory Monitoring Pollution in the Tanning Industries; UN/INT/93/054; Technical report manual on laboratory equipment and reagents" ; prepared by M. Alloy, 12 July 1994 should be arranged by KTWMA for IN-Consult.

**27-01-99**  
**(Sixth day)**

Final preparation minutes of the meetings

**28-01-99**  
**(Seventh day)**

Discussions with Dr Robert G. Gumen at PC Lahore at 9:00 AM

For TEH PROJEKT-----

For In-Consult -----

For Kasur Tanners-----

For KTWMA-----



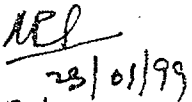
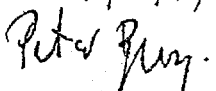
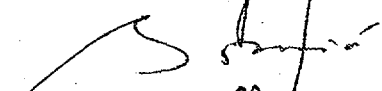


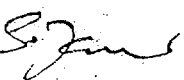
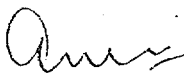


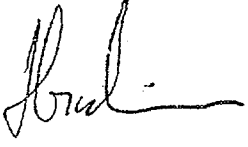
First technical meeting  
with TEH team held at Ambassador  
Hotel, Lahore on 22.01.99 at 15:00h

## List of Participants

Name	Signature	Organization
Mian Shafiqe Pasari	TAD	TAD
Hafiz Abdul Samad	TAD	TAD
Muhammad Saleem Malik Senior Engineer.	KTWMA	KTWMA
M. A. BHUMA DPM	KTWMA	KTWMA
Dr. A. R. Siddiqi	PM/KTWMA	PM/KTWMA
PETAR BRUSIC	TEH-PROJEKT HIDRO	TEH-PROJEKT HIDRO
MLADEN BOSNIC	TEH-PROJEKT HIDRO	TEH-PROJEKT HIDRO
Ibrahim SAIED	UNIDO - Islamabad	UNIDO - Islamabad
Izbal P. Sheikh	INCONSULT	INCONSULT
MAEEM-UL-ZAMAN	INCONSULT	INCONSULT
YASAR AYUB	INCONSULT	INCONSULT
S. JAVAID	"	"
Amanullah	"	"



Second technical meeting with  
TEH team held at Ambassador Hotel  
Lahore on 23.01.99, at 08.30 hrs

Sr.	Names of Participants	Organisation	Signature
1.	M. A. Bhutta	DPM/ KTWAMA	
2.	Muhammad Saleem Malik	S.E/ KTWAMA	
3.	Dr A. R. Siddiqi	PM/ KTWAMA	 23/01/99
4.	PETAR BRUSIC	TEH-PROJEKT- HIDRO	
5.	MLADEN BOSNIC	— " —	
6.	IQ BAL P. SUEKHA	UN CONSULT	
7.	Naem ul Zaman	"	
8.	S. Javid	"	
9.	Amanullah	"	
10.	YUSUF ANSARI	"	
11.		UNIDO	

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**PREPARATION OF CONSTRUCTION DOCUMENTATION FOR  
THE CENTRAL EFFLUENT PRE-TREATMENT PLANT (CEPTP)  
UNIDO CONTRACT NO. 98/215**

Points to be discussed with TEH representative

**A. PROCESS**

1. What is the chemical reaction responsible for the decrease in Chromium content from 25 to 2 ppm?
2. What is the type of stainless steel recommended (304 or 316)? Locally SS 304 (18/8) is readily available and its repair, maintenance would be easy.
3. The pump sizes do not match with the flow rates. For example, the maximum flow rate at screen level is 13000 m<sup>3</sup>/12 hr, but the average flow rate for equalised effluent is 6300 m<sup>3</sup> per 12 hours and the pumps recommended have a flow rate of 300 m<sup>3</sup> per hour (page 11, TES) and 350 x 2 = 750 m<sup>3</sup> per hour at page 171 of tender document. This will require 24 hours pumping instead of 12 hours. Have we taken into an account any safety factor for flow rates?
4. Due to this difference in flow rates the level of water in equalisation tanks will vary and the hold up period will also decrease, in case pumping is done for over 12 hours.
5. The process water turbine is designed for 500 liter / minute flow rate, what are the process water requirements. What about a smaller pump and an overhead tank to meet the requirements with motors to develop the pressure?
6. For lime addition can we use hydrated lime powder and add it directly to sludge pumping tank. We may use a hopper and feeder system for powder. Feeder motor may be linked to automatic slurry feed valve.
7. Route of 125mm sludge pipelines after the bridge?
8. In case of intermittent pumping of sludge, possibility of choking of lines.
9. How to open the choked line. Possibility of fresh water pressure pipe line.
10. The design calculations provided in the volume are a summary of the design calculations done for the project, which only provides the final sizing of structures. Detailed calculations if available will be helpful in detailed design.
11. What are the criteria for selecting submersible pumps? As these pumps shall be imported, there will be problem in their maintenance in the long run. Platform mounted pumps may be a better solution.
12. Can we have some more information about aeration turbines and settling tank equipment? As specifications of this type of equipment is not readily available in the local market.

## B. CIVIL/STRUCTURE

1. Generally a fibre glass protective coating is applied on concrete surface for its protection, such as equalization tanks or settling tanks, what are TEH recommendations in this case?
2. What are the fire fighting design criteria? Use of the local standards shall be preferred?
3. The water supply/fire water systems does not have a ground or roof storage tank which could be utilized as the minimum emergency reserve for fighting.
4. What is the system designed for removal of sludge from aeration lagoons, How this sludge will be removed and disposed off and where?
5. The lagoons are to be lined with 300 mm of rammed clay. Have we identified the borrow pits of clay of desired specifications in the area. How about the use of geo membrane?
6. Settling pattern of sludge in permanent sludge lagoon. How to control un-even settling along 80 meter and how to collect effluent in this case?
7. Access Road: Gravel road could be replaced with brick paved roads, which are a common practice in Pakistan. The kind of vehicle traffic loading expected for this road is required.
8. Do we anticipate any seepage problem? Has it been accounted for in the design?

## C. CHEMICAL ANALYSIS

1. What is degree of accuracy required for chemical analysis? As it is not a research lab, delicate equipment might be replaced with kits or cheaper / rugged equipment.

## D. ELECTRICAL

1. A room is to be built at boundary line to install 11kV VCB for metering purposes. No place is designated for such room.
2. High voltage cable route is to be shown to lay HT cable from WAPDA room to high voltage Switch Board Room.
3. 35mm<sup>2</sup> ACSR (Al-Fe) conductor is not a standard WAPDA Conductor. A WAPDA Standard conductor will be used for overhead line system.
4. 11kV overhead line will be constructed on PC poles and not on Lattice Steel Structures.
5. Younus Nagar Pumping Station is proposed to be fed through Distribution Broad RO-1 by making use of 4c, 35mm<sup>2</sup> underground cable. Distance may not permit this exercise.
6. Fuel storage arrangement for GEN SETS is not shown

7. Nothing is mentioned about earthing of Neutral of Transformer and GEN SETS.
8. HV Broad suggests to connect 630 kVA transformers through a combination of Load Break Switch and Low Oil Circuit Breakers simultaneously.
9. Secondaries of both the Transformers are shown to be operated in parallel.
10. How the power supply to the pumping station of sludge supernatant pumps at sludge lagoons shall be managed at a distance of nearly 1.5km from the control building.
11. Is it required to bring an express feeder for the plant?
12. Fire Alarm System is not provided.

**ANNEX 5.**

**SLUDGE AND SOLID WASTE DISPOSAL PROBLEMS**  
**(a retyped edited version)**

## **Sludge and Solid Waste Disposal Problems**

In the first contact signed between UNIDO and TEH Project in 1991-92, different options for solid waste and sludge disposal were studied. The final option was to collect all the solid wastes from tanneries and Town as well as the dewatered sludge from CEPTP drying lagoons and transport it to Kaisergarh.

During the meeting of the Joint Formulation Mission in January 1993, it was decided to change the solid waste disposal site from Kaisergarh to the far end of the abandoned railway track between the destroyed bridge and the village "Maan". The reasons for this change were not communicated to TEH Projekt. Due to this fact, it was decided to change concept of sludge dewatering and transport (from sludge dewatering in shallow lagoons and transport of the dry sludge to solid waste disposal site) and to transport the liquid sludge hydraulically to the new disposal site and to carry out dewatering, drying and disposal in the same lagoon.

On the demand of UNIDO, TEH Project made a separate service report entitled: "Final Report on Additional Service under earlier Contract no. 91/106, May 1993". The part-I is comments on the Joint Formulation Mission report and part-II is description of the new alternative with solid waste disposal in the extension of CEPTP.

This report was made only as a study without tender documents. Four alternative were elaborated and one was suggested.

In the continuation of the activities in Kasur Project in 1997, UNIDO stated that the tender documents for this does not exist and the job was given to TEH Projekt under no. UNIDO-97/008/VK, dated March 1997.

After the first field mission, TEH Projekt prepared the report "First Field Mission Report, June 1997". The document consisted if the renewed study of the alternative accepted and also the additional alternatives a) use of chemicals, b) use of aerators in lagoons. For the alternative without chemicals or aeration, TEH Project prepared tender documents.

The basic concept is to dispose the sludge in permanent lagoons. As the first phase, a double lagoon was designed at the first 5000 meters of the track after the bridge. It was estimated that the life of this lagoon will be approximately 3 - 5 years. It was suggested to reserve a similar space for additional double lagoon of 500 meters. TEH Project was informed that the remaining length of the track available shall be reserved for solid waste. TEH Project stated that after the complete use of the area, new area for the sludge shall be found.

Tanners' Association Dingarh gave their comment in the letter dated 5th July, 1998. They asked to go back to previously suggested system, i.e. dry the sludge in shallow lagoons and transport it to some other site.

Now during this second mission from 22nd and 28th January, 1999, TAD, explained that they accept the new suggested method of transport, dewatering and disposal in permanent sludge lagoons but are worried about the future and suggest that all available land on the railway track after the bridge should be reserved for sludge storage and the solid waste disposal site may be

sifted to some other place (such as Kaisergarh). They (TAD) also suggested that the land reserved for solid waste disposal may be used for shallow lagoons for dewatering, and drying the sludge as previously suggested. The dried sludge may be transported to some other place.

Now, TEH Project agrees with this idea in principle, but would like to point out that in this case necessary equipment for handling and transportation of the dried sludge will be required. This equipment was cancelled due to the concept of hydraulic transport of the sludge to permanent sludge lagoons.

**ANNEX 6.**

**TEH PROJEKT'S E-MAIL TO BSO Mr. SCHMEL, dated 01.02.1999**



To: fschmel@unido.org  
From: mbosnic@zd.tel.hr  
Cc: teh-projekt-hidro@ri.tel.hr  
Subject: DP/PAK/93/006

Dear Mr. Schmel,

We are back to Croatia as planned.

I wish to brief you on our visit to Pakistan.

During the 7 days we have many meetings with:

- UNIDO Islamabad (Mr. Gumen and Mr. Saeed)
- Kasur Tanners (Mr. Shafique and other tanneries representatives)
- KTWMA (Mr. Siddiqi, Mr. Bhutta, Mr. Malik and other representatives)
- IN-CONSULT (Mr. Sheikh, Mr. Zaman and other representatives)

The main activities were:

- presentation of conceptual design prepared by TEH-PROJEKT
- discussion of some conceptual problems (selection of treatment processes for waste water, sludge and solid wastes treatment and disposal, selection of CEPTP site and problems of the site shape and dimensions, quality of the pre-treated effluent, the tanners' requirement for sludge and solid wastes handling and disposal dated 05.07.1998)
- visit of the executed works
- visit of the CEPTP site
- answering on the IN-CONSULT questions (in written and verbal) concerning our conceptual design and tentative tendering procedure and documents and their job on detailed design and final tendering procedure and documents
- preparation of the minutes on the TEH-PROJEKT mission
- final discussion and acceptance of the minutes with Mr. Gumen

The main conclusions were:

- after this mission and after the answering all questions by TEH-PROJEKT, IN-CONSULT is responsible for the detailed engineering and the preparation of construction documents.
- the tanners' requirement concerning the sludge and solid wastes disposal should be answered (because the tanners' requirement in the letter dated 05.07.1998 was not completely clear, this question was once more discussed and TEH-PROJEKT prepared the clearing of this question in writing)
- although some survey of the CEPTP site was made, the dimensions and shape of the site are not yet cleared and it is necessary to clear this problem a.s.a.p. and mark the site on the land

- the on-field activities did practically not moved from our last visit (May/June 1997), but the today's activities in the KTWMA and IN-CONSULT are encouraging
- practically no one page of the previous TEH-PROJEKT's documentation (1991 - 1993) was possible to find at KTWMA (the documentation disappeared during the commissioning between the old and new management). One non-complete set (maybe less than 50 %) was collected during our visit at Mr. Shafique and given to KTWMA (and also for the use of IN-CONSULT). It is absolutely necessary to provide one complete set of documentation (through UNIDO Vienna or Islamabad) to KTWMA to be able to work. The new TEH-PROJEKT's documentation (1997), except the First Field Mission Report were presented at KTWMA and copied in the necessary numbers of copies. The TEH team left also their copy of the complete new documentation (1997) (including the First Field Mission Report) at the end of the mission to KTWMA.
- although the total effluent quantity is limited to 12700 m<sup>3</sup>/d it is necessary to recheck the actual tanneries number, their capacity, water consumption and effluent quantity (as was stated during the TEH-PROJEKT's first field mission in 1997)
- as the specific, the problem of the Younus Nagar pumping station capacity should be rechecked
- depending on the final solution for the solid wastes disposal the problem of the correct approach road and the bridge (on the place of destroyed railway bridge) should be solved, taking into account also the flowing of the water under the bridge

A minutes on the TEH-PROJEKT mission which also include some annexes is prepared. I hope that this document will reach you directly from Pakistan (or maybe it reached you already).

As per contract, TEH-PROJEKT will prepared the Final Report which will include this second field mission, the recapitulation of all previous activities as well as the final version (only with some small rectifications) of the technical documentation. We estimate that these documents will reach you approx. on the end of the February 1999.

Best regards

M. Bosnic

Zadar, 01.02.1999.

**ANNEX 7.**

**LIST OF ALL DOCUMENTATION PREPARED BY TEH PROJEKT AND  
ITS EXPERTS THROUGH THE FIRST CONTRACT, ADDITIONAL  
JOBS AND ALSO THROUGH THIS SECOND CONTRACT**

## **LIST OF THE DOCUMENTS PREPARED BY TEH PROJEKT HIDRO d.o.o. RIJEKA, CROATIA AND ITS EXPERTS**

### **A) DOCUMENTS PREPARED THROUGH FIRST CONTRACT**

1. DP/PAK/89/025  
BOOK ONE  
PART ONE: REPORT ON THE FIRST FIELD MISSION; Collection and calculation of the basic input data  
PART TWO: RECOMMENDATION CONCERNING EVACUATION OF THE "STAGNANT POOLS"  
GRAPHIC PARTS

Submitted: August 1991

2. DP/PAK/89/025  
BOOK TWO  
PART ONE: TECHNO-ECONOMIC STUDY  
PART TWO: ANNEXES:
  - ANNEX 0: CONCLUSIONS AND RECOMMENDATIONS OF THE FIRST FIELD MISSION, EXPRESSED IN THE BOOK ONE
  - ANNEX 1: IN-HOUSE ARRANGEMENTS AND CHROMIUM AND BY-PRODUCTS RECOVERY
  - ANNEX 2: RECONSTRUCTION OF THE SECONDARY DRAINAGE AND ROADS WITHIN THE TANNERY CLUSTERS
  - ANNEX 3: THE ROHI NULLAH RESECTIONING
  - ANNEX 4: DINGARH MAIN COLLECTOR, PUMPING STATION AND TRANSPORT PIPELINE TO "PUCCA DRAIN"
  - ANNEX 5: PROLONGATION AND RECONSTRUCTION OF THE "PUCCA DRAIN"
  - ANNEX 6: Y. NAGAR TANNERY EFFLUENT DRAINAGE AND PUMPING STATION.
  - ANNEX 7: FINAL OUTFALL
  - ANNEX 8: PHYSICAL-CHEMICAL PRETREATMENT OF TANNERY EFFLUENTS
  - ANNEX 9: TANNERY EFFLUENT PRETREATMENT BY LAGOONING
  - ANNEX 10: EVALUATION OF THE ANAEROBIC TANNERY EFFLUENT PRETREATMENT POSSIBILITIES
  - ANNEX 11: COMMON MUNICIPAL EFFLUENT TREATMENT PLANT (CMETP) - CONVENTIONAL "ACTIVE SLUDGE" SYSTEM -
  - ANNEX 12: COMMON MUNICIPAL EFFLUENT TREATMENT PLANT (CMETP) - BIOLOGICAL TRICKLING FILTERS -
  - ANNEX 13: SOLID WASTE DISPOSAL
  - ANNEX 14: ANALYTICAL LABORATORY
  - ANNEX 15: ORGANIZATIONAL SCHEME OF THE "KASUR WATER & ENVIRONMENT IMPROVEMENT BOARD"

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- ANNEX 16: RECOMMENDED SYSTEM FOR THE KASUR TANNERY EFFLUENT DRAINAGE AND PRETREATMENT

GRAPHIC PARTS

Submitted: Draft January 1992 (without Annex 16. and Executive Summary)  
Final June 1992

- 3. DP/PAK/89/025  
BOOK TWO  
EXECUTIVE SUMMARY; CONCLUSIONS AND RECOMMENDATIONS

Submitted: June 1992

- 4. DP/PAK/89/025  
BOOK THREE  
TENDER DOCUMENTS  
VOLUME 1.: RECOMMENDATION OF THE TENDERING PROCEDURE  
VOLUME 2.: GENERAL DOCUMENTS  
VOLUME 3.: TECHNICAL DOCUMENTATION FOR PARTICULAR TENDERS
  - TENDER No. 1: DINGARH TANNERY EFFLUENT COLLECTION AND PUMPING TO THE "PUCCA DRAIN"
    - Textual part
    - Graphic part
  - TENDER No. 2: PROLONGATION AND RECONSTRUCTION OF THE "PUCCA DRAIN"
    - Textual part
    - Graphic part
  - TENDER No. 3: YOUNUS NAGAR TANNERY EFFLUENT MAIN COLLECTOR AND PUMPING TO THE "PUCCA DRAIN"
    - Textual part
    - Graphic part
  - TENDER No. 4: FINAL OUTFALL
    - Textual part
    - Graphic part
  - TENDER No. 5: COMMON TANNERY EFFLUENT PRETREATMENT PLANT (CEPTP)
    - Textual part
    - Graphic part
  - TENDER No. 6: ANALYTICAL LABORATORY
  - TENDER No. 7: Cr-RECOVERY AND BY-PRODUCTS PROCESSING PILOT PLANT
    - Textual part
    - Graphic part

- 
- TENDER No. 8: TRANSPORT VEHICLES AND SOLID WASTE HANDLING EQUIPMENT
    - Textual part
    - Graphic part
  - TENDER No. 9: SOLID WASTE DISPOSAL (Access road & Disposal site)
    - Textual part
    - Graphic part

Submitted: Draft June 1992  
Final July 1992

**B) DOCUMENTS PREPARED AS ADDITIONAL JOB OF THE TEH-PROJEKT AND TEH-PROJEKT'S EXPERTS**

5. DP/PAK/89/025  
FINAL REPORT ON ADDITIONAL SERVICES UNDER EARLIER CONTRACT No. 91/106; PART I: COMMENTS ON THE JOINT FORMULATION MISSION; PART II: DESCRIPTION AND CALCULATION OF THE NEW ALTERNATIVES WITH SOLID WASTE DISPOSAL IN THE EXTENSION OF THE CETP

Submitted: May 1993

6. DP/PAK/89/025  
Letter to UNIDO  
Subject: 1. SUMMARIZED COMMENTS ON DIFFERENCES IN JFM AND THE-PROJEKT COST ESTIMATIONS; 2. SUMMARY OF THE STUDY OF THE NEW ALTERNATIVES FOR THE KASUR TANNERY SOLID WASTE DISPOSAL

Submitted: 09.06.1993

7. DP/PAK/93/006  
TECHNICAL REPORT; FIELD MISSION OF THE CONSULTANT IN CIVIL ENGINEERING (Mr. Petar Brusic)

Submitted: July 1996

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**C) DOCUMENTS PREPARED THROUGH SECOND (ACTUAL) CONTRACT**

8. DP/PAK/93/006  
FIRST FIELD MISSION REPORT

Submitted: June 1997

9. DP/PAK/93/006  
TECHNO-ECONOMIC STUDY OF THE ACCEPTED ALTERNATIVE  
COMPRISING CEPTP, CEPTP SLUDGE DEWATERING, DRYING AND  
PERMANENT DISPOSAL AND THE LABORATORY EQUIPMENT AND  
CHEMICALS

Submitted: October 1997

10. DP/PAK/93/006  
TENDER DOCUMENTS  
VOLUME 1.: RECOMMENDATION OF THE TENDERING PROCEDURE  
VOLUME 2.: AN OUTLINE OF GENERAL DOCUMENTS  
VOLUME 3.: TECHNICAL DOCUMENTS; COMMON EFFLUENT  
PRETREATMENT PLANT, CEPTP SLUDGE DISPOSAL, LABORATORY  
EQUIPMENT AND CHEMICALS  
3.1 Textual part  
3.2. Graphic part

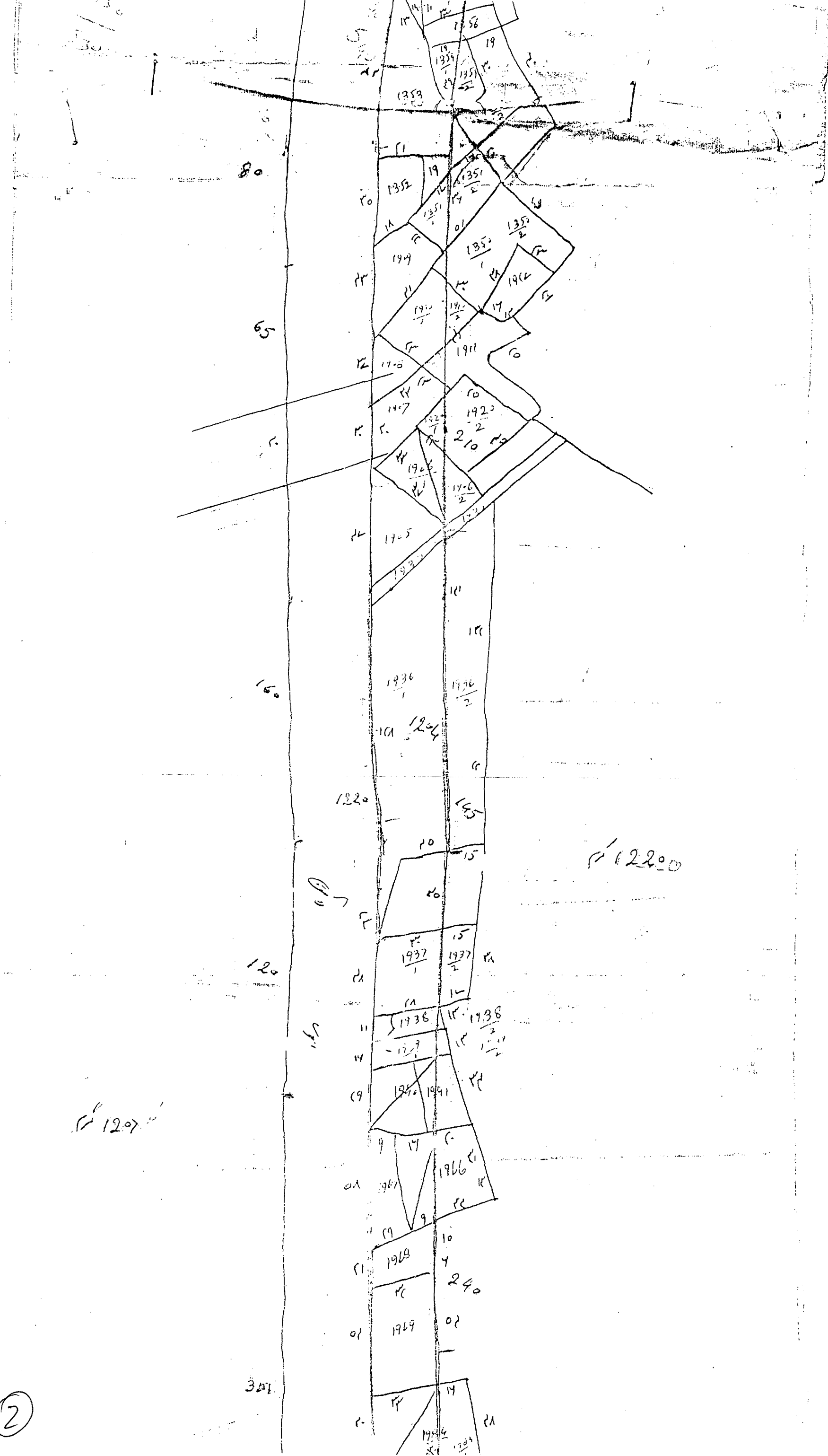
Submitted: Draft - October 1997  
Final - February 1999

11. DP/PAK/93/006  
FINAL REPORT & SECOND FIELD MISSION REPORT

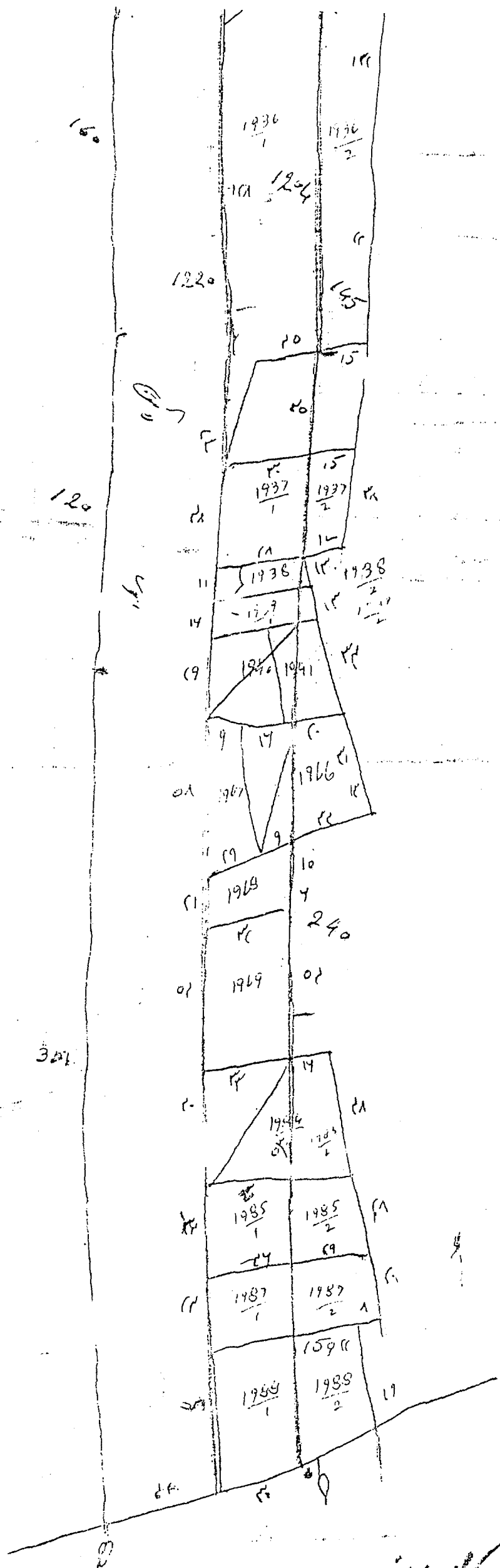
Submitted: Draft - February 1999  
Final - May 1999







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