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(R) TANNERY EFFLUENTS .\*/  
SI/BRA/79/801/11-01/31.7.D.  
BRAZIL .J

Prepared for the Government of Brazil by the  
United Nations Industrial Development Organization,  
executing agency for the  
United Nations Development Programme

Based on the work of David Winters,  
adviser on tannery effluents

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## I SUMMARY

Based on a two week visit to Brazil, with brief survey of 10 Tanneries (capacity 15 - 20% of Brazilian industry) together with visits to the Tannery School at Estancia Velha (E.T.C.), Secretary of Health, State of Rio Grande do Sul (R.G.S.), and other Government departments and institutions, the expert reports on the situation in R.G.S. regarding tannery pollution and measures proposed to reduce such environmental degradation.

It is apparent that in R.G.S. (and other states?) tanneries discharge their effluents into local watercourses with little or generally no treatment at all.

The State, Secretary of Health has instituted a two phase programme to compel tanners to reduce the pollutant level of their discharge:-

By March 1981 - Primary Treatment to be operational

By March 1984 - Secondary Treatment to be operational

Currently there does not seem to be available, within the country, sufficient expertise to formulate the large number of individual projects required to allow tanners to install plant to meet the norms proposed. To overcome this deficiency it is suggested that the Tanning School at Estancia Velha install a pilot demonstration tannery effluent treatment plant. It is suggested that such pilot plant would allow evaluation of many of the conventional treatment systems under local conditions. Dissemination of such findings by extension and other services will assist tanners to institute the most realistic recycling and effluent treatment systems, with regard to both cost and technical efficiency. A detailed draft project proposal for this pilot demonstration tannery effluent treatment plant may be found annexed at Pages 1 - 24.

It is suggested that such pilot plant could solve the major problems within this area and it is suggested that the project needs rapid implementation if the timetable and norms are to be attained, and technically acceptable industrial treatment projects installed at all tanneries.

In addition to preparing the draft project proposal the adviser gave detailed advice to assist in the correct orientation and design of two specific tannery effluent treatment projects.

## II BACKGROUND

David Winters was assigned a three week mission to Brazil.

His duties were : -

"The adviser will be attached to the Tannery School (ETC) SENAI, at Estancia Velha and will work in close co-operatin with the director and specialised staff of the ETC and representatives of the tanneries of the region. "

"In particular he will be expected to :-

1. During initial briefing at UNDP Brasilia, visit the Secretaria del Medio Ambiente en el Ministerio del Interior, to obtain up-to-date information about the regulations concerning tannery effluents established by the Federal Government of Brazil;
2. Visit local authorities in Porto Alegre, Rio Grande do Sul, to obtain information on the regulations concerning tannery effluents established in Rio Grande do Sul;
3. Visit the Tanning School at Estancia Velha and a selected number of tanneries in the region of Novo Hamburgo to assess the present situation in the tanneries with respect to tannery effluent treatment, recycling processes used, etc.;
4. Based on the above information and assessment, prepare a realistic proposal for a pilot plant for tannery effluent treatment to be attached to the Tannery School at Estancia Velha. The expert will also be expected to prepare a final report setting out the findings of his mission and his recommendations to the Government on further actions which might be taken."

Accordingly the adviser was on duty in Brazil from 28th October - 14th November 1979. He then returned to his home to detail the project proposal (2 days).

During his stay in Brazil the adviser was not able to contact the Federal Authorities in Brasilia due to unfortunate circumstances which precluded the counterpart personnel travelling to Brasilia.

However, he made visits to all relevant persons in R.G.S. and met:-

- 1) Director and technicians of Department of the Environment, Secretary of Health and Environment, R.G.S.
  - 2) Superintendent and Staff of Centro Tecnológico do couro, calzados e Afins.
  - 3) The Brazilian Association of Leather Chemists & Technologists (ABQTIC - Associação Brasileira de químicos e técnicos industriais em couro )
  - 4) The Association of Tanners of R.G.S. (Associação dos curtidores do R.G.S)
  - 5) The State Directorate of SENAI
- 

Tanneries Visited

<u>R.G.S.</u>	<u>Discharging To</u>
Tannery of Calçados, Relim, S.A. Ind. Com. Estancia Velha (R.S.)	Estancia Velha Arroio
Curtume Bender Schuck S.A. Estancia Velha (R.S.)	" " "
Curtume Leuck Mattes S.A. Estancia Velha (R.S)	" " "
Curtume Momberger S.A. Novo Hamburg (R.S)	Arroio Peri
Curtume Sander S.A. Ind. com. Novo Hamburg (R.S.)	" " (All above flow into R.Sinos)
Curtume Pelesinos S.A. Sao Leopoldo (R.S.)	River Sinos
Curtume Vacchi Sapucaia do Sol (R.S.)	" "
Covasa Couros Do Vale S.A. Encantado (R.S)	River Taquari

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SAO PAULO

Cortume Cantusio S.A  
Campinas

Cortume Firmino Costa S.A.  
Campinas

### III FINDINGS

The majority of the adviser's findings and recommendations are embodied in the draft project proposal and need not be repeated here.

However in one area specific report must be made :-

The adviser found after detailed examination of several industrial effluent treatment projects that the projects were poorly orientated and designed. Indeed great doubt exists that the plants proposed would function technically, and certainly the cost of the installations were far higher than necessary - one plant may even have been lethal to operate due to production of H<sub>2</sub>S gas.

The adviser spent several days trying to advise the industrialists how to redesign the plants, but the point is emphasized that the Civil and Consulting Engineers in Brazil do not appear to have sufficient knowledge of the specialised nature of leather effluents. It also appears that the local authorities do not have the expertise to assist in correct project design and evaluation. Thus it seems imperative that the engineers and the Department of the Environment seek external assistance in the design and evaluation of such effluent projects.

PROJECT DATA SHEET      PROJECT PROPOSAL

PART A      -      BASIC DATA

COUNTRY	BRAZIL
PROJECT TITLE	ESTABLISHMENT OF A PILOT, DEMONSTRATION TANNERY EFFLUENT TREATMENT PLANT.
SCHEDULED START	SPRING 1980
SCHEDULED COMPLETION	JULY 1981 (Subject to funding)
GOVERNMENT COUNTERPART AGENCY	SENAI (BRAZILIAN TANNERY SCHOOL, AT ESTANCIA VELHA)
TOTAL EXTERNAL AID SOUGHT	US\$ 357,400

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PART B      -      NARRATIVE

1. BACKGROUND INFORMATION AND JUSTIFICATION

Brazil during the last decade has greatly developed its tanning and leather utilization sectors of industry, and today it has sufficient capacity to process all of its indigenous hides and skins. During this rapid sectoral development no attention was paid to the waterborne pollution which would inevitably be produced in increasing volume. The industry is highly competitive, both internally and externally, and in the absence of compulsion by Government at that time, tanneries did not install any effluent treatment plant at all. Their aqueous discharges are in most cases passed into adjacent rivers without even primary treatment or screening.

As a result of this development of the sector, without regard to the environmental degradation that would be caused, pollution of watercourses has greatly increased. No firm data is available concerning the tanning industry's production of effluent, but an estimate of the major section, i.e. Bovine tanning and finishing would suggest that this sector alone could produce some 14 Million M<sup>3</sup> of effluent annually, with characteristically high pollutants, e.g. Biological Oxygen Demand (B.O.D.<sub>5</sub>) > 2,500 mg/l and Suspended Solids (S.S.) > 4,000 mg/l.

On 17th January 1976 the Federal Government published a "Ministerial Order Establishing Quality of Water". This order classified watercourses into four categories and outlined the characteristics of allowable discharges into these recipients. The implementation of this order was assigned to competent local authorities. Consequently each state has promulgated its own proposed regulations for effluent discharges. A typical example is the "Norm" of the Secretary of Health and Environment, State of Rio Grande do Sul dated March 14th 1979.

The essence of this proposed regulation for the Leather and Hide industries of the state of Rio Grande do Sul is:-

(i.) Prospective new industries must submit projects for control of pollution and environmental protection for approval before they may initiate production.

(ii.) Existing industries, within the fields of leather and hides, must fulfil the following norms according to timetable :-

Primary Treatment: - Within two years of above date i.e. by 14.3.81. (Recycling of tanning solutions, fine screening, homogenisation and primary sedimentation).

Secondary Treatment:- Within five years of above date i.e. by 14.3.84. (Aeration, secondary sedimentation and handling and disposal of sludge).

(iii.) Existing industries were to submit their Primary Treatment projects for approval by 14th September 1979.

(iv) Maximum discharge standards are proposed :-

B.O.D. <sub>5</sub>	-	60 mg/l
Sulphides	-	1 mg/l

It is manifest that sufficient expertise is not available, within the state of Rio Grande do Sul (or within Brazil) for the timely preparation of the necessary plans and projects. In this connection it may be noted that due to employment within tanneries of differing technologies and dissimilar layouts and locations, it is not possible to install a "standard" treatment system. The Secretary of Health & Environment does not have the manpower to advise the tanners and unfortunately the consulting and civil engineers in Brazil have, in general, no detailed knowledge of the tanning industry and the specialised treatment of its waste waters. There exists no published comprehensive



handbook on tannery effluent control and the published papers in journals need careful evaluation before acceptance. Thus tanners are finding it impossible to obtain professional assistance necessary in preparing their treatment projects. Indeed it is reported that in the State of Rio Grande do Sul less than half of the tanners have been able to prepare the statutory projects and only one project has been approved. A similar situation is reported in other states and it is understood that many projects have been rejected yet no one is available to advise and assist tanners in reformulating and designing technically acceptable treatment plant.

The state of Rio Grande do Sul is the most significant leather processor within Brazil (processing circa 45% of Brazil's bovine hides). Within the state of Rio Grande do Sul it is found that over 60% of the state's tanning activity is located in the P. Alegre - Novo Hamburgo area. Within this area of heavily concentrated tanning activity (Fig. I annexed shows the tannery distribution in this area) is located the Brazilian Tannery School (E.T.C.) at Estancia Velha.

The Tannery School itself has proposed to install a primary effluent treatment plant by July 1980. This primary treatment at E.T.C. was originally due to be of a simplistic nature merely so that the effluent from its pilot tannery may conform to the norms noted earlier. However, with the urgent needs of the industry at large, to be able to obtain detailed technical and economic information it is now suggested that a pilot demonstration Tannery Effluent Treatment Plant be installed at E.T.C. The E.T.C. is ideally situated for demonstration purposes in this heavily concentrated tanning area, and is well regarded and accepted by the whole Brazilian Tanning Industry. E.T.C. has several staff members who have recently specialised in effluent treatment and has given short courses within this area of activity, thus it must be the automatic site for any demonstration or research activities relating to tannery effluents. E.T.C. has a fully developed and equipped pilot tannery to process 50 hides daily and the pilot effluent plant would thus complete the facilities.

It is envisaged that this pilot demonstration plant will be established rapidly so that it will be in a position to demonstrate treatment techniques and disseminate its findings and advise tanners as to the technical feasibility and economics of effluent treatment.

To be of assistance to the industry it is essential that the pilot plant have available the majority of the conventional systems of treatment, so that the efficiency and economy of such systems may be evaluated and, if necessary, adapted in the context of the Brazilian situation.

In order to evaluate the situation of the Brazilian Tanneries U.N.I.D.O. fielded an advisor on tannery effluent. The adviser felt the lack of knowledge in this area to be most marked. Many of the partially prepared treatment projects seemed incorrectly orientated. Thus the need for a pilot plant is most acute and urgent. The U.N.I.D.O. advisor, in association with the staff of E.T.C. prepared a detailed proposal for the pilot demonstration plant which is outlined at Figs. II - IV, and specified and costed at Pages 10 - 19.

The proposed pilot plant should have great flexibility in choice and sequence of treatment operations which will allow differing recycling and treatment techniques to be demonstrated. The plant proposed while not employing high cost, ultra sophisticated units, should be able to obtain similar results at economic levels, more acceptable to the Brazilian Tanning Industry. Thus a pilot demonstration plant at E.T.C. should assist and promote measures to minimise the tanning industry's level of pollution, lessen the level of environmental degradation now caused, and at the same time it must assist the industry to achieve these objectives with reasonable economic outlay that will not unduly disturb the Brazilian leather sectors current and future development.

E.T.C. has some funds available - sufficient for its original simple preliminary treatment unit, but it is insufficient for the enlarged pilot plant now envisaged. Thus E.T.C. seeks funds from Government, bilateral or multilateral sources.

It may be noted that in no other country does there exist such a pilot demonstration plant with such flexibility and it may be that when this pilot plant is installed at E.T.C. it could become a regional centre - South America - for tannery effluent treatment demonstration and research. Most of the other countries of the region do not yet have stringent effluent controls, but it is expected that these will be instituted in the near future. Thus a centre of expertise within the region may be invaluable.

## 2. OBJECTIVES

### a) Development Objectives

To minimise the environmental degradation caused by the pollutants contained in the tanning industry's large volume effluents. To ensure that during the introduction of mitigating measures adequate utilization of the most applicable systems, both from technical and economic standpoints shall ensure that the industry is not impeded in its development strategy.

### b) Immediate Objectives

To establish in Brazil a pilot, demonstration tannery effluent treatment plant capable of :-

- Assisting the Brazilian tanning and allied industries to obtain reduction in the levels of pollutants of their effluent; to achieve the "norms" promulgated by the competent local authorities.
- assisting both the local authorities and the tanning industry in the preparation and evaluation of the technically feasible projects necessary to achieve such lessened pollution at minimal economic cost.
- to evaluate, under local conditions, the cost effectiveness of a variety of effluent treatment techniques.
- to conduct a systematic programme of training to develop a cadre of qualified personnel in this field
- to carry out a programme of applied research in the treatment of tannery wastes and the economic recovery of materials from such wastes.
- to initiate a programme of demonstration, extension services and dissemination to ensure that all sectors of the leather industry in Brazil (and the region of S. America) are able to obtain updated technical and economic information relating to the introduction of better environmental processes, (recycling and other means) and the treatment of tannery wastes (aqueous and solid).
- to liaise between local authorities and tanners to ensure that the Governments ultimate objectives are understood by the industry.

### 3. PROJECT OUTPUTS

- A pilot, demonstration, tannery effluent treatment plant, fully equipped and serviced by qualified personnel capable of evaluating the technical and economic efficiency of the "Better Environmental Processing" of leather and the economic treatment of tannery effluents and solid wastes.
- An associated, specialised, chemical laboratory to allow relevant analysis of tannery liquors, effluents and solid wastes.
- A centre of knowledge, with a cadre of qualified personnel who by means of extension service should prove capable of assisting local authorities and tanners in implementing realistic projects to minimise the environmental degradation currently caused by the leather industry.
- A centre of expertise which could advise local engineering fabricators of the specifications for tannery effluent treatment to ensure their manufacture locally at most economic cost
- A national and regional centre for the dissemination of knowledge relating to better environmental processing, effluent treatment techniques, solid wastes processing and recovery in the leather industry.
- A centre capable of training personnel at all levels in the introduction of better environmental processing and the treatment of solid and liquid tannery wastes and the control of such processes.
- A gradual, yet significant reduction in pollutants in tannery effluents and wastes so that the industry may be found more environmentally acceptable.

### 4. ACTIVITIES

To obtain the objectives and achieve the proposed outputs, the project will undertake the following activities :-

- Design, install and equip the demonstration pilot effluent treatment plant.
- Design, install and equip the associated chemical laboratory and ensure its capacity to control all effluent treatment processes.
- Assist the counterpart personnel of E.T.C. in the planning and operation of the pilot plant to ensure that the wide choice of "Better Environmental Processes" and treatment techniques are evaluated under local conditions and ensure that the findings, technical and economic are available to interested parties in Brazil

and South America.

- Evaluate in particular recycling systems available (tanning and dipilatory) and where found necessary develop such processes to suit local conditions to ensure maximum economy for the tanners and optimum effluent characteristics.
- In close cooperation with local authorities and tanners assist in the orientation, preparation and evaluation of commercial projects for effluent treatment schemes to ensure that statutory norms are achieved.
- Assist E.T.C. personnel in planning and executing a systematic programme of applied research in the areas of "Better Environmental Processing" and waste treatment handling.
- Organise and assist the counterpart personnel in promoting extension service to offer direct inplant assistance to tanners; to implement "Better Environmental Processing" (recycling etc.) and keep them updated on these technologies in addition to disseminating technical and economic data relating to solid and liquid waste treatments.
- Assist the national personnel of E.T.C. in planning and implementing a series of training courses, at all levels, covering the introduction and operation of "Better Environmental Processing" and the operation and control of effluent treatment plants and waste handling systems, in order to develop a cadre of qualified specialists in this field for Brazil and the South American region.
- Encourage and assist the E.T.C. personnel to prepare handbooks and other documentation (or translate existing publications if found suitable) in order to disseminate basic knowledge on "Better Environmental Processes" and effluent and solid wastes treatment and handling to overcome the current lack of published material at a level suitable for industrialists.
- Liase with consulting and manufacturing engineers to ensure that the required effluent treatment plant is available from local manufacturers at the correct specification and realistic cost.
- Accumulate a data bank/library of relevant technical information
- Advise local authorities on the feasible adjustments which may be effected within tanneries; pollutant levels of effluent technically and economically achievable within tanneries so that long term authoritative strategy may be evolved to progressively minimise tanneries environmental impact.

5 INPUTS

A. NATIONAL BRAZILIAN - E.T.C. / SENAI

PERSONNEL

Counterparts to the expatriate experts must be available together with administrative and support personnel:-

	<u>No. Required</u>
Pilot Plant Manager	1
<u>Graduates:</u>	
Pilot Plant Operation (Engineer/Technologist)	1
Extension/Recycling (Technologist)	1
Research/Control ((Bio) Chemist)	1
Laboratory Assistant	1
Plant Operator	1
Admin. Assistant	1
Clerk/Typist	1
Driver	1

Equipment:

Physical structure for control laboratory  
Land for pilot plant  
Office space for project staff  
Furniture and general office equipment

B. EXTERNAL ASSISTANCE INPUT (SOUGHT)

PERSONNEL

Team Leader (Specialist in treatment of tannery effluent)	18 m/m
Technologist (Specialist in Recycling process)	12 m/m
Consultants	3 m/m
	<hr/>
	33 m/m

(As source of expertise/aid is not known, 33 m/m costed initially at typical international rate @ US\$ 5,000 p.m.)

= US\$ 165,000

Equipment

Pilot Plant (Shown at Figs II - IV and detail costed in Annex II)	U.S. \$ 147,400
Laboratory Equipment	25,000
Project Vehicle (extension service)	10,000
Misc./Office Equipment	10,000
	<hr/>
TOTAL EQUIPMENT	U.S. \$ 192,400
	<hr/>

C. WORK PLAN

Utilization of Staff

Team Leader (Specialist in Tannery Effluent)	March 1980 - Aug 1981
Technologist (Recycling)	July 1980 - June 1981
Consultants (as found necessary)	

Activities

The activities of the project are to be dovetailed with existing timetable of events in State of Rio Grande do Sul, i.e.:-

Phase I	Primary Plant to be installed & operational at E.f.C. by	July 1980
Phase II	Secondary Plant to be installed & operational at E.T.C. by	July 1981
	Primary Treatment obligatory in Tanneries by	March 1981
	Secondary Treatment obligatory in Tanneries by	March 1984

Thus Project activities must be :-

March 1980	-	July 1980	-	Finalise design of Phases I & II and assist in installation of Phase I
July 1980	-	June 1981	-	Operate Phase I plant. Develop extension service to disseminate results. Install Phase II
July 1981	-	June 1983	-	Operate Phase II - advise tanners to allow them to comply with "norms".

ANNEX I

BASIC ASSUMPTIONS

The Pilot Effluent treatment plant shown at Figs. II - IV is based on the following assumptions :-

School Pilot Tannery Input

50 hides per day @ 20 Kg = 1.0 metric tonnes salted

(range from 20 - 22 Kg)

Yielding  $\pm$  1.0 m.t. limed

(Grain 625 - 750 Kg. Splits 125 - 250 Kg)

Yielding  $\pm$  0.8 m.t. Chrome Shaved.

{Hide Grain 10 - 15 Kg. i.e. 750 Kg. MAX}

{Hide Split 0.5 - 2 Kg. i.e. 100 Kg. MAX}

Water Usage

(1) Assume all processes require 50 l/Kg = 50 M<sup>3</sup> day

(High water usage due to small scale operation)

(2) Assume separation of flows has been arranged :-

a) LIME LIQUOR + 1 or 2 Delime Washes

i.e. Lime	=	100%float	=	1 M <sup>3</sup>	} TOTAL 3 M <sup>3</sup>
1 st Delime Wash	=	100%float	=	2 M <sup>3</sup>	
2nd Delime Wash	=	100%float			

( or  
(1 Delime Wash of 200% float )

b) CHROME LIQUOR

Currently employing 50% float = 0.5 M<sup>3</sup> but allow for  
100% 1 M<sup>3</sup>

(will collect drainings from "horsing")

c) All other liquors i.e. 50 - (3 + 1) = 46 M<sup>3</sup>

Effluent Characteristics

Assume initial equalised liquor would be

circa 2800 mg/l B.O.D.<sub>5</sub>

4200 mg/l Suspended Solids (S.S.)

(based on analysis carried out at the school, employing calculated aliquot parts of each liquor - not able to obtain a natural equalised liquor.)



Assume catalytic oxidation and primary sedimentation would  
remove B.O.D.<sub>5</sub> - 35% = 1820 mg/l  
S.S. - 60% = 1680 mg/l

(Precipitation of protein, for which facility is provided, may reduce B.O.D. by up to 70% but secondary facilities are planned to be available for treating effluent from which the protein has not been ppt.)

#### Effluent Flow Ratio

With a maximum daily input of 50 M<sup>3</sup> the pilot plant has been designed to process 7 M<sup>3</sup>/hr from the equalisation/homogenisation tanks. There are two of these tanks so that when effluent flow is well below maximum only one tank may be employed to allow operations to continue on a daily basis at a lower level of flow.

However, with regard to the chrome and lime flows of 1 and 3 M<sup>3</sup> respectively the flows are so low that employing continuous flow in traditional vessels is not feasible. Therefore in the primary treatment of these two flows batch systems are employed.

#### Separation of Flows

For the efficient operation of the proposed pilot plant it is essential to ensure three separate flows. A possible means to achieve this is shown on Fig III. This will involve specific drums being utilized for specific processes. Although the modifications suggested on Fig III do not look extensive it must also be noted that it will be necessary to realign the gradients in some areas of the existing channels. No detailed estimates can be given for this work but perhaps a budget price for this modification of the drainage system could be U.S.\$ 5,000

ANNEX II

OUTLINE SPECIFICATION AND COST OF INDIVIDUAL TREATMENT UNITS

NOTE:

In the limited time available at Estancia Velha it was not possible to establish "firm" prices for most of the equipment. Indeed there were tremendous variations in prices quoted for apparently similar equipment. Thus the cost estimates given below must be taken as tentative and it is understood that staff at the Tanning School will continue to search for realistic costs.

The following sources of cost were utilized: -

Sources/References regarding cost of equipment

- (1) Quotes obtained by the Director of the Tanning School
- (2) Quotes obtained by Hugo Springer of the Tanning School
- (3) Estimates of cost in other countries - doubled to approximate delivered cost Estancia Velha
- (4) Estimates by U.N.I.D.O. Consultant
- (5) Quotes given by Sanai engineer

(6) Specific quotes given by Sanai engineer :-

Excavate Manual - 120 Cr\$ M<sup>3</sup>  
 Excavate Mechanical - 30 Cr\$ M<sup>3</sup>  
 Concrete Complete = 6,000 Cr\$ M<sup>3</sup>  
 Therefore concrete wall 20 cms. Thick 1,200 Cr\$ M<sup>2</sup> - Includes reinforcing  
 Sand, Stones 250 Cr\$ M<sup>3</sup> shuttering etc.

In all calculations the official conversion rate has been accepted :-

30.0 Brazilian Cruzeiro = 1 U.S.\$

NOTE: As the exact location of individual units is not known, neither is their relative heights, the need for pumps is not known. Obviously gravity will be employed where possible, but additionally in the secondary treatment provision is allowed for :-

- 6 liquor pumps
- 4 sludge pumps.

TOTAL PILOT PLANT & EQUIPMENT ESTIMATES:

	<u>U.S.\$</u>
Total Primary and Sedimentation	45,715
" Secondary Units	76,666
" Sludge Handling	14,950
" Miscellaneous	<u>10,000</u>
	<u>U.S.\$</u> 147,331
<u>Brasilian Cr. \$</u> 4,479,930	

		<u>COST</u>	
		<u>Cr. \$</u>	<u>U.S.\$</u>
<u>A. FLOW SEPARATION</u>		150,000 (4)	5,000
		<hr/>	<hr/>
<u>B. CHROME FLOW</u>			
To include facility to recycle or precipitate chrome. Volume 1 M <sup>3</sup> . Assume pumps/pipes capable of discharging at 2 M <sup>3</sup> /h.			
(i) <u>Catchpit/Precipitation/Recycle Tank</u>			
Pit volume	1.0M <sup>3</sup> (R = 0.4 M.h = 2.0 M)		
Excavate	2.0 M <sup>3</sup>	240	(6)
Concrete work	6.0 M <sup>2</sup>	7,200	(6)
(ii) <u>Accessories :-</u>			
1	Agitator	18,000	(4)
1	Pump Sludge (Cr(OH) <sub>3</sub> ppt to Filter Press)	20,000	(4)
1	Pump Liquid (forward flow or recycle)	6,000	(4)
1	Flow meter	12,000	(4)
(iii) <u>Screen</u> (0.6 x 1.0 M)			
		7,000	(2)
<u>TOTAL CHROME FLOW</u>		<hr/>	<hr/>
		70,440	
		<hr/>	<hr/>

C. LIME FLOW

To process 3 M<sup>3</sup> daily by batch process.  
If required could process up to 2 batches a day i.e. 6 M<sup>3</sup>

(i) <u>Screen</u> - Bauer - self cleaning			
.5 M x .36 M x 1.22 M/h - Flow 4.8 M <sup>3</sup> /h (80l/min)			
Complete in Stainless Steel.			
		40,162	(1)
(ii) <u>Holding Tank</u>			
Drain 1.75 Depth 1.25 M i.e. Vol = 3.0 M <sup>3</sup>			
Pit	Excavate	4 M <sup>3</sup> @ 120 Cr.	480 (6)
Pit	Walls	6.9 M <sup>2</sup> @ 1,200	
Pit	Base	2.6 M <sup>2</sup> @ 1,200	
		<hr/>	
		9.6 M <sup>2</sup> @ 1,200 Cr. M <sup>2</sup>	11,400 (6)
<u>Agitator</u>			
			18,000 (4)
<u>Pump</u>			
			6,000 (4)

	<u>COST</u>	
	<u>Cr. \$</u>	<u>U.S.\$</u>
<u>(iii) Catalytic Oxidation Tank (Catalyst added manually)</u>		
Volume 3 M <sup>3</sup> (usable) i.e.:-		(1)(4)
Diam. 1.4 M Depth 2.6M (2.0 M usable) Steel	20,000	
Air Compressor & Diffusers or Rotary Vane blower and dome diffusers		60,000 (4)
<u>iv) Beamhouse Sedimentation Tank</u>		
For batch sedimentation of lime liquors and subsequent protein precipitation		
Volume 3 M <sup>3</sup> with 60° conic base and outlet		
Steel	40,000	(1)(4)
<u>TOTAL LIME FLOW</u>		
	196,042	6,535
<u>D. OTHER LIQUORS</u>		
<u>Screen</u> 1.0 M x 0.6 M Stainless Steel	7,000	(2)
<u>Pump</u>		20,000 (4)
<u>TOTAL OTHER LIQUORS</u>		
	27,000	
<u>E. EQUALIZATION/HOMOGENISATION</u>		
2 Tanks each 4 M x 2.5 M x 2.5 M deep (i.e. Total 50 M <sup>3</sup> )		
Excavate 50 M <sup>3</sup> @ 120 Cr.		6,000 (6)
Tank Concrete :-		
Base 20 M <sup>2</sup>		
Walls 55 M <sup>2</sup>		
75 M <sup>2</sup> @ 1,200 Cr. M <sup>2</sup>		90,000 (6)
(Steel Tank perhaps similar in cost (1))		
2 Agitators @ 60,000 Cr. each		120,000 (2)
<u>TOTAL HOMOGENISATION</u>		
	216,000	7,200

F. SEDIMENTATION

COST  
Cr. \$      U.S.\$

(Assume that only one automatic dosing pump will be available - dosing will otherwise be manually adjusted )

Flow now equalized - 50 M<sup>3</sup> day (48 M<sup>3</sup> if recycling) - flow over 7 - 10 hours day = (7 - 5 M<sup>3</sup>/h) say 6 M<sup>3</sup> hr.

(i) pH Adjustment Tank

Volume 0.5 M<sup>3</sup> (5 mins. retention)

1 M x 1 M x 0.5 M deep

Excavate 1 M<sup>3</sup> @ 120 Cr.

Concrete 3 M<sup>2</sup> @ 1,200 Cr. M<sup>2</sup> = 3,600 = 3,720<sup>(6)</sup>

1 Agitator (Portable?) 9,000<sup>(3)</sup>

1 Manually adjusted doser 1,000<sup>(4)</sup>

13,720      13,720

(ii) Coagulant Tank

Volume 0.5 M<sup>3</sup> (1 M x 1 M x 0.5 M. deep)

Plus accessories as pH Tank 13,720

(iii) Flocculant Tank

Volume 1.0 M<sup>3</sup> (1M x 1 M x 1 M)

Plus accessories as above 13,720

Extra for Tank 2,400 16,120

16,120

(iv) Auto dosing pump suitable for any of the above 10,000<sup>(2)</sup>

(v) Primary Sedimentation Tank

At flow of 5 M<sup>3</sup>/hr with required upflow of 0.5 M/hr will require surface area of 10 M<sup>2</sup> i.e. 2 tanks of 5 M<sup>2</sup> i.e. Radius 1.26 M 2.0 M high with 60° base cone Fitted central entry and outflow weirs. Steel fabrication @ 119,680 Cr. each<sup>(1)</sup> (May expect up to 6 M<sup>3</sup> sludge day)

239,360<sup>(1)</sup>

TOTAL DOSINGS / SEDIMENTATION

292,920

	<u>COST</u>	
	<u>Cr. \$</u>	<u>U.S.\$</u>
<u>TOTAL PRIMARY TREATMENT - FLOW SEPARATION, PRIMARY TREATMENT AND SEDIMENTATION</u>	<u>952,402</u>	<u>31,747</u>
Plus 20% Preliminary and General =		<u>38,096</u>
Plus 20% Contingencies =		<u>45,715</u>

G. SECONDARY TREATMENTS

(i) Nutrient Tank

Volume  $0.5 \text{ M}^3$  i.e.  $1.0 \text{ M} \times 1.0 \text{ M} \times 0.5 \text{ M}$  deep  
as pH tank

13,720

(ii) Trickling Filter

Total daily B.O.D. load =  $50 \text{ M}^3$  at  
 $1.82 \text{ Kg}/\text{M}^3 = 91 \text{ Kg. B.O.D. day}$  (Assume  
protein not precipitated)

At a loading of  $2 \text{ Kg. B.O.D. per M}^3/\text{day}$  need  
 $46 \text{ M}^3$  of medium. If  $3 \text{ M}$  high =  $15 \text{ M}^2$  area  
i.e. diameter of  $4.38 \text{ M}$ .

Concrete Walls  $41 \text{ M}^2$

Base  $15 \text{ M}^2$

$56 \text{ M}^2 @ 1,200 \text{ Cr } \$ 67,200^{(6)}$

Filter Medium  $46 \text{ M}^3$  of 110/130 mm.

Graded stores at 250 Cr. \$ =  $11,500^{(6)}$

Base drainage  $20,000^{(4)}$

Distributor  $30,000$

128,700

(Must have provision for liquor recirculation.)

(iii) Oxidation Ditch

(Provision must be made to keep or recycle the  
majority of suspended solids within the ditch).

If 2.5 days retention is allowed, need volume  
 $125 \text{ M}^3$ . If cross section of  $1 \text{ M}$  deep ditch is  
 $3.0 \text{ M}$  at top and  $1.0 \text{ M}$  at base ( $45^\circ$  sloped sides)  
will need total length  $62 \text{ M}$  i.e.  $2 \times 30 \text{ M}$  long  
parallel semi trapezoidal channels, separated with  
a  $2 \text{ M}$  island.

2 aeration rotors (7.5 H.P. each or smaller?)

$@ 150,000^{(2)} 300,000$

Excavate (Mechanised)  $125 \text{ M}^3 @ 80 \text{ M}^3^{(6)} 10,000$

Concrete  $62 \times 2.8 = 174 \text{ M}^2 @ 1,200 208,800$

Total  $518,800$

518,800

(To lower cost could only concrete around rotors and  
on bends)

	<u>COST</u>	
	<u>Cr. \$</u>	<u>U.S.\$</u>
(iv) <u>Activated Sludge</u>		
Loadings of 0.5 - 5.0 Kg. BOD/M <sup>3</sup> day have been reported. At a loading of 3 Kg/M <sup>3</sup> day would need 30 M <sup>3</sup> . This could be effected in a vessel 4 M x 4 M x 2.5 M high (2.0 M effective)		
Excavation 30 M <sup>3</sup> @ 80 Crs.\$ M <sup>3</sup> (6)	2,400	
Concrete Base 16 M <sup>2</sup>		
Concrete Walls 40 M <sup>2</sup>		
56 M <sup>2</sup> @ 1,200 Cr.\$ M <sup>2</sup> (6)	67,200	
1 Aerator @ 5.0 H.P. Cr. \$	190,000 <sup>(2)</sup>	259,600

(Aeration intensity reportedly 0.7 - 1.3 Kw.Hr per Kg BOD treated = 90 x 1.3 = 117 Kw Hr.day = 5.0 Kw per hour.

2 Aerators at 2.5 Kw each could be employed)

(v) Aerated/Facultative Lagoon

For cost purposes it may be expedient to install a dual purpose lagoon. The mode of operation will be dependant on the aeration intensity. To lower costs it may be necessary to leave the base of the tank unconcreted (depending on porosity, seepage etc.)

Maximum retention time of 4 weeks may be visualised i.e. 1,000 M<sup>3</sup>.

A lagoon 2 M deep 16 M x 32 M may be suitable (if necessary could employ a separation wall to enable lower volume throughput or lessened retention in half unit only.)

Excavate 1,000 M<sup>3</sup> at 80 Cr. M<sup>3</sup> 80,000<sup>(6)</sup>

Concrete Walls (including division)

224 M<sup>2</sup> at 1,200 Cr. M<sup>2</sup> 268,800<sup>(6)</sup>

2 Aerators (each 3 Kw.) @ Cr.\$85,000 ea. 170,000<sup>(2)</sup>

(If possible adjustable output aerators)

(For aerobic conditions need over 3 Watt M<sup>3</sup>)

For facultative conditions need about 3 Watt M<sup>3</sup>) 518,800

	<u>COST</u>	
	<u>Cr. S</u>	<u>U.S.\$</u>
(vi) <u>Secondary Sedimentation Tank</u>		
As per primary sedimentation tank (If flow over 2.5 M <sup>3</sup> /hr may need to operate longer than 10 hours)		<u><u>119,680<sup>(1)</sup></u></u>
(vii) <u>Rapid Gravity Sand Filter</u>		
Usual flow rate suggested = 5 M <sup>3</sup> /M <sup>2</sup> hr - Thus for this unit will need surface area of circa 1 M <sup>2</sup> i.e. .56 M radius. The filter bed may consist of 0.6 M bed of 1 mm graded sand supported on 0.2M bed of 20 - 30 mm gravel, covering a set of drainage pipes beneath. The filter unit must be at least 2 M high to obtain sufficient head of pressure Two similar units required to allow 1 out of action for backwashing etc.		
<u>Each unit:</u>		
0.6 M <sup>3</sup> sand - Selected	500 <sup>(4)</sup>	
0.2 M <sup>3</sup> gravel - Selected	200 <sup>(4)</sup>	
Under drainage	3,000 <sup>(4)</sup>	
7 M <sup>2</sup> concrete walls	<u>8,400<sup>(6)</sup></u>	
Cr. \$	<u>12,100</u>	<u>24,200</u>
(viii) <u>Chlorination Tank</u>		
As pH adjustment tank		<u><u>13,700</u></u>

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<u>TOTAL SECONDARY TREATMENT UNITS</u>	<u>1,597,200</u>	<u>53,240</u>
Plus 20% Preliminary and General	=	<u>63,888</u>
Plus 20% Contingencies	=	<u>76,666</u>

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H. SLUDGE TREATMENT

(i) <u>Sludge Thickener</u> - Steel.		
Expect circa 6 M <sup>3</sup> /day. If processed in batch process need volume 6 M <sup>3</sup> i.e. 3 M high area - 2 M <sup>2</sup> i.e. diam. 1.6 M		<u><u>100,000<sup>(6)</sup></u></u>



	<u>Cr. \$</u>	<u>U.S.\$</u>
(Expected sludge production =		
{ From Suspended Solids 50 M <sup>3</sup> at 4.2 Kg. M <sup>3</sup> = 210 Kg.)		
{ From B.O.D. (say 50%) 50 M <sup>3</sup> @ 1.4 Kg. M <sup>3</sup> = 70 Kg }		
{	<u>DAILY</u>	<u>280 Kg.</u>
{ at 5% solids = 5.6 M <sup>3</sup> )		

(ii) Filter Press

5.6 M<sup>3</sup> of 5% solid sludge pressed into cakes of 40% solids would yield approx. volume of 0.7 M<sup>3</sup> day.

(Actually less as ignores density of solids)

A mini filter press of 0.5 M x 0.5 M x 12 chambers if producing cake at 5 cm thick could yield 0.15 M<sup>3</sup> per cycle. Thus 2 - 3 cycles daily would process 50% at least of the expected volume. (The balance going direct to drying beds for comparative trials).

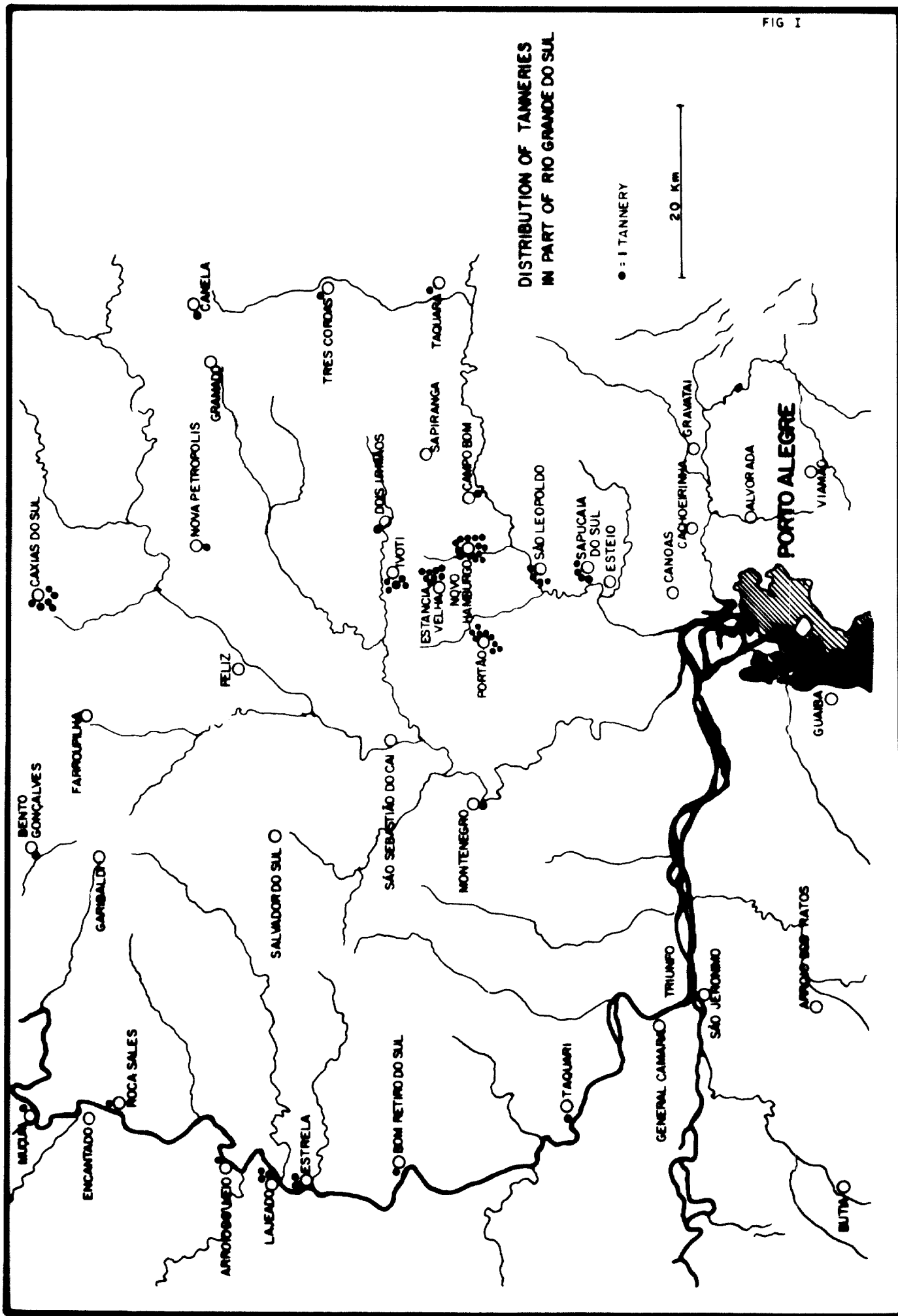
165,220<sup>(1)</sup>

(iii) Drying Beds

6 M<sup>3</sup> daily if spread at 0.5 M would nominally require 12 M<sup>2</sup> day. However the sludge thickener and filter press should greatly reduce this requirement. Thus if one allows 6 M<sup>2</sup> day for 4 weeks (20 days) = 120 M<sup>2</sup> should suffice (If no filter press installed will need to double area at least) i.e. 15 M x 8 M (15 M split into 5 separate chambers by brick walls).

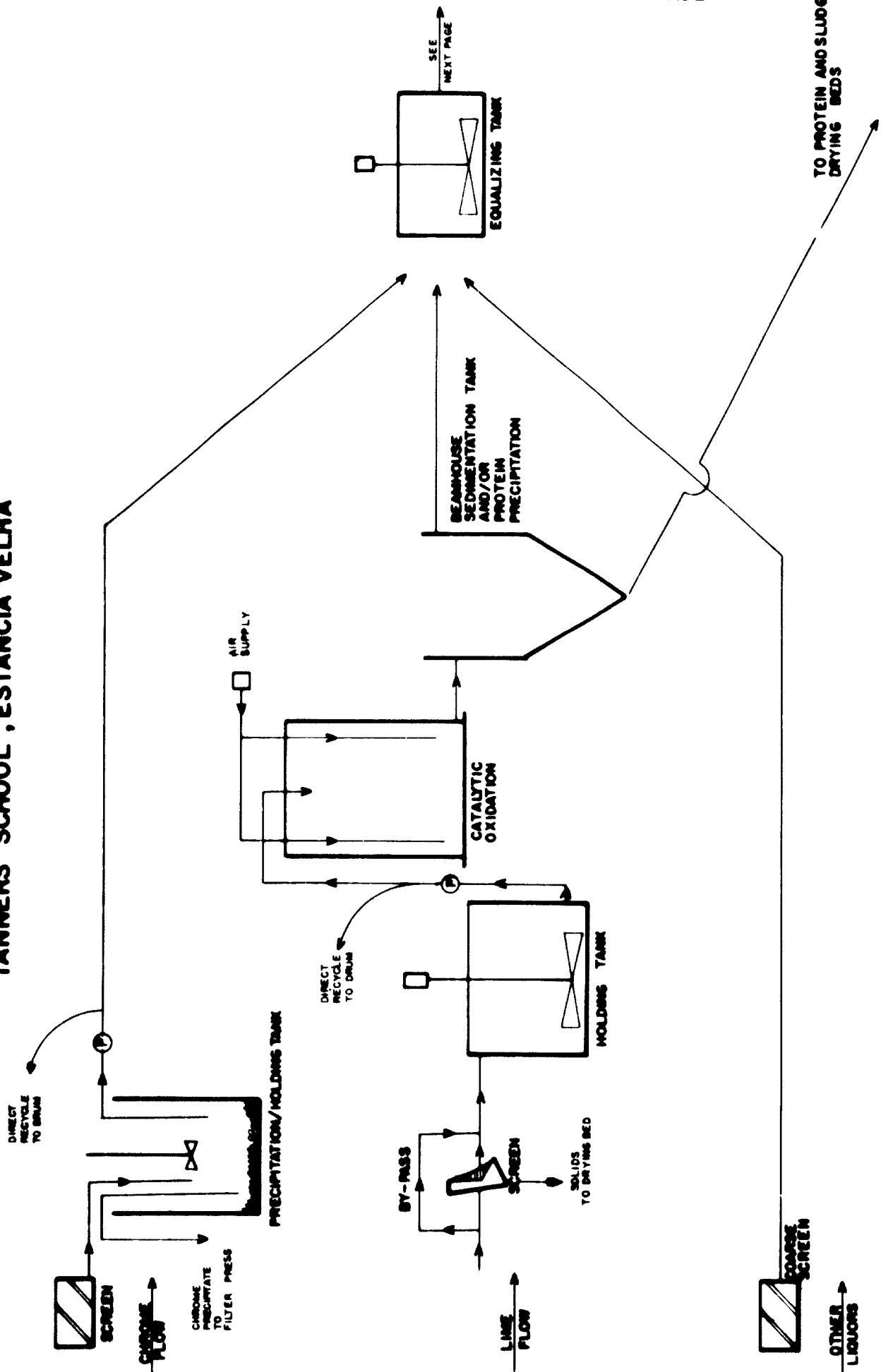
Assume · 2M deep sand = 24 M <sup>3</sup> @ 500 Cr. M <sup>3</sup>	<u>12,000</u>	
Assume · 1M deep stone = 13 M <sup>3</sup> @ 500 Cr. M <sup>3</sup>	<u>6,000</u>	
Base drainage 120 M <sup>2</sup> at 200 Cr. M <sup>2</sup>	<u>24,000</u>	
Brick wall 0.5 M high x 70 linear Metres		
= 35 M <sup>2</sup> @ 120 Cr. M <sup>2</sup>	<u>4,200</u>	<u>46,200</u>

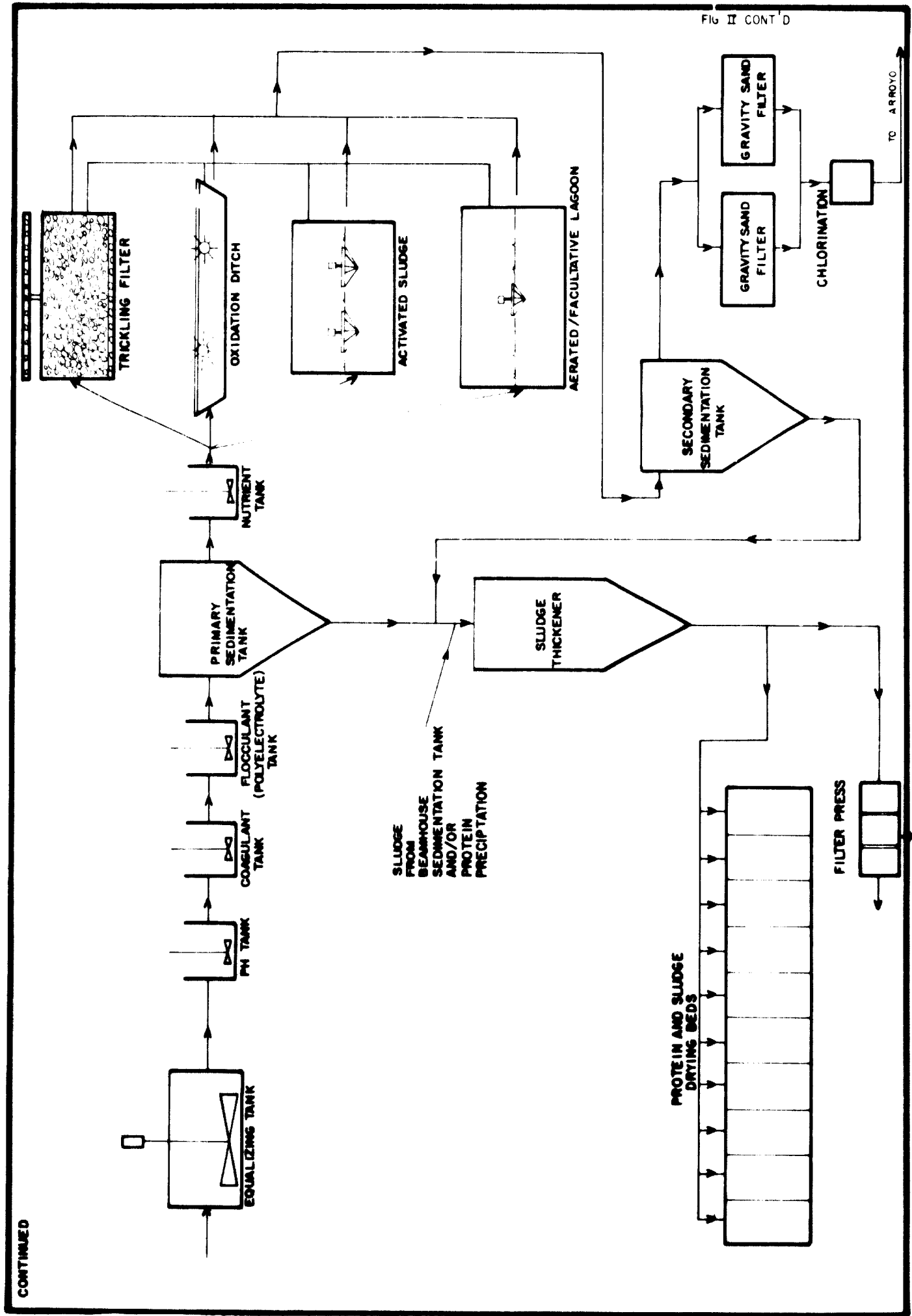
<u>TOTAL SLUDGE THICKENER, FILTER PRESS AND BEDS</u>	<u>311,420</u>	<u>10,380</u>
Plus 20% Preliminary and General	-	<u>12,460</u>
Plus 20% Contingencies	-	<u>14,950</u>
<hr/>		
<u>MISC. ITEMS</u>		
Valves, Pumps, Pipes, etc.	<u>300,000</u>	<u>10,000</u>



# FLOWCHART FOR PILOT EFFLUENT PLANT TANNERS SCHOOL, ESTANCIA VELHA

FIG II

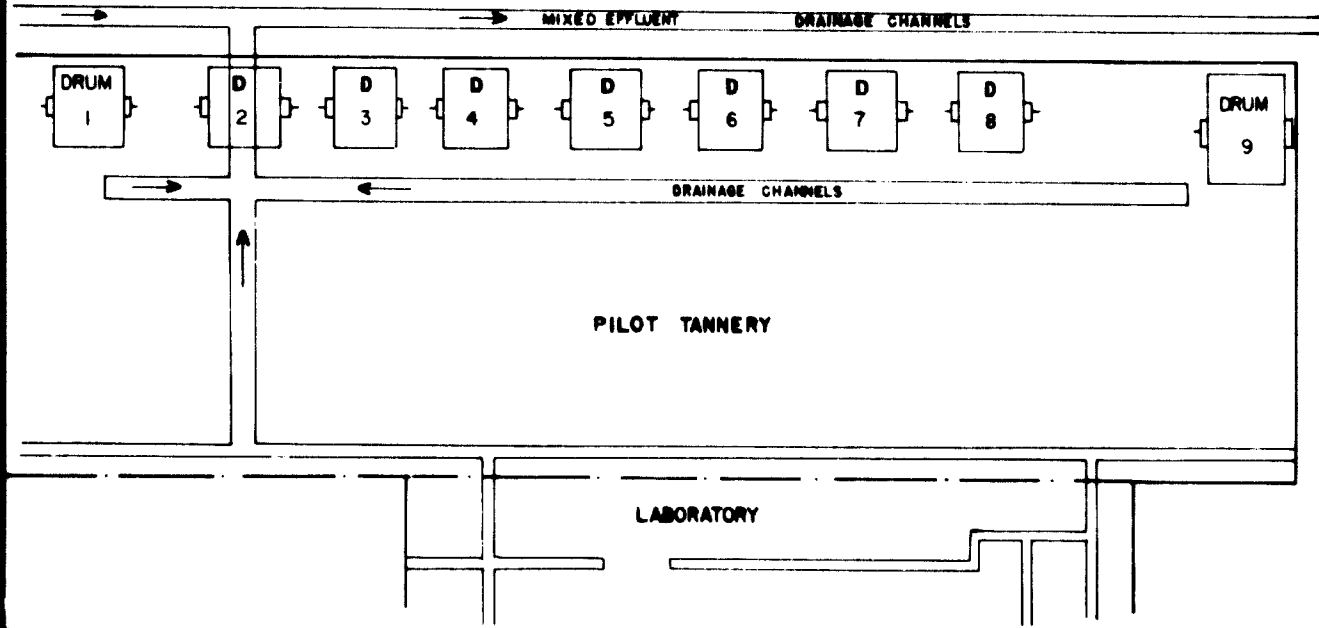




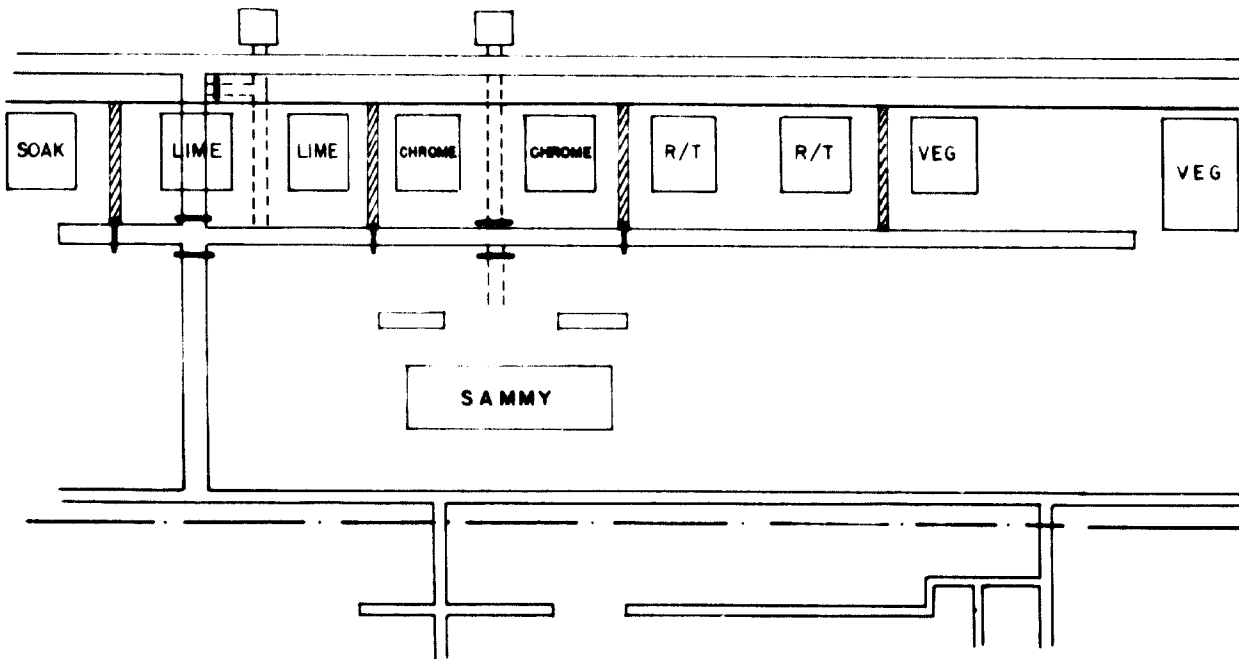
# DIAGRAMATIC SCHEME TO SEPARATE PILOT TANNERY EFFLUENTS INTO 3 STREAMS

(NOT TO SCALE)

## A - EXISTING SITUATION



## B - SUGGESTED MODIFICATIONS



### symbols


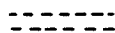


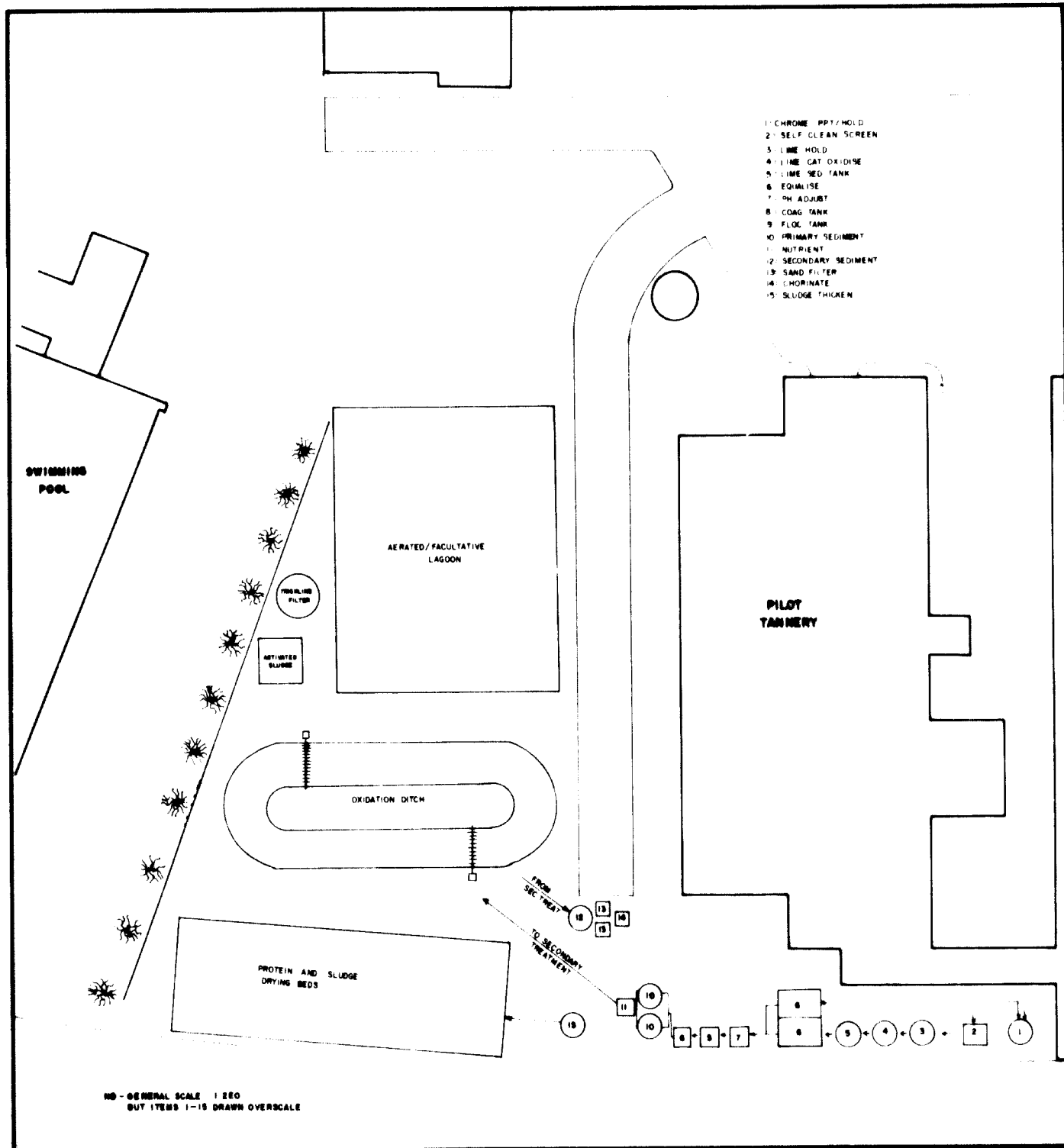
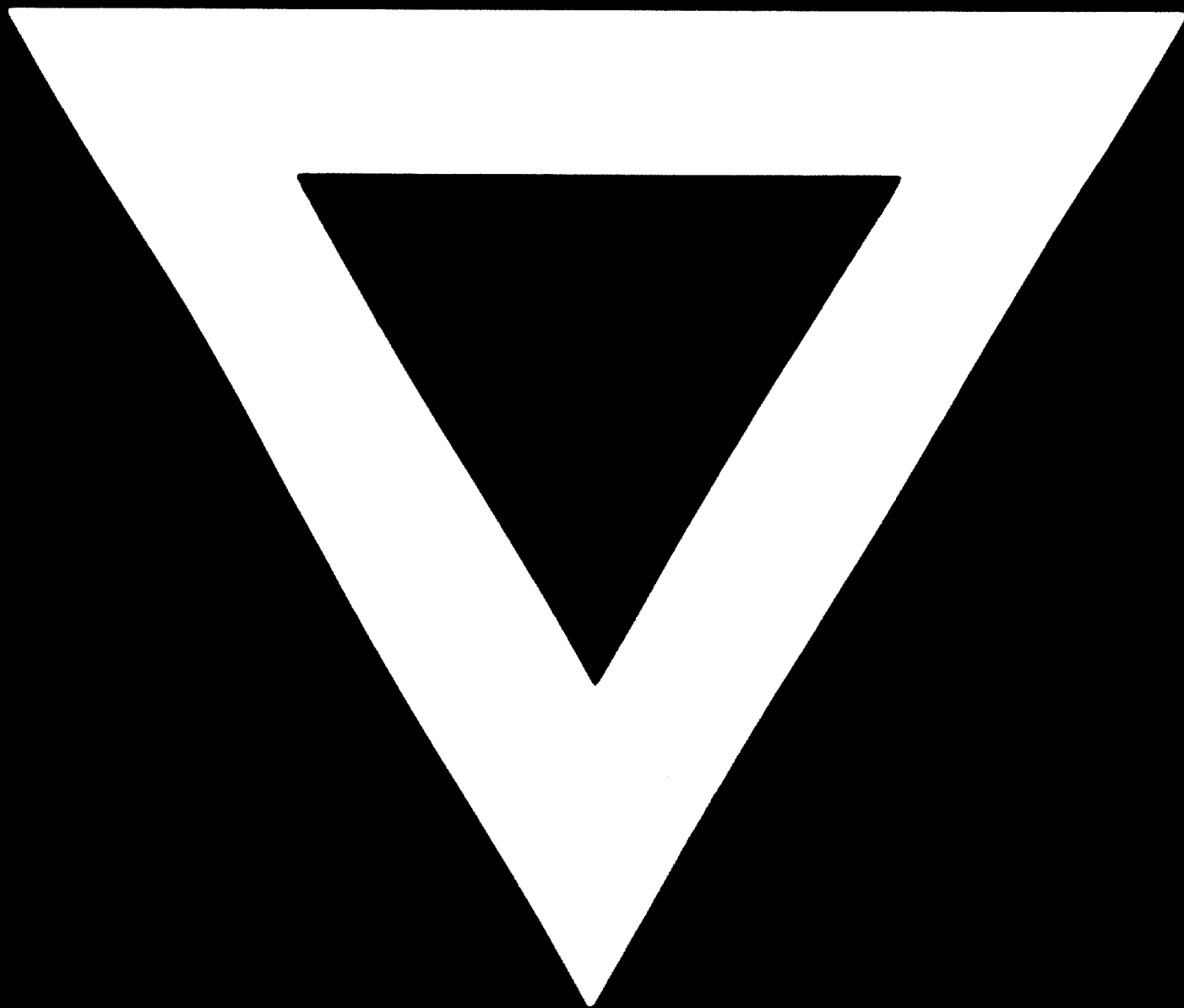
-  = 30 cm HIGH ANTI SPLASH WALLS
-  = NEW CHANNEL (OR PIPE)
-  = REMOVABLE DAMS
-  = CATCHPIT

FIG III



**B-368**



**80.12.08**