

## TABLE OF CONTENTS

	<u>Page</u>
<b>1. INTRODUCTION -----</b>	<b>1</b>
1.1 Background of the Study -----	1
1.2 Objective of the Study -----	1
<b>2. DESCRIPTION OF THE STUDY AREA -----</b>	<b>3</b>
2.1 Natural Condition-----	3
2.2 Socioeconomic Conditions -----	4
2.3 Waterway Transportation System in Orinoco Delta-----	9
<b>3. NATURAL CONDITIONS OF THE ORINOCO RIVER DELTA -----</b>	<b>10</b>
3.1 River Characteristics -----	10
3.2 Coastal Characteristics-----	14
<b>4. FORECAST OF CARGO TRANSPORTATION / SHIP TRAFFIC -----</b>	<b>16</b>
4.1 Methodology -----	16
4.2 Economics and Development Plans-----	16
4.3 Ports in the Study Area -----	17
4.4 Production and Transportation Situation of Main Enterprises-----	17
4.5 Micro (commodity-wise) Forecast-----	18
4.6 Assumption of Plant Schedule and Cargo Throughput Forecast -----	18
4.7 Ship Traffic Volume Forecast-----	19
<b>5. WATERWAY TRANSPORTATION SYSTEM -----</b>	<b>21</b>
5.1 Existing Waterway Transportation System-----	21
5.2 Existing Ports and Channels-----	23
5.3 Review of New Port Development Plans -----	26
5.4 Future Waterway Transportation System -----	29
<b>6. MASTER PLAN FOR RIVER CHANNEL IMPROVEMENT -----</b>	<b>39</b>
6.1 Basis of Channel Improvement-----	39
6.2 Structural Measures -----	40
6.3 Non-structural Measures-----	42
6.4 Dredging Improvement -----	43
6.5 Institution and Organization Study -----	48
6.6 Environmental Study-----	51
6.7 Economic and Financial Evaluation-----	53
<b>7. PRIORITY PROJECT FOR CHANNEL IMPROVEMENT -----</b>	<b>55</b>
7.1 Priority Reaches for Structural Measure -----	55

7.2	Structural Measure .....	55
7.3	Non-Structural Measures .....	61
7.4	Dredging Improvement .....	64
7.5	Implementing Agency.....	68
7.6	Environmental Impact assessment (EIA).....	69
7.7	Economic and Financial Evaluation.....	72
<b>8.</b>	<b>CONCLUSIONS AND RECOMMENDATIONS .....</b>	<b>75</b>
8.1	Conclusions .....	75
8.2	Recommendations .....	76

### LIST OF TABLES

Table S.3.1	Navigation Potential of 3 Channels.....	13
Table S.4.1	Assumption of Realization Year of Three Stages.....	18
Table S.4.2	Forecast Result of Cargo Throughput .....	19
Table S.4.3	Forecast Result of Ship Traffic Volume.....	19
Table S.5.1	Typical Sizes of Vessels.....	22
Table S.5.2	Possible Alternative Waterway Transportation System.....	30
Table S.5.3	Future Waterway Transportation System in Orinoco Delta.....	31
Table S.5.4	Barge Transportation Facilities.....	35
Table S.5.5	Results of Economic Analysis.....	37
Table S.6.1	Concept of Channel Improvement.....	39
Table S.6.2	Present Dredging Sections.....	40
Table S.6.3	Applicability of Structural Measures.....	41
Table S.6.4	Alternatives of Structural Measures.....	42
Table S.6.5	Particulars of the Dredge Equipment.....	46
Table S.6.6	Economic Cost and Economic Benefit for Alternative B2.....	54
Table S.7.1	Alternatives for B2 Scheme.....	56
Table S.7.2	Project Cost for Structural Measures (Alternative B2-1 & B2-3).....	61
Table S.7.3	Dredging Improvement Cost.....	68
Table S.7.4	The information on the Relating Villages.....	72
Table S.7.5	Economic Evaluation of Structural Measure.....	72
Table S.7.6	Economic Evaluation of Dredging Improvement Plan.....	73

### LIST OF FIGURES

Fig. S-1-1	Study Area.....	2
Fig. S-2-1	Location of the Orinoco River Basin.....	5
Fig. S-4-1	Cargo Throughput Forecast by Industry .....	20
Fig. S-7-1	Results of 2 Dimensional Simulation Analysis.....	59
Fig. S-7-2	Location and Plan View of the Channel Improvement Structure.....	62
Fig. S-7-3	Typical Sections of Channel Improvement Structure.....	63

## **LIST OF REPORTS ON THIS STUDY**

### **Including This Report**

#### **SUMMARY**

Chapter	1	Introduction
Chapter	2	Description of The Study Area
Chapter	3	Natural Conditions of The Orinoco River Delta
Chapter	4	Forecast of Cargo Transportation / Ship Traffic
Chapter	5	Waterway Transportation System
Chapter	6	Master Plan for River Channel Improvement
Chapter	7	Priority Project for Channel Improvement
Chapter	8	Conclusions and Recommendations

#### **MAIN REPORT**

Chapter	1	Introduction
Chapter	2	Description of The Study Area
Chapter	3	Natural Conditions of The Orinoco River Delta
Chapter	4	Forecast of Cargo Transportation / Ship Traffic
Chapter	5	Waterway Transportation System
Chapter	6	Master Plan for River Channel Improvement
Chapter	7	Priority Project for Channel Improvement
Chapter	8	Conclusions and Recommendations

#### **SUPPORTING REPORT**

Chapter	1	Introduction
Chapter	3	Natural Conditions of The Orinoco River Delta
Chapter	4	Forecast of Cargo Transportation / Ship Traffic
Chapter	5	Waterway Transportation System
Chapter	6	Master Plan for River Channel Improvement
Chapter	7	Priority Project for Channel Improvement
Appendix A		Site Survey
Appendix B		Satellite Image Analysis

#### **DATA BOOK**

1	LOCATION MAP
2	GPS NETWORK MAP
3	GPS POINTS DATA
4	GPS POINTS DESCRIPTION
5	PLAN AND CROSS SECTION
6	LONGITUDINAL PROFILE

Note: All the reports are translated into Spanish language and Summary is in Japanese language as well.

## ABBREVIATIONS

CAN	Comunidad Andina de Naciones ( <i>Community of the Andean Nations</i> )
COPLANARH	Comisión Nacional de Planificación y Aprovechamiento de los Recursos Hidráulicos ( <i>National Commission for Planning and Exploitation of Water Resources</i> )
CORDIPLAN	Oficina Central de Coordinación y Planificación, actualmente incluida en el Ministerio de Infraestructura ( <i>Central Bureau of Coordination and Planning, presently included in the Ministry of Infrastructure</i> )
CVG	Corporación Venezolana de Guayana ( <i>Venezuelan Corporation of Guyana</i> )
DGSPOA	Dirección General Sectorial de Planificación y Ordenación del Ambiente, MARN ( <i>General Sectorial Directorate for Environmental Planning and Ordinance, MARN</i> )
DG-PROA	Dirección General Sectorial Programa Orinoco-Apure, MARN ( <i>General Sectorial Directorate for the Orinoco-Apure Program, MARN</i> )
FLASA	Fundación La Salle de Ciencias Naturales ( <i>La Salle Foundation for Natural Sciences</i> )
FMO	Ferrominera del Orinoco C.A., CVG ( <i>Ferromining of Orinoco C. A., CVG</i> )
FUNVISIS	Fundación Venezolana de Investigación Sísmica ( <i>Venezuelan Foundation for Seismic Research</i> )
INC	Instituto Nacional de Canalizaciones, MTC ( <i>National Institute of Canalization, MTC</i> )
INTEVEP	Centro de Investigación y Apoyo Tecnológico de Petróleo de Venezuela, PDVSA      Petróleos de Venezuela ( <i>Research Center and Technology Support for Venezuelan Oil, PDVSA</i> )
IVSS	Instituto Venezolano del Seguro Social ( <i>Venezuelan Institute for Social Security</i> )
JICA	Agencia de Cooperación Internacional de Japón ( <i>Japan International Cooperation Agency</i> )
LNH	Fundación Laboratorio Nacional Hidráulico, INC-MTC ( <i>Foundation for the National Hydraulics Laboratory, INC-MTC</i> )
LOA	Ley Orgánica del Ambiente ( <i>Organic Law of the Environment</i> )

LOAC	Ley Orgánica de la Administración Central ( <i>Organic Law of the Central Administration</i> )
LOOT	Ley Orgánica para la Ordenación del Territorio ( <i>Organic Law for Land Use and Management</i> )
MARN	Ministerio del Ambiente y Recursos Naturales (anteriormente MARNR) ( <i>Ministry of the Environment and Natural Resources (previously MARNR)</i> )
MINFRA	Ministerio de Infraestructura (incluye el Ministerio de Transporte y Comunicaciones, MTC y el Ministerio de Desarrollo Urbano, MINDUR) ( <i>Ministry of Infrastructure (includes the Ministry of Transportation and Communications, MTC and the Ministry of Urban Development, MINDUR)</i> )
MOP	Ministerio de Obras Públicas ( <i>Ministry of Public Works</i> )
MPyC	Ministerio de la Producción y del Comercio (incluye Ministerio de Industria y Comercio y Ministerio de Agricultura y Cría) ( <i>Ministry of Production and Commerce (includes Ministry of Industry and Commerce and Ministry of Agriculture and Livestock)</i> )
MPyD	Ministerio de Planificación y Desarrollo ( <i>Ministry of Planning and Development</i> )
MRE	Ministerio de Relaciones Exteriores ( <i>Ministry of Foreign Affairs</i> )
OCEI	Oficina Central de Estadística e Informática ( <i>Central Bureau of Statistics and Information</i> )
ODEPRI	Dirección General Sectorial de Desarrollo Profesional y Relaciones Internacionales, MARN ( <i>General Sectorial Directorate of Professional Development and International Affairs, MARN</i> )
OMC	Orinoco Mining Company
PIB	Producto Interno Bruto ( <i>Gross Domestic Product</i> )
PCI	Pacific Consultants International
PDVSA	Petróleo de Venezuela S.A. ( <i>Venezuelan Oil, S. A.</i> )
PNOT	Plan Nacional de Ordenación del Territorio ( <i>National Plan for Land Use and Management</i> )

PROFAUNA	Servicio Autónomo de Protección, Restauración, Fomento y Aprovechamiento de la Fauna Silvestre y Acuática del País, MARN <i>(Autonomous Service for the Protection, Renovation, Promotion and Exploitation of the Country's Wildlife and Aquatic Fauna, MARN)</i>
SAGECAN	Servicio Autónomo de Geografía y Cartografía Nacional, MARN <i>(Autonomous Service for National Geography and Cartography, MARN)</i>
SENIAT	Servicio Nacional Integrado de Administración Tributaria <i>(National Integrated System for Tax Administration)</i>
SIDOR	Siderúrgica del Orinoco <i>(Iron and Steel Industry of Orinoco)</i>
TEM	Títulos de Estabilización Monetaria <i>(Credits for Monetary Stabilization)</i>
UCV	Universidad Central de Venezuela <i>(Central University of Venezuela)</i>
UDO	Universidad de Oriente <i>(Eastern University)</i>
USB	Universidad Simón Bolívar <i>(Simon Bolivar University)</i>
1 mile	1.852 km