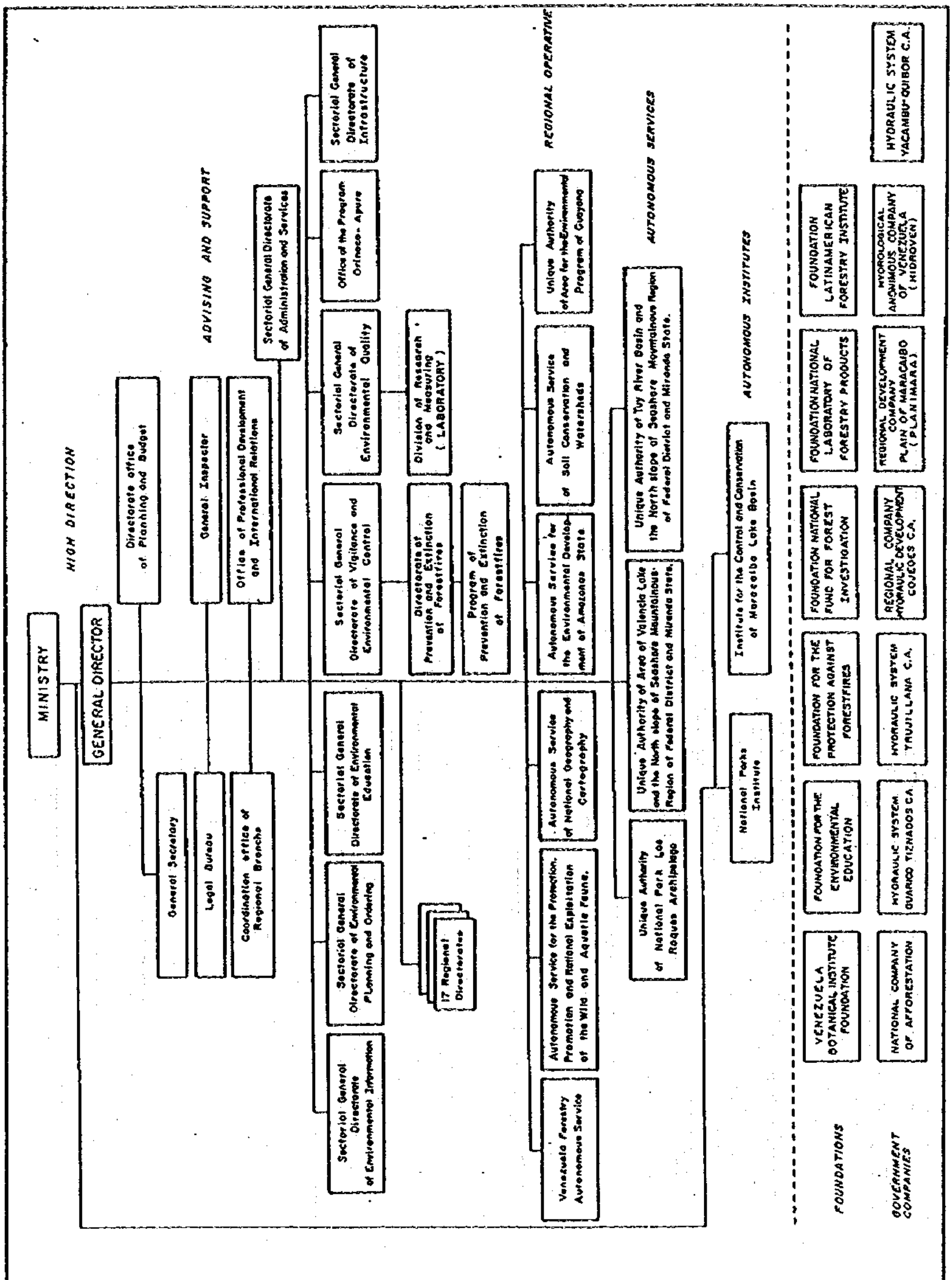
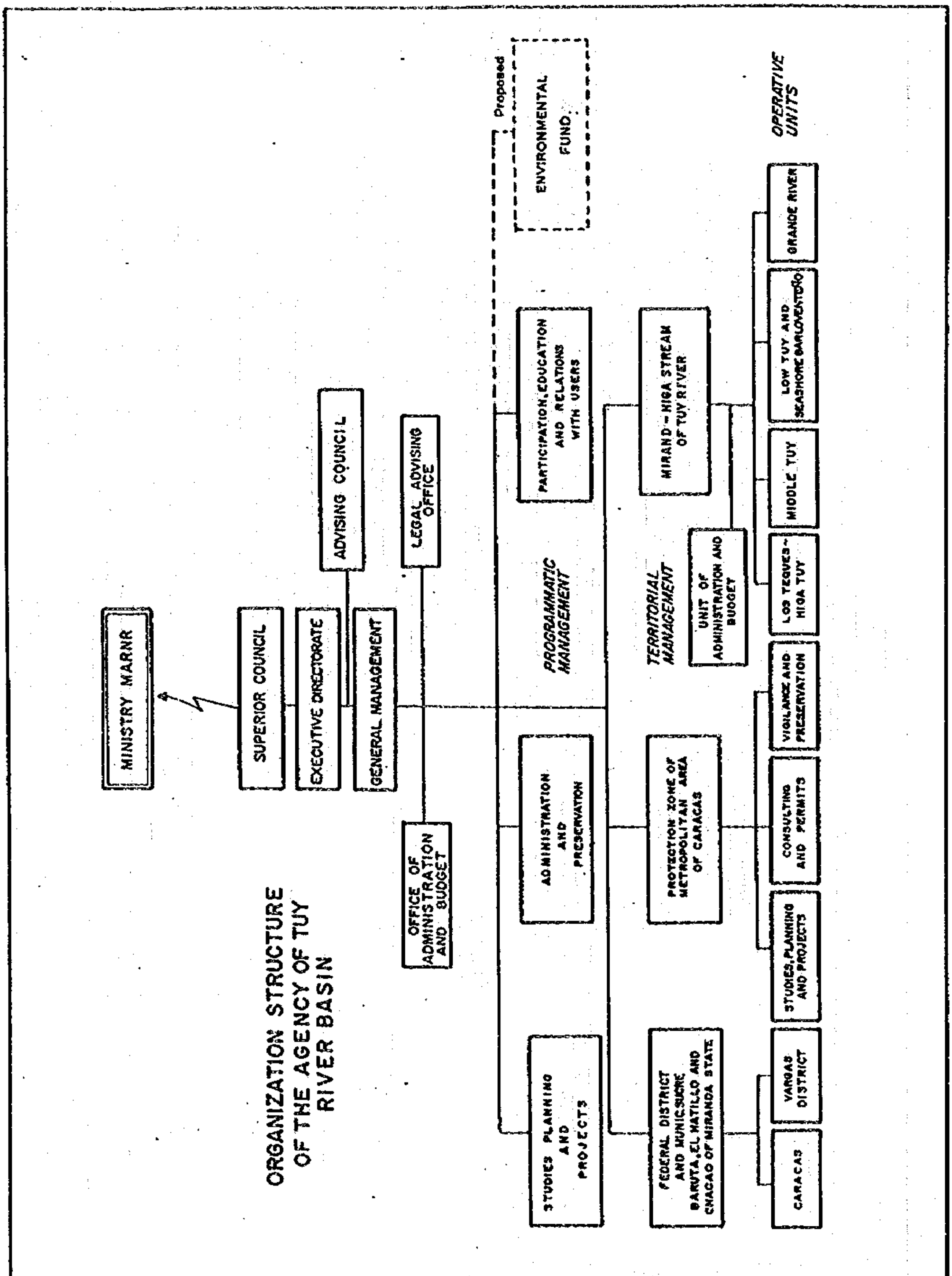
SECTOR G

FIGURES



THE STUDY ON THE ENVIRONMENTAL IMPROVEMENT PROGRAM OF THE UPPER AND MIDDLE STREAM OF THE TUY RIVER BASIN IN THE REPUBLIC OF VENEZUELA	Fig. 1.1-1	Organization Chart of the Ministry of Environment and Natural Renewable Resources
JAPAN INTERNATIONAL COOPERATION AGENCY		



THE STUDY ON THE ENVIRONMENTAL IMPROVEMENT PROGRAM OF THE UPPER AND MIDDLE STREAM OF THE TUY RIVER BASIN IN THE REPUBLIC OF VENEZUELA	Fig. 1.1-2 Organization Chart of the Tuy River Basin Agency
JAPAN INTERNATIONAL COOPERATION AGENCY	

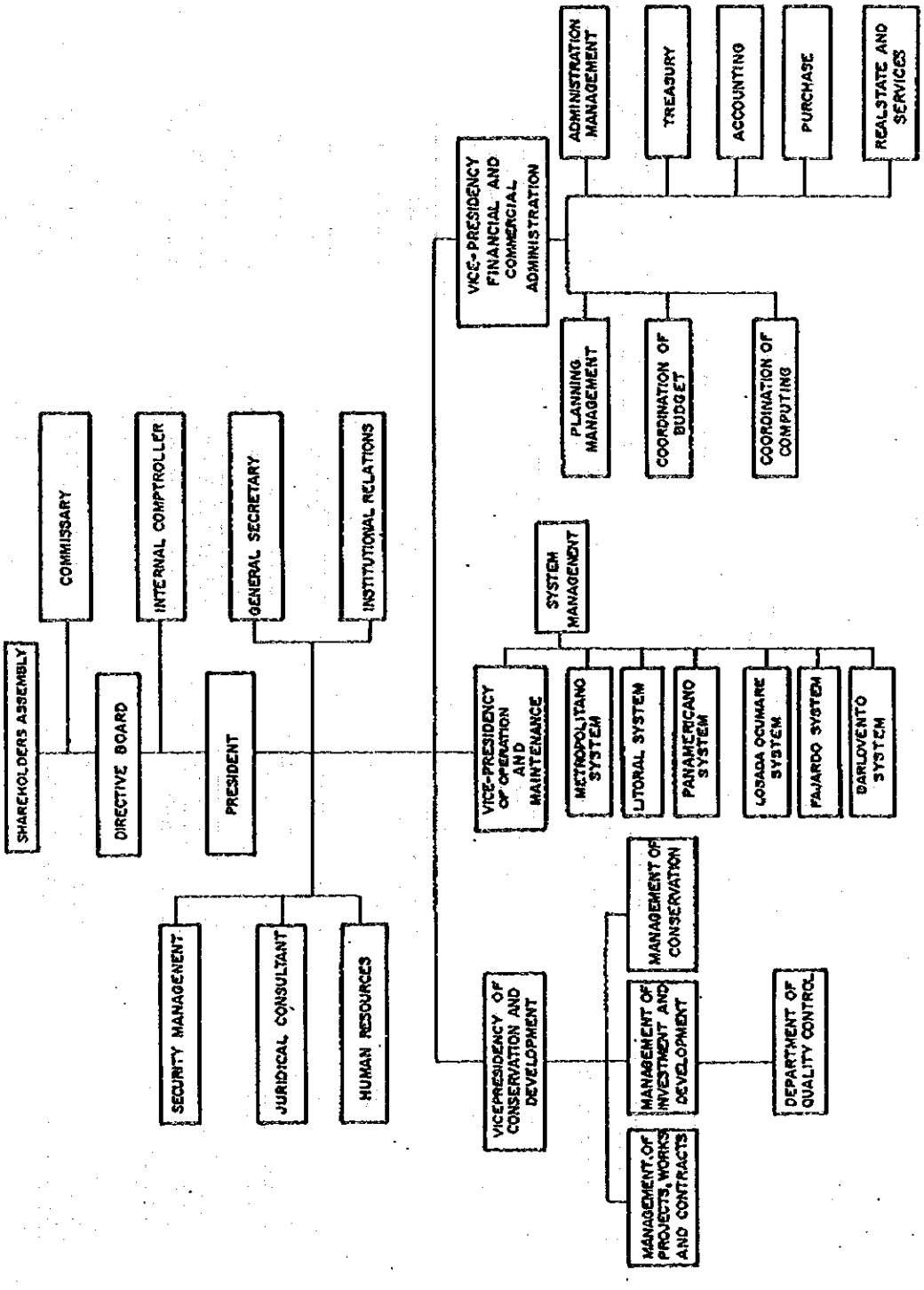


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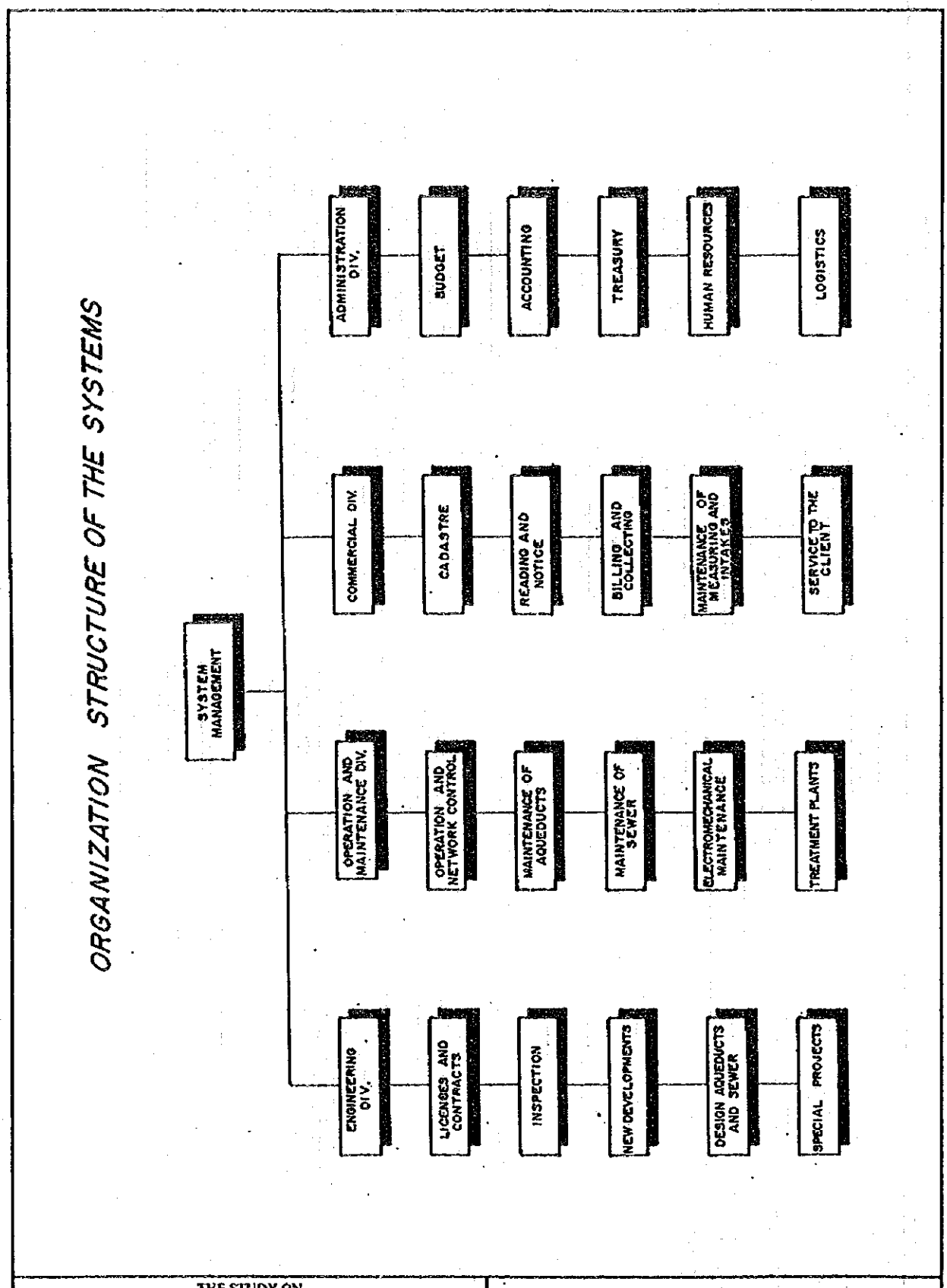
Fig. 1.1-3 General Organization Structure of Hidrocapital



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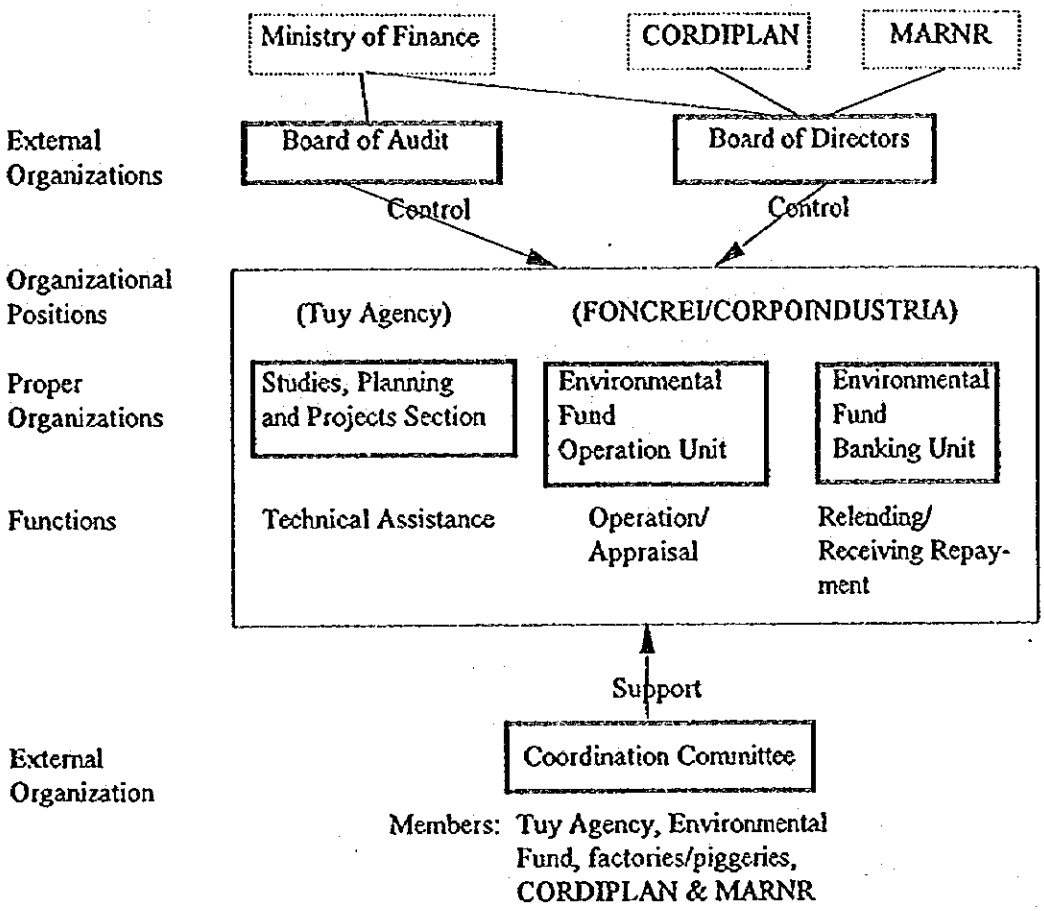
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 1.1-4 Organizational Structure of Hidrocapital System



Note: FCA (Fondo de Credito Agropecuario) will perform banking functions for piggeries. However, it will not undergo any organizational change upon the introduction of the Environmental Fund.

THE STUDY ON THE ENVIRONMENTAL IMPROVEMENT PROGRAM OF THE UPPER AND MIDDLE STREAM OF THE TUY RIVER BASIN IN THE REPUBLIC OF VENEZUELA JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. 3.3-1 Organizations Relate the Environmental Fund

SECTOR G

ANNEX

ANNEX

A: Request to SENIAT: Juridical Interpretation on Incentive Regulations

- Applicability of Decree 1,302 (10/10/1986)
- Applicability of Decree 1,793 (07/10/1991)
- Applicability of Income Tax Law (25/5/1994), Art.27, item 10

B: Reply from SENIAT

- Decree 1,302 not applicable
- Decree 1,793 not applicable
- Current Income Tax Law: Applicable Art.27, item 10 for sanitary as well as environmental regulations

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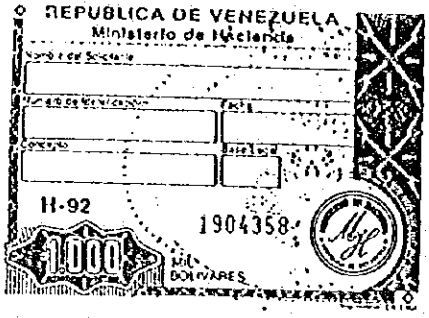

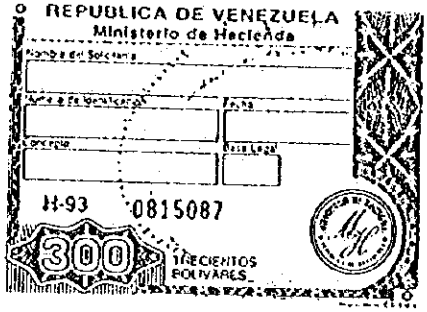

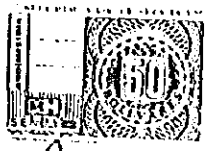

20-02-96

SOLICITUD DE INTERPRETACION JURIDICA

Caracas, 20 de Febrero de 199

Sr. Gerente Jurídico Tributario
SENIAT
Ministerio de Hacienda
Dr. Humberto Dascoli
Presente:

Actualmente la Agencia de Cuenca del Río Tuy del Ministerio del Ambiente, está realizando un Estudio de Factibilidad para el Saneamiento de la Cuenca del Río Tuy, a través de una cooperación técnica de la Agencia de Cooperación del Japón (JICA).

Dentro de tal estudio se está tratando de determinar cuales son los incentivos fiscales existentes actualmente para las industrias que apliquen métodos e instalen equipos para evitar, reducir o eliminar la contaminación.

En lo que el equipo de estudio ha podido investigar tales incentivos han estado contemplados en regulaciones anteriores y actuales (algunas de las cuales pueden requerir una interpretación legal), desde, por lo menos el año 1960.

Considerando la larga historia de incentivos fiscales por aspectos relativos a la protección y mejoramiento del ambiente, estimamos que tales incentivos han de existir actualmente, así como los hay para otras actividades.

Entendemos que por modificaciones a las leyes de impuesto sobre la renta anteriores a 1994, esas regulaciones ya no son vigentes, lo mismo que los decretos que han sido derogados especificamente.

De allí que consideramos que las leyes y decretos que actualmente podrían ser aplicables son los siguientes:

1. Decreto 1.302 del 10 de Octubre de 1986 (Art. 3)
2. Decreto 1.793 del 7 de Octubre de 1991 (Art. 8)
3. Ley de Impuesto sobre la Renta de 25 de Mayo de 1994 (Art 27, No.10, Art 58, Art 118)

Por lo cual estamos solicitando interpretación jurídica sobre lo siguiente:

a) La aplicabilidad de los Decretos 1792, 1793, y 1794 de impuesto sobre la Renta de 1994, en lo que respecta a incentivos fiscales de rebajas y deducciones de impuestos por inversiones en equipos, obras civiles u otras instalaciones para la conservación, preservación y conservación del medio ambiente.

b) Desearíamos específicamente conocer si el Numeral 10 del Art. 27 de la Presente Ley de Impuesto sobre la Renta incluye a disposiciones ambientales al establecer las disposiciones sanitarias. Tal inciso a la letra dice:

" El costo de las construcciones que deban hacer los contribuyentes en acatamiento de la Ley Orgánica del Trabajo o de disposiciones sanitarias".

Nuestro equipo considera que debido a que las aguas del Río Tuy se utilizan para abastecer parte del agua potable que llega a Caracas, (después de un tratamiento realizado por Hidrocapital en la región de Ocumare del Tuy), las disposiciones ambientales que le rigen deberían considerarse a efectos de aplicación de la ley, como de tipo sanitario; pues es en favor de la salud de los habitantes que consumen esa agua. De todas maneras nosotros sugeriríamos incorporar en el futuro el término ambiental a efecto de que no haya ambigüedad en la interpretación, y considerando también que cualquier inversión en el mejoramiento del ambiente, no produce renta, y por lo cual sería aconsejable estimularla, sobre todo considerando que los daños causados a la comunidad y el costo al gobierno en el tratamiento más sofisticado de las aguas, puede ser mayor que el valor que se estaría deduciendo del impuesto sobre la renta.

En espera de su atención a la presente,

Atentamente,

Dr. Valerio Gutiérrez L.

Misión JICA Río Tuy

REPUBLICA DE VENEZUELA
MINISTERIO DE HACIENDA

SENIAT
SERVICIO NACIONAL INTEGRADO DE ADMINISTRACION TRIBUTARIA

HGJT-97-200 0823

Caracas 26 FEB. 1997

Señores
Misión Jica Río Tuy
a/c Valerio Gutiérrez
Caracas

Asunto:Incentivos fiscales para la instalación de equipos anticontaminantes.

Tengo a bien dirigirme a usted en la oportunidad de dar respuesta a su escrito de fecha 20-02-97, en el cual expone que actualmente la Agencia de Cuenca del Río Tuy del Ministerio del Ambiente, está realizando un estudio de factibilidad para el saneamiento de la Cuenca del Río Tuy, a través de una cooperación técnica de la agencia de Cooperación del Japón.

En tal sentido solicita que esta Gerencia Jurídico Tributaria le informe si en la actualidad existen incentivos fiscales para las industrias que apliquen métodos e instalen equipos para evitar o reducir la contaminación, y a tal efecto señala que actualmente podrían estar aplicables los decretos 1302 del 10-10-86, 1793 del 07-10-91 , así como también la deducción de impuesto sobre la renta prevista en el numeral 10 del artículo 27 de dicha ley.

Al respecto, esta Gerencia Jurídico Tributaria cumple con darle respuesta en los términos siguientes:

En lo relativo a los decretos mencionados por usted en su escrito, mediante los cuales se creaban estímulos a las personas que efectuaran inversiones en equipos, obras civiles e instalaciones para la conservación, defensa y mejoramiento del medio ambiente, es conveniente hacer de su conocimiento que el otorgamiento de los beneficios fiscales, dentro de los cuales se encuentra la exoneración del impuesto, se efectúa estrictamente bajo el principio de legalidad consagrado en el artículo 224 de nuestra Carta Magna.

El Código Orgánico Tributario en desarrollo del referido principio establece un conjunto de normas que regulan todo lo atinente a los beneficios fiscales en general (art 64 al 69 ambos inclusive). Específicamente en cuanto a las exoneraciones se refiere, debemos acotar que se trata de un beneficio otorgado por el Ejecutivo Nacional, en los casos autorizados por la

Ley, mediante el cual se dispensa total o parcialmente el cumplimiento de la obligación tributaria.

De manera que para determinar la procedencia de la exoneración de impuesto se deben cumplir los supuestos específicos establecidos por la norma con un total apego al citado Principio de Legalidad, por cuanto al constituirse como una excepción a la regla general de gravabilidad del impuesto, en cierta manera se están quebrantando los principios de igualdad,generalidad,capacidad contributiva entre otros, que rigen nuestro sistema tributario.

En este orden de ideas, nos permitimos transcribir parcialmente el criterio manifestado por nuestra jurisprudencia en cuanto a beneficios fiscales se refiere (C:S:J:, Sala Político Administrativa, Sentencia del 27-04-88).

> *"(...)Es unánime el criterio, tanto en la doctrina como en la jurisprudencia, de que tales figuras tributarias sean establecidas o promulgadas por la Ley. La necesidad de esta fundamentación deriva del principio de legalidad que es punto cardinal de todo buen régimen impositivo, mediante el cual se reserva al Poder Legislativo la facultad de ejercer el poder tributario del Estado, o sea la potestad de crear tributos, pero también la capacidad para crear el derecho a la exención o al privilegio de la exoneración, pues gravar y desgravar no son otra cosa que manifestaciones de la potestad tributaria del estado, sin embargo es muy frecuente en ciertos países, entre ellos el nuestro, que mediante ley especial, se autorice al Poder Ejecutivo para conceder exoneraciones impositivas. En estos casos la doctrina tributaria moderna expone que, para evitar las funestas consecuencias que una conducta inspirada en la arbitrariedad o el favoritismo, por parte del Poder Ejecutivo, al concederlas, pueda ocasionar al sistema impositivo, y evitar la posible desviación de los objetivos socio económicos perseguidos con ellas, el Poder Legislativo debe establecer de manera concreta y absoluta claridad y precisión, los casos en que el Ejecutivo pueda otorgar dichos beneficios, señalando las condiciones que han de llenarse al efecto , sin que la Administración tributaria Activa tenga la facultad de dispensar de ninguna de ellas, ni para modificar, alterar o exigir otras, es decir, en unas pocas palabras el incentivo tributario de la exoneración debe concederse mediante disposiciones incorporadas por la propia ley habilitante y no por decisión facultativa del Poder Ejecutivo.*

Se desprende de la transcripción parcial, las condiciones y requisitos bajo los cuales procede propiamente el beneficio de exoneración de manera que a falta de una disposición expresa, el Ejecutivo Nacional se encuentra imposibilitado para otorgar el referido beneficio.

Aún cuando la doctrina lo califica como un instrumento de política fiscal, que atiende a factores de índole económico, político, social, entre otros, cuyo objetivo es el estímulo e incentivo de determinados sectores o actividades en aras del desarrollo económico del país no podemos obviar que se trata de una excepción que compete al Ejecutivo Nacional sólo

en los casos autorizados por la ley, en consecuencia deben establecerse expresamente los supuestos, las condiciones para su procedencia y su vigencia en el tiempo.

Asimismo es importante destacar que las exoneraciones no pueden ser establecidas con carácter indefinido, y al efecto el artículo 68 del Código Orgánico Tributario señala:

> *Artículo 68." Las exenciones y exoneraciones pueden ser derogadas o modificadas por ley posterior, aunque estuvieren fundadas en determinadas condiciones de hecho.*
> *Sin embargo, cuando tuvieren plazo cierto de duración, los beneficios en curso se mantendrán por el resto de dicho término, pero en ningún caso por más de cinco (5)años a partir de la derogatoria o modificación".*

Ahora bien, en ejercicio de esta facultad atribuida al Ejecutivo Nacional, para conceder exoneraciones, se dictó en fecha 06-10-86,el decreto N° 1302, publicado en Gaceta Oficial N° 33574 de fecha 10-10-86,mediante el cual se exoneraban del impuesto sobre la renta los enriquecimientos obtenidos por aquellos contribuyentes que utilicen métodos destinados a eliminar o evitar la contaminación del medio ambiente en la cantidad equivalente a la relación porcentual que existía entre el costo de los equipos, obras civiles o instalaciones incorporadas en el ejercicio y en el costo neto de los activos fijos destinados a la producción de la renta, excluidos los terrenos y edificaciones.

Posteriomente el Ejecutivo Nacional en el marco de la reestructuración económica llevada a cabo a principios de esta década,como una medida de política fiscal, y en su afan de reducir al máximo los incentivos fiscales, dictó el decreto N° 1817 del 30-08-91, publicado en Gaceta Oficial N° 34788 , mediante el cual se derogaron una serie de decretos, entre los cuales se encontraba el decreto N° 1302 de fecha 10-10-86. El referido decreto 1817 en su artículo 2 establecía que todos los contribuyentes que venían disfrutando de las exoneraciones acordadas en los decretos que se derogaban , seguirían gozando de dichos beneficios por el resto del lapso establecido en los mismos pero en ningún caso por mas de cinco (5)años, a partir de la fecha de la derogatoria.

Posteriormente en fecha 01-08-91, el Ejecutivo Nacional dictó el decreto N° 1793, publicado en Gaceta Oficial N°34814 del 07-10-91.

Mediante este decreto, se dictaron las normas para promover la inversión privada por razones de utilidad pública en la recuperación ambiental de áreas degradadas, estableciendo este decreto en su artículo 8 que los promotores que ejecuten los proyectos para recuperación ambiental, podían acogerse a los estímulos establecidos en el decreto 1302 del 08-10-86 .

Ahora bien en virtud de que este decreto no tenía plazo cierto de duración , de acuerdo a lo dispuesto en el artículo 67 del Código Orgánico Tributario,su término máximo de vigencia era de cinco (5) años, es decir hasta el 07-10-96., por lo que consecuencialmente esta Gerencia concluye que, actualmente no existe decreto alguno mediante el cual se exoneren los enriquecimientos obtenidos por contribuyentes que utilizen métodos destinados a eliminar o evitar la contaminación del medio ambiente.

En cuanto a la posibilidad de que a su representada se le otorguen rebajas de impuesto en materia de impuesto sobre la renta, se le informa que la ley en referencia en su artículo 58, establece lo siguiente:

Artículo 58.-Se concede una rebaja de impuesto del veinte por ciento (20%) del monto de las nuevas inversionesque se efectúen en los cinco(5) años siguientes a la vigencia de la presente Ley de Reforma, a los titulares de enriquecimientos derivados de actividades industriales y agroindustriales, distintas de hidrocarburos y actividades conexas , representadas en nuevos activos fijos, distintos de terrenos, destinados al aumento efectivo de la capacidad productiva o a nuevas empresas, siempre y cusando no hayan sido utilizados en otras empresas.....(omissis) Subrayado de la Gerencia.

De la transcripción parcial de la norma se puede inferir que la ley exige ciertos requisitos para que proceda la rebaja de impuesto por las inversiones efectuadas por los contribuyentes, siendo uno de ellos que la inversión se destine a la capacidad productiva de la empresa o a nuevas empresas, de lo que podemos concluir que si se realiza una inversión exclusivamente para reducir la contaminación ambiental, por ejemplo una planta purificadora de aguas residuales o efluyentes, tal inversión no daría lugar a la rebaja.,puesto que no estaría dirigida al aumento efectivo de la capacidad productiva de la empresa, requisito éste indispensable para el goce del beneficio, y consecuencialmente su representada no se encontraría amparada por este beneficio fiscal.

Por último y en cuanto a la interrogante expuesta por su representada en el sentido de conocer si las disposiciones ambientales podrían estar incluidas dentro del término de las disposiciones sanitarias a que se refiere el numeral 10 del artículo 27 de la ley de impuesto sobre la renta, con la finalidad de deducir dicho gasto de su renta bruta, se le informa lo siguiente:

El artículo 27, numeral 10 de la ley en estudio establece lo siguiente:

Artículo 27.-Para obtener el enriquecimiento neto se harán de la renta bruta las deducciones que se expresan a continuación, las cuales salvo disposición en contrario, deberán

corresponder a egresos causados, no imputables al costo, normales y necesarios, hechos en el país con el objeto de producir el enriquecimiento:

10,-El costo de las construcciones que deban hacer los contribuyentes en acatamiento de la Ley Orgánica del Trabajo o de disposiciones sanitarias.

De la norma transcrita podemos inferir que al referirse la norma a disposiciones sanitarias, se esta refiriendo a un mandato de carácter general y abstracto, realizado por el Estado a los particulares, con una finalidad de carácter general que redunda en la salud y sanidad ciudadana.

Por tanto, al devenir el gasto del cumplimiento de las referidas disposiciones es justo que pueda el contribuyente deducir los egresos a los fines de calcular su enriquecimiento neto.

En tal sentido, la Ley Penal del Ambiente publicada en Gaceta Oficial Nº 4358 de fecha 03-01-92, en su artículo 28 establece sanciones de prisión de tres (3) meses a un (1) año y multa de trescientos (300) a mil (1000) días de salario mínimo, al que vierta o arroje materiales no biodegradables,sustancias, agentes biológicos o bioquímicos, efluentes o aguas residuales no tratadas según las disposiciones técnicas dictadas por el Ejecutivo Nacional, objetos o desechos de cualquier naturaleza en los cuerpos de las aguas, sus riberas, cauces,cuencas, mantos acuíferos, lagos, lagunas o demás depósitos de agua, incluyendo los sistemas de abastecimiento de aguas, capaces de degradarlas, envenenarlas o contaminarlas. (Subrayado de la Gerencia).

De la norma antes señalada podemos inferir que es de carácter obligatorio para las empresas, la instalación de equipos anticontaminantes, a fin de evitar el envenenamiento o la contaminación de las aguas , preservando de esta manera la salud de la población, de lo que podemos concluir que dentro de las disposiciones sanitarias a que hace referencia el numeral 10 del artículo 27 de la Ley de Impuesto Sobre la Renta pueden estar incluidas las disposiciones ambientales a fin de deducir el gasto en que incurriría su representada al momento de la instalación de equipos anticontaminantes.

Por todo lo antes expuesto esta Gerencia Jurídico Tributaria concluye lo siguiente:

1.-En la actualidad no existe normas de efectos generales, que establezcan exoneraciones a los enriquecimientos obtenidos por contribuyentes que utilicen métodos destinados a evitar la contaminación del medio ambiente.

2.-La Ley de Impuesto Sobre la Renta vigente, no establece rebajas de impuesto para este tipo de inversiones.

3.-La Ley de Impuesto sobre la Renta, vigente, prevé en su artículo 27 numeral 10 la deducción de gastos en que incurre el contribuyente en virtud del cumplimiento de disposiciones sanitarias, dentro de las cuales podemos incluir las disposiciones ambientales..

Esta consulta se evacúa sin perjuicio de que su representada pueda gozar de cualquier otro tratamiento preferencial, no tributario, previsto en la legislación vigente.

En los términos precedentes, queda expuesto el criterio de esta Gerencia al asunto sometido a su consideración.

Atentamente

Humberto D'ascoli Centeno
Gerente Jurídico Tributario

RSS/MMM/POM
Ceos N°322-97

G-A-10

SECTOR H

CONSTRUCTION PLAN AND COST ESTIMATE

THE STUDY ON
THE ENVIRONMENTAL IMPROVEMENT PROGRAM OF
THE UPPER AND MIDDLE STREAM OF THE TUY RIVER BASIN

SECTOR H: CONSTRUCTION PLAN AND COST ESTIMATE

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SECTOR H: CONSTRUCTION PLAN AND COST ESTIMATE

1. UNIT COSTS

The unit costs used in the preparation of the cost estimates of the Master and Feasibility studies are from published data, namely, the *Guia de Costos* (Guide to Costs) put out by the Institute of Costs of Construction and the *Manual de Costos*, published by Data Construction Company. This cost data is updated every three months and is considered reliable, being confirmed by discussions with local contractors. Further cost data was obtained from local contractors and material and equipment suppliers whom undertake similar works.

It should be noted that some unit costs of the Feasibility Study vary from those stated in the Master Plan. This is due to two reasons, firstly, a more detailed investigation into the costs was undertaken during the Feasibility Study stage. Secondly, the unit costs were strongly influenced in the past year by very high inflation rates. A 175% depreciation of the Bolivar and a fivefold increase in fuel prices, among other factors, resulted in a 125% increase (Dec. 95 to Dec. 96) in construction material indices. To reduce the influence of future price fluctuations unit costs have been converted into US dollar terms.

Generally, costs of construction materials manufactured in Venezuela such as concrete, steel reinforcing, and pipe are similar to international prices. While, costs such as fuel, energy, and labor, however, are substantially lower, the cost of imported items are high and are further increased due to import tariffs, ranging from 15 to 20%.

Unit costs are contained in the respective cost estimates for the individual projects presented in the following pages. These unit costs contain the cost of material, transport to site, labor, equipment, and government duties.

2. MASTER PLAN STUDY

2.1 Implementation Plan

Based on the prioritization in section 6.4.1 and discussion of short-term and mid-term program, a phased implementation plan is formulated, and the implementation schedule is prepared as shown in Fig. 6.3-1. In this implementation plan, the construction period for each measure is assumed considering similar projects in Venezuela and other countries, as well as the design scale of the proposed measures.

As for the construction of Guare dam in this implementation plan, it is scheduled to commence the construction from the beginning of short-term program, though the priority is lower than the installation of pump at the Ocumarito reservoir. This is because the Guare dam requires 5 years construction period, while this measure should be completed by 2003 to achieve the target.

2.2 Preliminary Cost Estimates

The following cost estimates were prepared using prices prevailing in July of 1996, at the exchange rates of US$ 1.00 = ¥110 = Bs 470. Preliminary cost estimates include physical contingency and indirect costs. These additional costs add an extra 35% to the estimated cost.

(1) Ocumarito - Lagartijo Diversion Structure

Unit costs were obtained from suppliers of steel pipe and contractors working on the current Tuy IV system. The pipe will run along the surface, so the unit cost of such pipe has been used. Transportation and installation costs are also included in the unit cost.

(unit: US$ 1000s)

Works	Unit Cost	Quantity	Cost
Preparatory Works	30/L.S.	1	30
Elevated Pipeline	74/unit	2	148
Pipeline (ϕ 1800)	2.11/m	18 km	37,980
Valves, etc.	450/L.S	1	450
Total Cost			38,608

(2) Sand Settling Pond at Toma de Agua

Unit costs for the sand settling pond were obtained from local contractors and from published cost data.

Breakdown of preliminary cost estimate for sand settling pond

Works	Unit Cost	Quantity	Total
Land Acquisition	12.8/m²	4,000	51,200
Temporary Works	global	233,409	233,409
Excavation Works	8.6/m³	24,385	209,711
Concrete Works	428.6/m³	3,702	1,586,677
Piling	75.6/m³	1,200	90,720
Culvert	1,688.2/m	150	253,230
Embankment	45.6/m³	1,880	85,728
Gate	20,000/unit	5	100,000
Total Cost			2,610,700

(3) Treatment Plants for Factories and Piggeries

The cost of a treatment plant for factories and piggeries is estimated based on unit cost per volume of effluent from each factory or piggery as obtained from the interview survey as shown below:

Category (Factory/Piggery)	Average Discharge Wastewater Volume (ton/day)	Average Construction Cost of Treatment Plant (US$)	Unit Cost (US$/ton/day)	O&M Cost (US$/ton
Food Related	317	404,924	1,277	5.4
Non-Food Related	106	208,724	1,963	33.6
Piggery	11.5	20,000	1,739	1.0

The procedure of cost estimation is as follows:

- Total and average effluents of factories and piggeries in the blocked areas that do not meet the water quality standard are calculated based on the observed data of water effluent.
- The unit cost of treatment plant of the factories and piggeries in the blocked area is obtained based on the average effluent and unit cost shown in the above table.
- The total cost in the blocked areas is estimated multiplying the unit cost with the number of factories and piggeries.

(4) Sewage Treatment Plant

The main items of the sewage treatment plant cost estimate are: (1) land acquisition, (2) construction of treatment facilities, and (3) installation of sewer pipes. The cost of land was determined from the for sale price of similar parcels of land in the study area. The area of the proposed treatment plant was roughly estimated at 4 hectares per 10,000m³ of daily design flow.

The cost of constructing the treatment plants was calculated from cost charts published by The World Bank (Technical Paper Number 73) for sewage treatment plants constructed in the United States. These cost charts were adjusted for conditions existing in Venezuela.

Sewer pipe installation cost is determined from the cost to install a 18" class 3 rubber joint sewer pipe. This unit cost includes excavation, backfilling, disposal of excess material, installation of pits, and road pavement works.

Operation and maintenance costs have been determined from interviews and data from treatment plants operating in Venezuela and was estimated at 3.5% of the initial cost for the sewage treatment plant.

Ocumare Del Tuy Sewerage System (design flow 90,390 m³/day)

Item	Unit	Quantity	Unit Cost	Cost
Land Acquisition	ha	36.2	40,000	1,448,000
Construction of Treatment Facilities	m³/day	90,390	148	13,372,000
Installation of Sewage Pipe	m	220,000	60	13,200,000
Total Cost				**28,020,000**

O&M/year (3.5% of STP cost)	**518,700**

Las Tejerías Sewerage System (design flow 35,650 m³/day)

Item	Unit	Quantity	Unit Cost	Cost
Land Acquisition	ha	14	40,000	560,000
Construction of Treatment Facilities	m³/day	35,650	240	8,540,000
Installation of Sewage Pipe	m	60,000	60	3,600,000
Total Cost				**12,700,000**

O&M/year (3.5% of STP cost)	**318,500**

(5) Sand Settling Pond on Tributaries

The cost of the sand settling ponds is composed of (1) land acquisition, (2) excavation of pond, (3) concrete lining of channel, and (4) intake works.

The work quantities and unit costs are as shown below:

Hacienda Barrios

Works	Cost	Quantity	Cost
Land Acquisition	12.8/m³	40,000	512,000

Excavation & Hauling	8.6/m³	114,000	980,400
Concrete	428.6/m³	2,500	1,071,500
Intake Works	Unit	1	456,900
Total			**2,979,520**

Cagua

Works	Unit Cost	Quantity	Cost
Land Acquisition	12.8/m³	28,000	358,400
Excavation & Hauling	8.6/m³	77,700	668,220
Concrete	428.6/m³	2,500	1,071,500
Intake Works	Unit	1	441,000
Total			**2,539,120**

Maitana

Works	Unit Cost	Quantity	Cost
Land Acquisition	12.8/m³	40,000	512,000
Excavation & Hauling	8.6/m³	114,000	980,400
Concrete	428.6/m³	2,500	1,071,500
Intake Works	Unit	1	456,900
Total			**3,020,800**

Guare

Works	Unit Cost	Quantity	Cost
Land Acquisition	12.8/m³	40,000	512,000
Excavation & Hauling	8.6/m³	95,400	820,440
Concrete	428.6/m³	2,500	1,071,500
Intake Works	Unit	1	456,900
Total			**2,860,840**

(7) Reforestation

The cost of reforestation is roughly estimated based on the construction cost of forest roads and tree planting. The unit costs for these items are as follows:

Works	Unit Cost	Quantity	Total
Forest Road	240/ha	10,200	2,448,000
Tree Planting	510/ha	10,200	5,202,000
Total Cost			**7,650,000**

(8) Overall Cost

Preliminary cost estimates for the proposed projects are as shown in the following table:

(Unit: US$ 1,000s)

Stage	Category	Target	Measures	Initial cost	O&M cost	Annual cost*
Short term	Physical measures	Water quantity	Diversion (Ocumarito-Lagartijo)			
			Lessening color/odor			
			Lessening turbidity			
			(Sub-total)			
		Water quality	Treatment for existing factories			
			Treatment for newly constructed factories			
			Treatment of domestic wastewater (Ocumare del Tuy)	28,020	519	3,601
			Treatment of domestic wastewater (Las Tejerias)	12,700	319	1,716
			(Sub-total)			
	Institutional measures		Monitoring			
			Public education			
			Environmental fund			
			(Sub-total)			
	Total					
Mid term	Physical measures	Water quality and quantity	Treatment of newly constructed factories			
			Treatment of domestic wastewater (S. F. de Yare)	8,710	223	1,181
			Treatment of domestic wastewater (El Consejo)	10,030	257	1,360
			Lessening turbidity (reforestation)			
			Lessening turbidity (sand settling pond)			
			(Sub-total)			
	Institutional measures		Monitoring			
			Public education			
			Environmental fund			
			(Sub-total)			
	Total					

* Annual Cost = Initial Cost x 0.11 + O&M Cost (0.11 is conversion rate to estimate annual cost applying the project life of 50 years and discount rate of 12%)

3. FEASIBILITY STUDY

3.1 Basic Conditions

3.1.1 Conditions for Construction Planning

Preliminary designs of the following facilities have been undertaken during the feasibility study and are presented in Figures H-6 to H-10 .

- treatment plants at factories
- sand settling pond
- sewage treatment plant and sewer network in Ocumare del Tuy
- sewage treatment plant and sewer network in Las Tejerías
- facilities for reforestation
- monitoring system

(1) Implementation Schedules

Implementation schedules are shown in Figures H-1 to H-5. It has been assumed that the works will be broken down into individual contracts (i.e. civil works, process equipment supply and installation, sewer installation, etc.). Non construction works preceding the construction works have been included in the implementation schedules. These non construction works include:

- detail designs;
- preparation, review, and approval of contract documents;
- tender period;
- mobilization of the contractor.

On average six months has been allowed for these initial steps however the detail design phase of larger works such as the Ocumare del Tuy STP and sewer network is expected to be much longer. It is probable that the installation of the sewer network will be further broken down and undertaken in smaller stages than described here.

Table H-1 Cost Divided by Contract

Contract No.	Activity	1997 Cost (US$)
	Sand Settling Pond	
S1	General civil engineering works	4,826,515
S2	Bridge construction	227,450
S3	Steel pipeline installation	1,191,580
	Ocumare del Tuy Sewerage System	
O1	General civil engineering works	5,870,556

O2	Pump supply and installation	2,085,388
O3	Process equipment supply and installation	3,237,500
O4	Gas storage tank construction	200,000
O5	Main pumping station civil works	310,209
O6	Sewer network installation works	13,184,481
	Las Tejerías Sewerage System	
L1	General civil engineering works	3,096,680
L2	Pump supply and installation	1,107,250
L3	Process equipment supply and installation	2,105,000
L4	Gas storage tank construction	150,000
L5	Sewer network installation works	3,579,537
	Reforestation Activities	
R1	Nursery construction	190,268

Apart from those activities mentioned in the implementation schedules many other activities must be completed in conjunction with the works. These include:

Topic	Activity
Overall	Organize executing unit Confirmation of project definition Engage engineering consultants Provide financing
Treatment Plants to Factories	Approval of treatment method and capabilities
Sand Settling Pond	Obtain approval for land use Approval from HIDROCAPITAL for works on river near intake
Sewerage Systems	Obtain approval for STP sites and sewer routes from cities Coordinate traffic during installation of sewers Approval from HIDROCAPITAL for river crossings
Reforestation Activities	Obtain permission to reforest lands from owners Approval for construction of forestry roads from local authorities

(2) Standards

In general the design and construction of the facilities should follow construction methods common in Venezuela and in compliance with Venezuelan standards. Most standards relating to the proposed works are based on American standards but were introduced before 1980. Due to the age of the standards they should be reviewed before the detailed design is commenced.

(3) Capability

Though Venezuela is lacking in sanitation infrastructure and, therefore, has few contractors experienced in the sanitation works proposed, there are many general civil engineering contractors capable of undertaking the works described herein. As a result of being blessed with vast natural resources, in particular oil, Venezuela has well developed infrastructure. In Caracas there are many modern buildings and a modern subway system, an extensive and generally well maintained highway network connects major centers, numerous dams supply hydroelectricity and drinking water, and there are major ports.

Further, the labor force required for the proposed projects is expected to be large. Because of Venezuela's high unemployment rate and the close proximity of the project sites to urban centers, labor shortages are not expected to be a problem. Generally the works are not complex so with some prior training the skill level of the workers can be brought up to a sufficient standard.

(4) Rainy Season

Since most of the projects of the Feasibility Study involve excavation and are proposed to be carried out adjacent to the Tuy River or in mountainous regions, the rainy season, because of its intensity, is a major factor in the consideration of construction planning. Most of the rain falls in the upper and lower basins from June to October. Thus works involving excavation (e.g. earthworks for treatment plants, excavation of sewer trenches, excavation of the sand settling pond) where practical are scheduled to be carried out between November and May.

(5) Materials

As is generally the case the availability of construction materials is a major factor in governing what types of construction methods a country employs. Materials such as concrete and steel are manufactured locally and are readily available. Preliminary designs undertaken during the Feasibility Study, therefore, took into account common construction techniques and available materials. For example, steel sheet piling is not produced locally and its use is affected by fluctuations in the Bolivar, thus other methods such as slurry wall

construction and concrete sheet piles are viable due to their supply and price stability.

On the other hand, equipment such as pumps and treatment plant process equipment have to be imported as manufacturers do not exist in Venezuela. Though, there are many established suppliers that can also provide spare parts and maintenance. An issue which should be examined during the detailed design stage is to whether or not some of the process equipment can be manufactured by Venezuelan companies. If this is the case the cost of the treatment plants would be reduced.

3.1.2 Conditions of the Cost Estimate

Cost estimates have been made based on preliminary designs prepared during the Feasibility Study. These preliminary designs were made to a sufficient degree to permit quantities to be reliably estimated.

Costs have been estimated using several approaches. For routine items such as pipe laying, excavation, and concrete construction published data was used. Cost data for specific items such as pumps, bridge construction, steel pipe costs and slurry wall construction was obtained from local contractors and suppliers. The cost of land was obtained from local real estate agents.

An allowance of 15% of the basic cost estimate to cover physical contingencies is reasonable, based on the status of the designs for the project components. A further 10% is applied to cover support activities. These extra costs are termed "additional" costs in the cost estimates.

Cost estimates are prepared in prices prevailing at the end of 1996. The pattern of expenditures has been estimated for each project from detailed design, beginning in January 1998, through to completion in December 2003 (see table below). Actual final costs will depend on changes in price levels during the project implementation period. On the advice of economists future price increases have been assumed to be 3% per year. The following table was made in conjunction with the implementation schedules.

Table H-2 Annual Expenditures on Feasibility Study Projects

Project	Totals at Jan 1997 prices	1998	1999	2000	2001	2002	2003	Totals
Physical Measures								
Factory Treatment Plants								
Sand Settling Pond	6,245,545			702,942 (10%)	4,706,194 (65%)	1,864,377 (25%)		7,273,512

Ocumare del Tuy STP	13,578,652	2,593,007 (18%)	4,451,328 (30%)	6,418,815 (42%)	1,574,138 (10%)			15,037,287
Ocumare del Tuy Sewer Network	13,184,481	699,371 (5%)	2,737,337 (19%)	2,819,457 (19%)	2,904,041 (19%)	2,991,162 (19%)	3,080,897 (19%)	15,232,266
Las Tejerias STP	7,788,930			2,892,948 (33%)	1,805,901 (20%)	4,371,183 (47%)		9,070,032
Las Tejerias Sewer Network	3,579,537			282,016 (7%)	1,286,396 (31%)	1,324,988 (31%)	1,364,737 (31%)	4,258,137
Reforestation Activities	3,346,719	201,855 (5.7%)	689,720 (18.86%)	710,411 (18.86%)	731,724 (18.86%)	753,675 (18.86%)	776,286 (18.86%)	3,863,671
Totals	47,723,864	3,494,233	7,878,358	13,826,589	13,008,394	11,305,386	5,221,920	54,734,906

1. Assumes future price increases of 3% a year
2. All prices in US dollars
3. Numbers in brackets are percentage of total cost outlay per year

Foreign Component

Because of the availability of local contractors, construction equipment, and construction materials, imported goods are mainly confined to the acquisition of equipment for the sewage treatment plants such as pumps and process equipment. This, however, makes up a substantial percentage of the overall costs of the STPs. As shown in the table below it was estimated that 43% of the cost of the Las Tejerías STP and 41% of the Ocumare del Tuy STP consist of imported equipment.

Table H-3 Foreign Component of Cost Estimates (Unit: US$ 1,000s)

Short Term Measures	Initial Cost	Foreign Component	Percentage of Total
Physical			
Treatment plants for existing factories			
Sand Settling Pond	6,245	192	3
Ocumare del Tuy sewerage system (STP)	13,578	5,591	41
Las Tejerías sewerage system (STP)	7,788	3,344	43
Reforestation activities	3,346	NA	-
Institutional			
Monitoring	608	404	66
Public education	50	50	100
Environmental fund	200	200	100
Total			

3.2 Installation of Treatment Plants to Factories

3.3 Construction of Sand Settling Pond at Intake

3.3.1 Construction Plan

(1) Preliminary Design

The layout of the sand settling pond is shown in Figure H-6. The following are the major points of the feasibility construction planning of the sand settling pond.

A soil investigation of the site was carried out by a local geotechnical engineering firm and its recommendations were taken into account when devising the preliminary design, construction plan and cost estimates.

Due to the proposed location of the sand settling pond, year round high ground water levels, and the high permeability of the soil, it is recommended to construct the outside reinforced concrete walls using slurry trenches. The wall acts firstly as a retaining wall then functions as the outside wall of the sand settling pond structure. The cost estimation is based on this method. The slurry trench method is popular in Venezuela due to the constant availability of necessary materials (concrete and steel), equipment, technology, and low labor and fuel prices.

Because the site is very close to the river the possibility of flooding the construction works exists. It is therefore proposed to carry out all excavation and construction of the concrete superstructure during the one dry season.

Because of the pressures that are expected to act on the walls of the sand settling pond, provision for temporary and permanent lateral support was included in the preliminary design. Tieback anchors have been assumed for temporary support and lateral beams between the walls for permanent support.

It is also necessary to construct two bridges: (1) a 10 meter prestressed concrete road bridge, commonly used in Venezuela, crossing the outlet of the sand settling pond to provide access to the pumps and (2) a 50 meter pipe bridge crossing the Tuy upstream of the existing intake.

It is proposed to construct the pipe bridge using the same method used for bridges in the Tuy IV system, which is currently being undertaken. The method is simple and involves reinforcing the conduction pipe with steel collars and rings, spans of up to 60 meters can be achieved in this manner. The single span bridge is proposed to sit on two pile supported concrete piers.

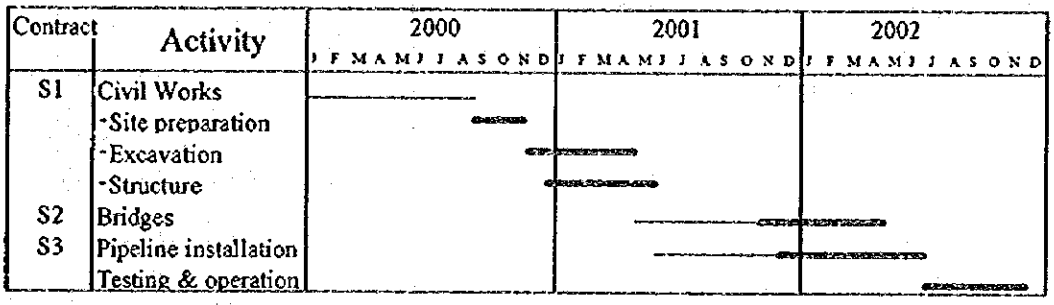
(2) Implementation Schedule

The implementation schedule (Figure H-1) was determined through comparison with comparable works and information received from contractors. The preliminary works (i.e. detailed design, tendering and procurement of equipment) are proposed to commence at the beginning of 2000 and the excavation works are to be undertaken predominantly during the

dry season with commissioning of the facility, following test operation, at the end of 2002.

It is expected that the works will be divided into three contracts: 1) excavation and superstructure construction, 2) bridge construction, and 3) pipeline installation.

Figure H-1 Sand Settling Pond Implementation Schedule



Fine line: detailed design, tendering, and procurement.
Coarse line: represents supply/construction

3.3.2 Cost Estimate

Table H-4 Sand Settling Pond Cost Estimate

Item	unit	qty	unit cost $	cost $
Site Preparation				
light clearing of site	ha	3	510.00	1,530
stripping and stock piling of top soil	m³	6,000	1.32	7,920
Excavation and Backfilling				
excavation in saturated soil	m³	50,000	6.30	315,000
soil removal, d = 2 km	m³	50,000	1.20	60,000
Structure Construction				
outside wall construction, concrete & steel	m³	2,180	463.00	1,009,340
gravel base t = 500 mm	m³	4,950	15.00	74,250
internal structure S/T concrete, including steel	m³	10,550	200.00	2,110,000
temporary wall supports	units	100	250.00	25,000
impermeable lining	m²	12,114	4.67	56,572
Bridges				
Maintenance and Pipe Bridge, span = 12 m, width = 6m	m²	72	650.00	46,800
60 m Pipe Suspension Bridge				85,000
concrete pier	m³	60	200.00	12,000
piles 0.8 m dia. x 15m length x 12 piles	m	180	212.00	38,160
Pipeline installation				
S/T/P 2.0 meter diameter steel pipe	m	700	1,265.00	885,500
pipe support, concrete base	m	50	235.00	11,750
pipe protective coating, bitumen	m²	950	6.33	6,014
valves and accessories	global		50,000.00	50,000
Gates and Screen				
2.3 x 5 m sluice gate	unit	8	11,500.00	92,000
motorized winch	unit	8	12,500.00	100,000
20 x 4.5 m @ 90 mm c/c, carbon steel screen	kg	4,000	2.40	9,600
				4,996,436
Total (includes 25% additional)				6,245,545

Note: Land acquisition is not included in the cost estimate as the site is already the property of HIDROCAPITAL

Table H-5 Sand Settling Pond Operation and Maintenance Costs

Item	unit	cleanings per year	unit cost	cost $
Labor	cleaning	33.2	422	14,010
Electricity	cleaning	33.2	90.4	3,001
Total/year				17,012

3.4 Construction of Sewerage System in Ocumare del Tuy

3.4.1 Construction Plan

(1) Sewage Treatment Plant (STP)

The layout of the Ocumare del Tuy STP is shown in Fig. H-7.

The site is low and close to the Tuy River with a dense cover of native vegetation. Ponding of sewage flowing from the sewers of Ocumare del Tuy is prevalent in the area.

Before any other works are possible the removal of this vegetation and ponding is necessary. This should be followed by the construction of the flood retaining levee. As no records of flood levels exist in the area information was obtained from locals as to the height and occurrence of flood waters.

According to the soil investigation the soil of the proposed site is alluvium, the top layers being composed of chiefly clay with sandy soil layers beneath. It has been recommended in the soil investigation to place the foundations on a 0.5 meter compacted layer of gravel resting on the subgrade at least 1.0 meter below the existing surface level.

All structures are relatively light having their foundations between 1 and 3 meters below the existing surface and construction is proposed to be cast in place concrete and is not expected to be difficult. The exception, however, is the main pumping station. Due to the depth of the incoming sewers the base of the pumping station is estimated to be 20 meters below the existing surface level. The slurry trench method was assumed as the construction method.

Foreign expertise will be necessary to supervise the installation and initial operation and testing of the process equipment as much of the equipment is new to Venezuela.

(2) Sewer Network

As mentioned in earlier chapters the proposed sewer network is based on the study carried out by INOS in 1987 titled *Proyecto de los Colectores Generales de la Futura Poblacion.* There are, however, significant differences, in particular, the proposed location of the STP. The resulting lengths of primary sewers is 40,550 meters and secondary sewers cover 181,000 meters.

Soil investigations and geological maps indicate that the soils of the Ocumare del Tuy area are alluvial (i.e. silty gravels, clayey gravels, silty sands, and clayey sands). It was assumed that, generally, the sewer pipe could be placed directly onto the prepared trench base without granular bedding, if undesirable material such as rock or organic material is not encountered.

However, installation of the sewers is expected to be made difficult by a number of other factors. Firstly, the large extent of the sewer network means that a large work force is required. It is estimated that it will take 4 teams of 42 workers (164 workers), 5 years to install approximately 225,000 meters of 18" rubber jointed sewer pipe (i.e. setting out, pavement removal, excavation, pipe installation, backfilling, and pavement reinstatement). This estimation assumes that 200 days per year are available for works, taking into account days lost due to rain and other problems, and does not include support staff. In the implementation schedule (Figure H-2) it has been assumed that the works will be carried out over 6 years. Further time is necessary to carry out the detail design, tendering of the project, and the procurement of materials and equipment.

Secondly, Ocumare del Tuy is an established city. Many of the routes of the proposed sewers run parallel to existing creeks and below streets. Creeks flowing through Ocumare del Tuy currently act as open sewers and generally have high flows throughout the year. In most cases sufficient space exists near the creeks for sewer installation, however, there are many locations where the buildings come right up to the edge of the creeks and there is insufficient space for sewer installation. As creek diversion is not possible the use of sheet piling may be necessary for the installation of the sewers.

Moreover, as the streets are narrow and well trafficked by vehicles and pedestrians. Sewer installation along streets, therefore, is expected to hinder traffic and vice versa.

(3) Implementation Schedule

Construction of the sewerage treatment plant and the sewer network is based on previous studies, namely the above mentioned INOS study. The implementation schedule roughly follows that described in this study (see Figure H-2).

(i) Detailed design, tendering, and procurement.

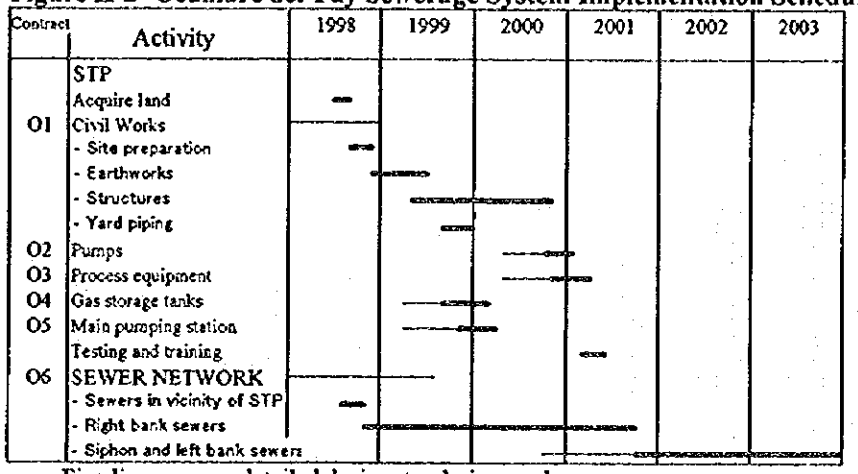
(ii) Sewers in the vicinity of the proposed STP will be repaired and redirected so that the inflowing sewage does not interfere with the construction of the treatment plant.

(iii) Construct the treatment plant.

(iv) Work on the major sewers (Araguita, Collector C, and Parroyo, etc.) on the right bank should begin and the respective secondary sewers.

(v) Construct the siphon and the left bank sewers. It is recommended that the design of the siphon be changed. The one proposed in the INOS study requires high velocity flowrate or else it will block. Since the flowrate and the velocity will be low in the early stages of the project, a siphon that can be cleaned is recommended.

Figure H-2 Ocumare del Tuy Sewerage System Implementation Schedule



Fine line: detailed design, tendering, and procurement.
Coarse line: represents supply/construction

3.4.2 Cost Estimate

(1) Initial Cost

Cost estimates have been prepared for the STP based on the preliminary design completed during the feasibility study. Cost estimate for sewer network is based on modified MINDUR and INOS designs.

All labor and construction materials such as concrete, reinforcing steel, concrete pipe and steel pipe are manufactured in Venezuela, it is however necessary to import the pumps and STP process equipment. International prices for such equipment are high and there influence on the overall cost estimate is large. Moreover, import tariffs of 15% to 20% add substantially to the overall cost.

Concerning the sewer network, sewer pipe unit costs include the supply, transport and installation (S/T/I) of sewer pipeline. Also included are the cost to excavate, backfill and remove excess soil as well as the cost to install pits at intervals of between 100 and 50 meters, depending on the pipe diameter.

Table H-6 Ocumare Del Tuy STP Cost Estimate

Item	unit	qty	unit cost $	cost $
Land Acquisition	ha	30	50,000	1,500,000
Site Preparation Works				
medium clearing	ha	17	657.00	11,169
stripping and stockpiling of topsoil	m³	40,000	1.32	52,800
cutting up of felled timber	ha	17	287.00	4,879
disposal of vegetation, 2km	ton	45,000	1.71	76,950
setting out site	ha	17	1,161.00	19,737
Earthworks				
grading of site	m³	10,000	1.31	13,100
excavation to subgrade of foundations	m³	30,725	2.95	90,639
excavation of sludge drying lagoons	m³	5,775	3.19	18,422
fill and compacting of embankments	m³	6,164	4.54	27,985
removal of excess soil	ton	24,700	1.71	42,237
soil cement	m³	6,700	5.68	38,056
Roadwork				
asphalt pavement	m	520	47.72	24,814
unpaved	m	890	27.02	24,048
Structures				
geotextile	m²	16,240	3.63	58,951
gravel base for structures	m³	8,120	22.52	182,862
lean concrete layer	m²	16,240	3.72	60,413
supply and placement of concrete includes steel & formwork	m³	12,000	200.00	2,400,000
impermeable lining	m²	25,850	4.67	120,720
administration and maintenance buildings	m²	700	300.00	210,000
Yard Piping				
S/T/I lined ductile iron pipe dia.=1000 mm	m	627	691.00	433,257
S/T/I lined ductile iron pipe dia. = 600 mm	m	290	313.00	90,770
S/T/I lined ductile iron pipe dia. = 350 mm	m	473	140.60	66,504
Valves, telescoping, eccentric, sluice, etc.	units	40	5,000	200,000

Table H-7 Continued

Supply and Installation of Pumps				
0.266 cumecs x 75kW (vertical)	units	5	177,178	885,891
0.284 cumecs x 22kW (vertical volute)	units	3	90,589	271,767
0.567 cumecs x 45kW (vertical volute)	units	3	130,884	392,651
0.05 cumecs x 2.2kW (sludge)	units	4	29,500	118,000
Filters				
riverbed gravel filter media	m³	9,326	29.24	272,692
drainage blocks	m²	7,772	20.00	155,440
Process Equipment				
stainless steel screens	units	2	20,000	40,000
Sludge collectors				
primary settling	units	12	43,000	516,000
secondary settling	units	12	50,000	600,000
Rotary Distributors				
1st step	set	4	46,000	184,000
2nd step	set	4	50,000	200,000
gravity thickeners	set	4	47,000	188,000
gas mixing equipment	set	6	77,000	462,000
incinerator	facility	1	75,000	75,000
chlorination	facility	1	20,000	20,000
Gas Storage				
steel gas storage tanks cap. = 325 m^3	tanks	4	40,000	160,000
Operation and Maintenance Equipment				
tractor/ front-end loader	unit	1	150,000	150,000
small dump truck	unit	1	133,000	133,000
pick-up	unit	1	22,000	22,000
Pumping Station				
excavation, slurry trench method	m³	2,417	6.30	15,227
concrete incl. Reinforcement	m³	613	380.00	232,940
sub-total				10,862,922
Total cost (includes 25% additional)				**13,578,652**

Table H-7 Ocumare del Tuy Sewer Network Cost Estimate

	unit	quantity	unit cost $	cost
Primary Collectors				
S/T/I Class 3 12" pipe	m	4,700	37.38	175,686
S/T/I Class 3 15" pipe	m	6,600	39.19	258,654
S/T/I Class 3 18" pipe	m	18,300	51.52	942,816
S/T/I Class 3 21" pipe	m	3,600	73.69	265,284
S/T/I Class 3 24" pipe	m	2,800	85.43	239,204
S/T/I Class 3 36" pipe	m	1,250	162.77	203,463
S/T/I Class 3 42" pipe	m	3,300	196.63	648,879
length of primary sewers	m	40,550		
Secondary Collectors				
S/T/I Class 2 18" pipe	m	181,290	43.1	7,813,599
sub-total				10,547,585
total cost (includes 25% additional)				**13,184,481**

(2) Operation and Maintenance Costs

The number of staff required was calculated by comparing the numbers of staff necessary to man similar plants in Japan and the United States and adjusted to local conditions. Pay rates are adjusted to include bonus, social security payments and government duties.

Electricity charges in Venezuela vary from area to area. The rates used are those for Miranda State. The method for calculating electricity charges is that the users pay for the electricity consumed (kWh) plus what they have contracted to use (kW).

The cost of general operation is based on the cost other treatment plants in Venezuela pay for similar services.

Table H-89/1 Ocumare del Tuy STP Labor Costs

	unit	qty	unit cost	cost
superintendent	day	1	8.51	40
assistant superintendent	day	1	5.32	25
operators	day	4	4.26	80
assistants	day	7	3.62	119
others, watchmen, caretaker	day	2	3.62	34
sub total $/day				297
total/year				71,368

Table H-8/2 Ocumare del Tuy STP Electricity Costs

	number in operation	kW	Operation hr./day	cost $
Pumps				
vertical	4	75	9.4	76,084
vertical volute	2	22	9.4	14,155
vertical volute	2	45	9.4	28,954
sludge	2	2.2	3	860
miscellaneous power requirements		10	7.5	4,204
sub total (cost /year)				124,257
total/year				144,759

Table H-8/3 General Operation

	frequency	cost	cost $
sludge disposal	once a week	51.9	2,700
equipment maintenance	periodically		40,000
testing	daily	20	7,300
miscellaneous			7,000
sub total			57000
labor + electricity + general operations			273,127
total O&M/year (includes 25% additional)			341,409

3.5 Construction of Las Tejerías Sewerage System

3.5.1 Construction Plan

(1) Sewage Treatment Plant (STP)

The layout of the Las Tejerías STP is shown in Figure H-9. The proposed site is on the right bank of the Tuy River, and similar to Ocumare del Tuy the site is low and susceptible to flooding. The topography is flat sloping gently to the east. There is good access to the site and only tall thick grasses that need to be cleared before works can begin.

According to the soil investigation the site consists of layers of alluvial soils. It also recommends to place the structures on a 0.5 m layer of structural backfill, and that the foundations be placed at least 1.0 m below the existing surface level.

The structures are relatively light having their foundations at a maximum 2.0 m below (above the water table) the surface and construction is proposed to be cast-in-place concrete and is not expected to be difficult. The main pump station, however, is proposed to have a level of approximately 6.0 m below the surface (below the ground water level). It will therefore be necessary to undertake dewatering activities during its construction.

Foreign expertise will be necessary to supervise the installation and initial operation and testing of the process equipment as much of the equipment is new to Venezuela.

(2) Sewer Network

The length of primary sewers is 13,800 meters and secondary sewers cover 47,800 meters.

Soil investigations and geological maps indicate that the soils are alluvial (i.e. silty gravels, clayey gravels, silty sands, and clayey sands). It is assumed that, generally, the sewer pipe could be placed directly onto the prepared trench base without granular bedding, if undesirable material such as rock or organic material is not encountered.

The extent of the proposed sewer network in Las Tejerías is less than that proposed for Ocumare del Tuy. For the Las Tejerías sewer network it has been estimated that it will take three teams of 42 workers 2 years to install approximately 65,000 m of 18" rubber jointed sewer pipe (i.e. setting out, pavement removal, excavation, pipe installation, backfilling, and pavement reinstatement), assuming 200 days per year are available for works. These calculations do not include support staff. Three years have been allowed for in the implementation schedule to take into account the detailed design, tendering and procurement stages.

Though, Las Tejerías is an established city the streets are generally wide and sufficient space exists for construction works. The grade of the terrain is steep in places and this expected to increase the difficulty in installing the sewer.

(3) Implementation Schedule

Because of the similarity of the systems, construction of the Las Tejerías sewerage system is similar to that of the Ocumare del Tuy system (see Figure H-3 Implementation Schedule).

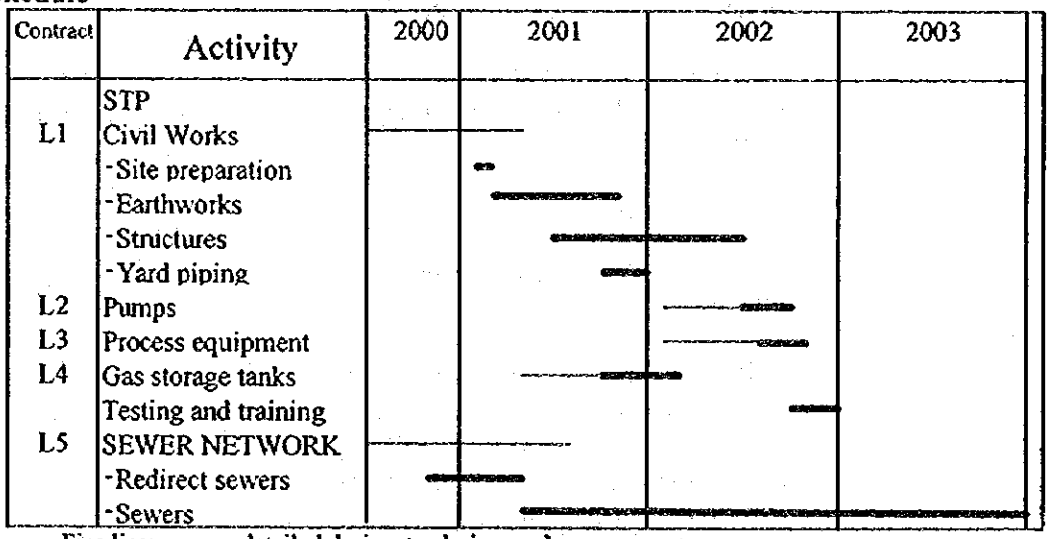
(i) Detailed design, tendering and procurement

(ii) Begin construction of the STP

(iii) Repair and redirect existing sewers in the vicinity of proposed STP.

(iv) Install remaining primary and secondary sewers

Figure H- 3 Las Tejerías Sewerage System Implementation Schedule



Fine line: detailed design, tendering, and procurement.
Coarse line: represents supply/construction

3.5.2 Cost Estimate

(1) Initial Cost

Cost estimates have been prepared for the STP based on the preliminary design completed during the feasibility study.

All labor and construction materials such as concrete, reinforcing steel, concrete pipe and steel pipe are manufactured in Venezuela, it is however necessary to import the pumps and STP process equipment. International

prices for such equipment are high and there influence on the overall cost estimate is large. Moreover, import tariffs of 15% to 20% add substantially to the overall cost.

Concerning the sewer network, sewer pipe unit costs include the supply, transport and installation (S/T/I) of sewer pipeline. Also included are the cost to excavate, backfill and remove excess soil as well as the cost to install pits at intervals of between 100 and 50 meters, depending on the pipe diameter.

Table H-9 Las Tejerías STP Cost Estimate

	unit	qty	unit cost $	cost $
Acquisition of land	ha	10	106,400	1,064,000
Site Preparation				
stripping and stockpiling of topsoil	m^3	12,000	1.32	15,840
disposal of vegetation	ton	9,000	1.71	15,390
setting out site	ha	6	1,161.00	6,966
Earthwork				
grading of site	m^3	2,000	1.31	2,620
excavation to subgrade of foundations	m^3	21,100	2.95	62,245
excavation of sludge drying lagoons	m^3	3,720	3.19	11,867
fill and compaction of embankments	m^3	5,200	4.54	23,608
removal of excess soil	ton	33,300	1.71	56,943
soil cement	m^3	3,400	5.68	19,312
Roadwork				
asphalt paved	m	630	47.72	30,064
unpaved	m	900	27.02	24,318
Structures				
geotextile	m^2	10,600	3.63	38,478
gravel base	m^3	5,300	22.52	119,356
lean concrete layer	m^2	10,600	3.72	39,432
supply and placement of concrete includes formwork and reinforcing	m^3	6,400	200.00	1,280,000
impermeable lining	m^2	14,400	4.67	67,248
administration and maintenance buildings	m^2	400	300.00	120,000
Yard Piping				
lined ductile pipe dia. = 500 mm	m	400	235.70	94,280
lined ductile pipe dia. = 350 mm	m	721	140.60	101,373
valves, telescoping, eccentric, sluice, etc.	m	24	5,000.00	120,000

Table H-10 continued

Supply and Installation of Pumps				
0.403 cumecs x 30kW (vertical)	units	3	121,822	365,467
0.116 cumecs x 11kW (vert. volute)	units	3	62,911	188,733
0.232 cumecs x 18.5kW(vert. volute)	units	3	84,687	254,600
0.023 cumecs x 1.5kW (sludge)	units	4	19,250	77,000
Filters				
riverbed gravel	m^3	5,520	29.24	161,405
drainage blocks	m^2	3,330	20.00	66,600
Process Equipment				
screens	units	2	20,000	40,000
Sludge collectors				
primary settling	units	12	22,000	264,000
final settling	units	12	26,000	312,000
Rotary Distributors				
1st step	set	2	43,000	86,000
2nd step	set	2	46,000	92,000
gravity thickeners	set	4	43,000	172,000
gas mixing equipment	set	4	77,000	308,000
incinerator	facility	1	75,000	75,000
chlorination	facility	1	30,000	30,000
Gas Storage				
steel gas storage tanks cap. = 250 m^3	tanks	4	30,000	120,000
Operation and Maintenance Equipment				
tractor/ front-end loader	unit	1	150,000	150,000
dump truck $9m^3$	unit	1	133,000	133,000
pick-up	unit	1	22,000	22,000
				6,231,144
total (includes 25% additional)				7,788,930

Table H-10 Las Tejerías Sewer Network Cost Estimate

	unit	quantity	unit cost $	cost $
Primary Collectors				
S/T/I Class 2 8" pipe	m	1,350	21.36	28,836
S/T/I Class 3 12" pipe	m	5,600	37.38	209,328
S/T/I Class 3 18" pipe	m	2,620	51.52	134,982
S/T/I Class 3 21" pipe	m	1,450	73.69	106,851
S/T/I Class 3 24" pipe	m	1,390	85.43	118,748
S/T/I Class 3 33" pipe	m	1,390	147.27	204,705
length of primary sewers		13,800		
Secondary Collectors				
S/T/D Class 2 18" pipe	m	47,800	43.10	2,060,180
primary + secondary				2,863,630
total (including 25% additional)				3,579,537

(2) Operation and Maintenance Costs

The number of staff required was calculated by comparing the numbers of staff necessary to man similar plants in Japan and the United States and adjusted to local conditions. Pay rates are adjusted to include bonus, social security payments and government duties.

Electricity charges in Venezuela vary from area to area. The rates used are those for Miranda State. The method for calculating electricity charges is that the users pay for the electricity consumed (kWh) plus what they have contracted to use (kW).

The cost of general operation is based on the cost other treatment plants in Venezuela pay for similar services.

Table H-11/1 Las Tejerías STP Labor Costs

	unit	qty	unit cost	cost $
superintendent	day	1	4000	39.91
assistant superintendent	day	1	2500	24.95
operators	day	4	2000	79.83
assistants	day	5	1700	84.82
others, watchman, caretaker	day	2	1700	33.93
sub total/day				263.44
sub total/year (240 days/year)				63,226

Table H-11/2 Las Tejerías STP Electricity Costs

	pumps in operation	kW	Operation hr./day	cost $
vertical	2	30	10.88	21,058
vertical volute	2	11	10.88	7,721
vertical volute	2	18.5	10.88	12,968
sludge	2	1.5	3	586
miscellaneous power supply		10	8	5,093
				47,444
sub total /year				55,273

Table H-11/3 Las Tejerías STP General Operation Costs

	frequency	cost	cost $
sludge disposal	once every 2 weeks	72.7	1890
equipment maintenance	periodically		25000
testing	daily	14	5110
miscellaneous			5000
sub total /year			37000
labor + electricity + general operation			155,498
total/year (incl. 25 % additional)			194,373

3.6 Reforestation of Priority Areas

3.6.1 Construction Plan

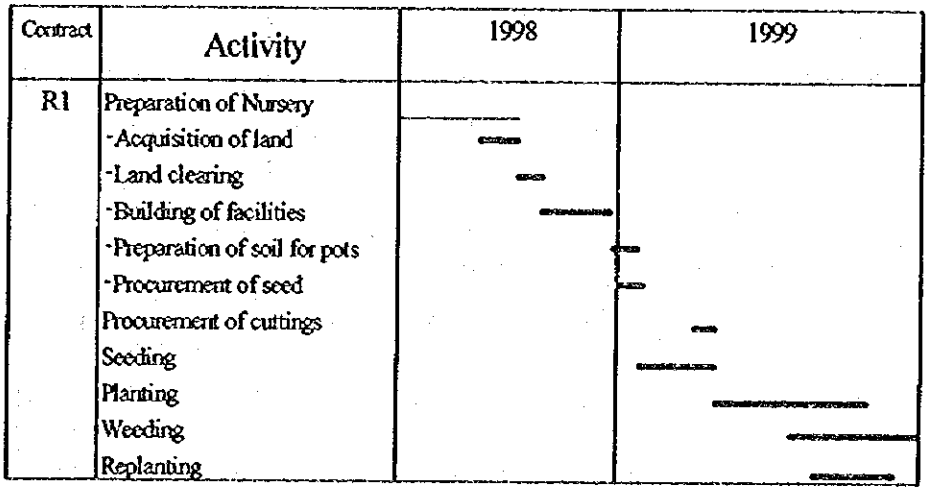
The 1.3 hectare tree nursery is planned to be situated on the same site as the proposed Las Tejerías sewage treatment plant. The construction of the nursery consists of the construction of planting beds, associated structures, roads, and irrigation system The planting beds are to be surrounded by a low, 0.2 meter wall constructed of concrete blocks sitting on sand bedding.

Details of the irrigation system:

Tank:	10 m³ elevated steel tank
Supply and distribution:	37.5 mm and 25 mm PVC pipe (700 meters)
Pump:	15 meter, 40 l/min

Preliminary works are expected to begin in early 1998 and the construction of the nursery is planned to be completed around the beginning of 1999. Reforestation works are to begin immediately at the beginning of 1999 and continue until the end of 2003 in the two areas, Palo Negro and Quebrada Santa Maria, see Figure H-4/1.

Figure H-4 Reforestation Activities Implementation Schedule



Fine line: detailed design, tendering, and procurement.
Coarse line: represents supply/construction

Unit cost data for the construction of the nursery was obtained from published data and from data from contractors. Cost data for the planting activities was obtained from discussions with forestry experts belonging to the Tuy River Basin Agency working in the Upper Tuy Los Teques office. The cost of land acquisition has been included in the cost estimate for the Las Tejerías sewage treatment plant. However, the nursery is planned to be constructed before the STP plant so the acquisition is included in the nursery implementation schedule (see Figure H-4).

Table H-12 Tree Nursery Cost Estimate

item	unit	qty	unit cost $	cost $
Site Preparation				
stripping and stockpiling of topsoil	m^3	2,500	1.32	3,300
excavation	m^3	1,300	1.56	2,028
backfilling and compacting	m^3	860	4.54	3,904
Roadwork				
unpaved 4.0 m wide road	m	500	27.02	13,510
Buildings	m^2	300	320	96,000
Irrigation system				
pump: 0.4 kW x 0.1 m^3/min	units	1	2,000	2,000
37.5 mm PVC pipe	m	400	4.50	1,800
25 mm PVC pipe	m	300	3.50	1,050
elevated tank 10 m^3				
tank	kg	1,280	1.90	2,432
elevated stand 4.2 m	kg	2,267	1.13	2,562
plumbing			1,000	1,000
Nursery beds				
sand bedding	m^3	440	19.80	8,712
concrete block frames	m^2	1,960	7.10	13,916
				152,214
sub total (including 25% additional)				190,268

Table H-13 Reforestation Activities Costs

	unit	qty	unit cost	total
Qda. Santa Maria				
forest road	km	0.8	5,314	4,251
fire resistant trees	ha	140	703	98,420
mixed planting	ha	2535.2	721	1,827,879
clearing	ha	2675.2	187	500,797
sub total				2,431,348
Palo Negro				
forest road	km	4	5,314	21,256
fire resistant trees	ha	170	703	119,510
mixed planting	ha	637.3	721	459,493
clearing	ha	666.9	187	124,844
sub total				725,103

Total (nursery + activities) = $ 190,268 + $2,431,348 + $725,103 = **$3,346,719**

This translates into a cost of **$1,001** per hectare.

3.7 Institutional Measures

3.7.1 Establishment of Monitoring System

The continuous monitoring systems are planned to be attached to existing bridges over the Tuy River. A small building containing recording and processing equipment is to be built adjacent to the bridge. The sites selected for the continuous monitoring stations are a bridge near the confluence of the Cagua and Tuy rivers (Boca de Cagua) and on the bridge crossing the Tuy in Ocumare del Tuy. Cost estimate data was obtained from suppliers of monitoring equipment and materials. No equipment manufacturers exist in Venezuela so all the equipment contained in the following cost estimates has to be imported.

Operation and maintenance costs were obtained from data from the existing central laboratory in Caracas.

Table H-14 Continuous Monitoring Station Cost Estimate

	Unit	Qty	Unit cost ($)	Cost ($)
Equipment Cabinet for sensing equipment Sensors pH, EC, DO, turbidity temp., Water level, Operation Manual Recording device Climitization system Voltage regulator (dimension 1860 x 830 x 610 mm, 220 AC 1kW, weight 200 kg)	set	2	33,400	66,800
Pump	unit	2	3,850	7,700
Installation	global	2	1,650	3,300
Calibration		2	2,200	4,400
Building 4 m x 2.5 m	m²	20	260	5,200
Additional civil works		2	5,000	10,000
Computer				
Desk top	unit	1	3,300	3,300
Modem	unit	1	550	550
Telephone				
Line	km	7	6,500	45,500
Connect electricity to site	km	2	9,400	18,800
4WD	unit	1	27,500	27,500
Training	day	10	300	3,000
sub-total				196,050
Total (25% additional)				245,063

H-15 Field Measurement Equipment Costs

Equipment	Unit	Quantity	Unit cost($)	Cost ($)
Current meter	Set	2	4,000	8000
EC meter	Set	1	2,000	2000
pH meter	Set	1	2,000	2000
DO meter	Set	1	2,000	2000
Turbidity meter	Set	2	4,500	9000
Simple water analyzer	Set	1	10,000	10000
Sub-total				33000
Total (25% additional)				41,250

H-16 Central Laboratory Equipment Costs

Equipment	Unit	Quantity	Unit cost($)	Cost ($)
TOC analyzer	unit	1	30,000	30,000
AA spectrometer	unit	1	110,000	110,000
ISE (10 electrodes)	set	1	9,000	9,000
Spectrophotometer (UV-visible)	unit	1	17,000	17,000
Refrigerator	unit	2	3,000	6,000
Freezer	unit	1	5,000	5,000
Water distillation apparatus	unit	2	2,500	5,000
BOD gauge	unit	3	4,500	13,500
Incubator (BOD)	unit	2	5,000	10,000
Incubator (37 C)	unit	2	5,000	10,000
Chemical balance (0.1 mg - 200 g)	unit	2	2,000	4,000
Chemical balance (0.01 mg - 45 g)	unit	2	4,000	8,000
Concentrator	unit	2	5,000	10,000
Autoclave	unit	2	4,000	8,000
Ultrasonic bath	unit	2	2,500	5,000
Distillation unit	unit	2	1,500	3,000
Water filtering set	set	5	800	4,000
Sub-total				257,500
Total (includes 25% additional)				321,875

Total Initial Cost of Monitoring System

= Continuous System + Field Equipment + Laboratory Equipment

= $245,063 + $41,250 + $321,875

= **$608,188**

H-17/1 Monitoring System Personnel Costs

	Salary/ month ($)	Number	Cost/year ($)
Engineer	500	1	6,000
Technician	400	1	4,800
Operator	400	1	4,800
Total/year ($)			15,600

H-17/2 Monitoring System Material Costs

	Cost/year ($)
Reagent	18,000
Gas (acetylene, nitrogen, etc.)	8,000
Glass ware	4,000
Lamp for AA	2,000
Electrodes	1,500
Others	7,000
Electricity	16,000
Telephone	3,500
Total	60,000

Total operation cost per year = personnel costs + material costs
=$15,600 + $60,000
=**$75,600**

3.7.2 Establishment of Environmental Fund

Cost data for staff was obtained from government bodies undertaking similar works in Venezuela. Rental costs are current market prices for office space in the central business area of Caracas as advertised in local newspapers.

Table H-18 Environmental Fund Executing Unit Personnel Cost

Organization	Personnel	Number	Annual Cost (US$)
Environmental Fund Operation Unit	General Manager	1	10,200
	Assistant Manager	1	6,000
	Secretary	1	3,600
	Clerk	1	2,500
	Driver	1	3,000
	sub total	5	25,300
Environmental Fund Head Office	Manager	1	10,200
	Assistant Manager	1	6,000
	Secretary	1	3,600
	Lawyer	1	7,000
	Accountants	2	14,000
	Clerk	1	2,500
	Driver	1	3,000
	sub total	8	46,300
Total			114,300

Table H-19 Environmental Fund Office Rental Cost

Organization	Rent/m²/month	Floor Area (m²)	Annual Rent (US$)
Environmental Fund Operation Unit	8	100	9,600
Environmental Fund Head Office	8	150	14,400
Total			24,000

Personnel + Rental = 71,600 + 24,000 + 25% (additional costs)

= **US$119,500/year**

Table H-20 Environmental Fund Executing Unit Equipment Cost

Organization	Equipment	Quantity	Cost (US$)
Environmental Fund Operation Unit	Vehicle (4WD with A/C)	1	28,000
	Copying machine	1	4,000
	Computer/printer	1	3,500
Environmental Fund Head Office	Vehicle (sedan with A/C)	1	19,000
	Computer/printer	1	3,500
	Copying machine	1	4,000
Total			62,000

Initial + Additional costs = 62,000 + 138,000 = **US$200,000**

3.7.3 Establishment of Public Education System

Table H-21 Public Education Program Personnel Cost

Personnel	Quantity	Cost (US$)/year
Sociologist	1	8,000
Social worker	1	6,000
Graphic designer	1	4,000
Logistic support	set	2,000
Training abroad	3 months	20,000
Total		**40,000/year**

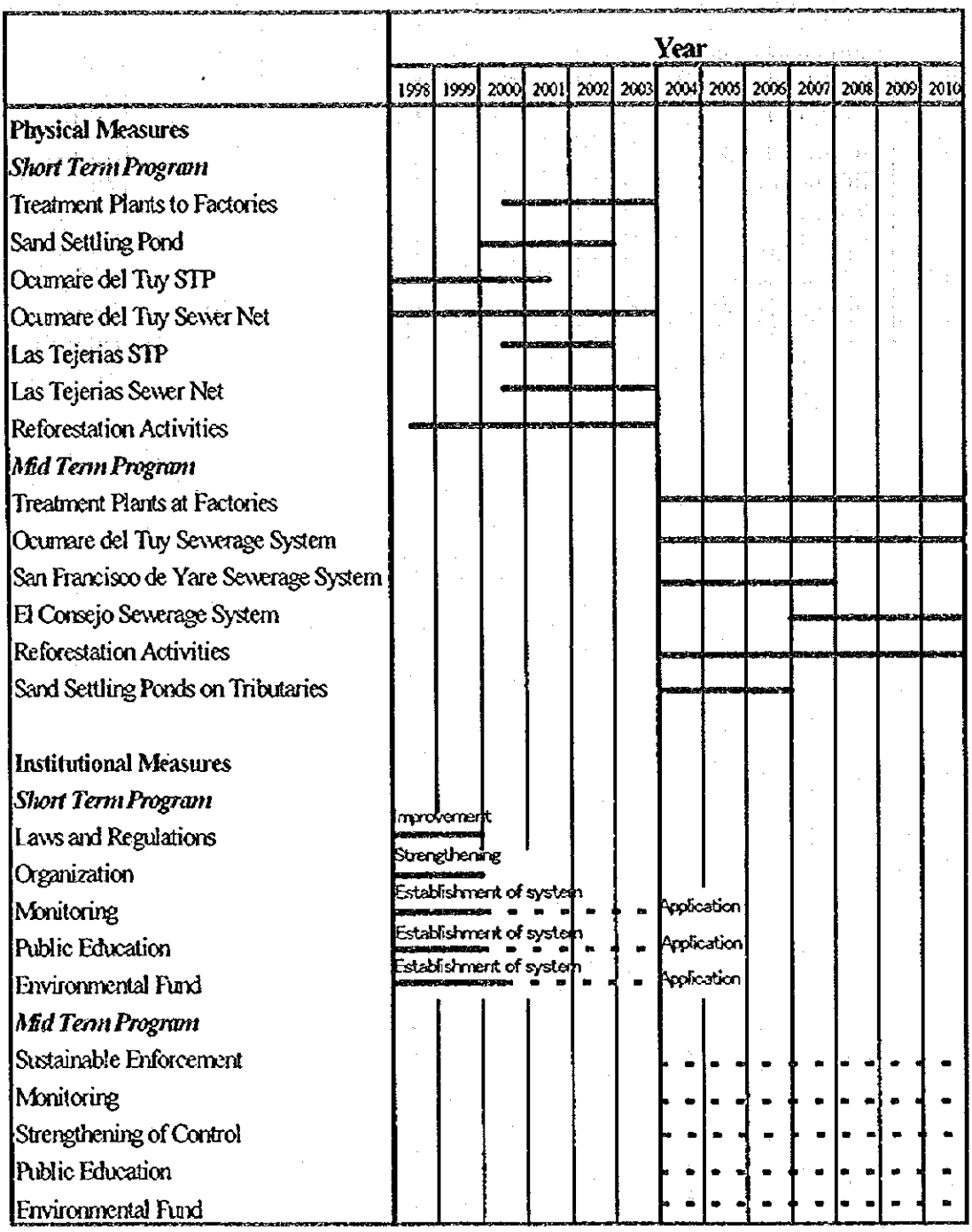
Table H-22 Public Education Program Equipment Cost

Equipment	Quantity	Cost (US$)
Vehicle	1	30,000
Computer/printer	2	7,000
Portable computer/printer	1	4,000
Copy machine	1	4,000
Overhead projector	1	1,000
Slide projector	1	800
VCR	1	700
Color TV	1	700
Video camera	1	1,500
Photographic camera	1	300
Total		50,000

3.8 Overall Projects

3.8.1 Project Implementation Plan

Figure H-5 Implementation Schedule for Feasibility Schedule



3.8.2 Cost Estimation

Table H-23 Feasibility Study Cost Estimates (Unit: US$ 1,000s)

Stage	Category	Target	Measures	Initial cost	O&M cost	Annual cost*
Short term	Physical measures	Water quantity	Lessening color/odor			
			Lessening turbidity	6,245	17	
			(Sub-total)			
		Water quality	Treatment for existing factories			
			Treatment for newly constructed factories			
			Treatment of domestic wastewater (Ocumare del Tuy)	13,578	341	
			Sewer network (Ocumare del Tuy)	13,184		
			Treatment of domestic wastewater (Las Tejerias)	7,788	268	
			Sewer network (Las Tejerias)	3,579		
			Lessening turbidity (reforestation)	3,346		
			(Sub-total)			
	Institutional measures		Monitoring	608	75	
			Public education	50	40	
			Environmental fund	200	120	
			(Sub-total)			
	Total					
Mid term	Physical measures	Water quality and quantity	Treatment of newly constructed factories			
			Treatment of domestic wastewater (S. F. de Yare)	10,300	343	
			Sewer Network (S. F. de Yare)	3,800		
			Treatment of domestic wastewater (El Consejo)	10,000	300	
			Sewer Network (El Consejo)	3,100		
			Treatment of domestic wastewater (Ocumare del Tuy)	4,914	172	
			Lessening turbidity (reforestation)			
			Lessening turbidity (sand settling pond)			
			(Sub-total)			
	Institutional measures		Monitoring	0	75	
			Public education	0	40	
			Environmental fund	0	114	
			(Sub-total)			
	Total					

* Annual Cost = Initial Cost x 0.11 + O&M Cost (0.11 is conversion rate to estimate annual cost applying the project life of 50 years and discount rate of 12%)