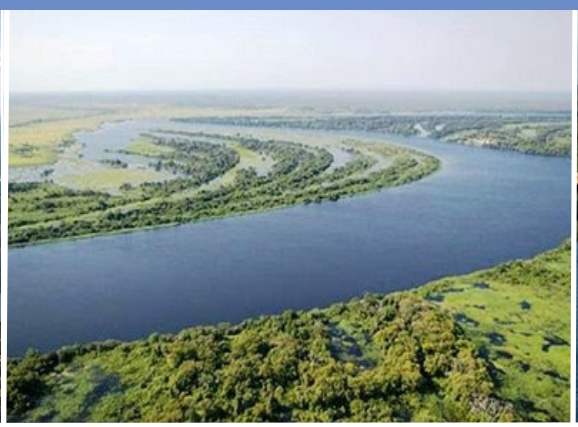
Ministério dos Transportes

PHE

Plano Hidroviário Estratégico

Inland Waterways Strategic Plan



Produto 3 - Relatório de Diagnóstico e Avaliação

Product 3 - Assessment and Diagnosis Report

Chapters 3.8 to 4

2013

Consórcio

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ACRONYMS

AES - AES Eletropaulo

AHIMOC- Administração das Hidrovias da Amazônia Ocidental

AHIMOR – Administração das Hidrovias da Amazônia Oriental

AHINOR – Administração das Hidrovias do Nordeste

AHIPAR – Administração da Hidrovia do Paraguai

AHRANA – Administração da Hidrovia do Paraná

AHSFRA – Administração das Hidrovias do São Francisco

AHSUL – Administração das Hidrovias do Sul

ANA – Agência nacional de Aguas

ANEEL - Agência Nacional de Energia Elétrica

ANTAQ - Agencia Nacional de Transportes Aquaviários

ANTT - Agência Nacional de Transportes Terrestres

ANVISA - Agência Nacional de Vigilância Sanitária

ARCON - Agência de Regulação e Controle de Serviços Públicos do Estado do Pará

BNDES - Banco Nacional de Desenvolvimento Econômico e Social

CAP - Conselho de Autoridade Portuária

CBH - Comitês das Bacias Hidrográficas

CDP - Companhia Docas do Pará

CEHIDRO - Conselho Estadual de Recursos Hídricos

CEMIG - Companhia Energética de Minas Gerais

CENAT - Comissão Executiva para a Navegação do Tietê-Paraná

CENTRAN - Centro de Excelência em Engenharia de Transportes

CERH - Conselho Estadual de Recursos Hídricos

CESP - Companhia Energética de São Paulo

CETESB - Companhia de Tecnologia de Saneamento Ambiental

CF – Constituição Federal

CGTMO - Coordenação Geral de Transportes, Mineração e Obras Civis

CHESF - Companhia Hidroelétrica do São Francisco

CIH - Comitê Intergovernamental da Hidrovia Paraguai-Paraná

CNA - Confederação da Agricultura e Pecuária do Brasil

CNRH - Conselho Nacional de Recursos Hídricos

CODESP - Companhia Docas do Estado de São Paulo

CODESUL - Conselho de Desenvolvimento e Integração do Sul

CODEVASF - Companhia de Desenvolvimento dos Vales do São Francisco e do Parnaíba

CODOMAR – Companhia Docas do Maranhão

CONAMA – Conselho Nacional de Meio Ambiente

CONAPORTOS - Comissão Nacional das Autoridades nos Portos

CONERH - Conselho Estadual de Recursos Hídricos

CONSETRANS - Conselho Nacional de Secretários de Transportes

COPPE - Coordenação de Programas e Projetos Estratégicos

CPAOR - Capitania dos Portos da Amazônia Oriental

CPH - Companhia de Portos e Hidrovias do Estado do Pará

DAQ – Departamento Aquaviário

DH - Departamento Hidroviário

DILIC - Despacho do Diretor da Diretoria de Licenciamento Ambiental

DNIT - Departamento Nacional de Infraestrutura de Transportes

DNIT – Departamento Nacional de Infraestrutura de Transportes

DNPM - Departamento Nacional de Produção Mineral

EAS - Estudos Ambientais Simplificados

EIA/RIMA - Estudo de Impacto Ambiental/ Relatório de Impacto Ambiental

EMAP - Empresa Maranhense de Administração Portuária

EPE - Empresa de Pesquisa Energética

EPL - Empresa de Planejamento e Logística

EVTEA - Estudo de Viabilidade Técnica Econômica e Ambiental

FONPLATA – Fundo Financeiro para o Desenvolvimento da Bacia do Prata

FUNAI - Fundação Nacional do Índio

GEOUT - Gerência de Outorga

IBAMA - Instituto Brasileiro do Meio Ambiente

ICMBio – Instituto Chico Mendes de Biodiversidade

IIRSA - Iniciativa para a Integração da Infraestrutura Regional Sul-americana

INCRA - Instituto Nacional de Colonização e Reforma Agrária

INPH – Instituto Nacional de Pesquisas Hidroviárias

IPHAN - Instituto do Patrimônio Histórico e Artístico Nacional

LI – Licença de Instalação

LO – Licença de Operação

LP - Licença Prévia

MD - Ministério da Defesa

MDA - Ministério do Desenvolvimento Agrário

MDL – Mecanismos de Desenvolvimento Limpo

MERCOSUL – Mercado Comum do Sul

MI - Ministério da Integração Nacional

MINC – Ministério da Cultura

MJ – Ministério da Justiça

MMA - Ministério do Meio Ambiente

MPA - Ministério da Pesca e Agricultura

MPF - Ministério Público Federal

MPF - Ministério Público Federal

MRE - Ministério das Relações Exteriores

MS – Ministério da Saúde

MT - Ministério dos Transportes

ONG's – Organizações Não Governamentais

ONS - Operador Nacional do Sistema Elétrico

PBA - Plano Básico Ambiental

PEI - Planos de Emergência Individual

PHE – Plano Hidroviário Estratégico

PNLT - Plano Nacional de Logística e Transportes

PNMA - Política Nacional de Meio Ambiente

PR – Presidente de Republica

RAP – Relatórios Ambientais Preliminares

SEP - Secretaria Especial de Portos

SFAT - Secretaria de Fomento para Ações de Transportes

SISNAMA - Sistema Nacional do Meio Ambiente

SNGRH - Sistema Nacional de Gerenciamento de Recursos Hídricos

SNPH – Superintendência Estadual de Navegação, Portos e Hidrovias

SNRH - Sistema Nacional de Recursos Hídricos

SOPH - Sociedade de Portos e Hidrovias do Estado de Rondônia

SRF – Secretaria da Receita Federal

STF – Supremo Tribunal Federal

TCU – Tribunal de contas da União

TR - Termo de Referência

TUP – Terminal de Uso Privativo

UC - Unidade de Conservação

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3.8 PARNAÍBA WATERWAY SYSTEM

3.8.1 Physical system of the river and environmental and social aspects

Parnaíba waterway system comprises the Parnaíba River basin's territory – located in between the states of Maranhão, Piauí and Ceará, in Brazil's northeastern region – its borders penetrate the Caatinga (53%) and Cerrado (47%) biomes.

The Parnaíba and das Balsas Rivers present poor navigation conditions. They are located in a region with intense erosion and sedimentation processes, which result in generalized aggradation problems and shallow waters along these rivers. In the upstream sections of both rivers are presented several rapids and rock outcrops, restricting navigation. Several sections of these rivers are shallow waters.

The Boa Esperança hydroelectric plant, the only plant built in this waterway system, does not have operating locks, blocking the passage of vessels through this HPP. The main characteristics in terms of physical conditions and navigability of the waterways that compose the Parnaíba waterway system can be seen in the following Linear Diagram diagram.

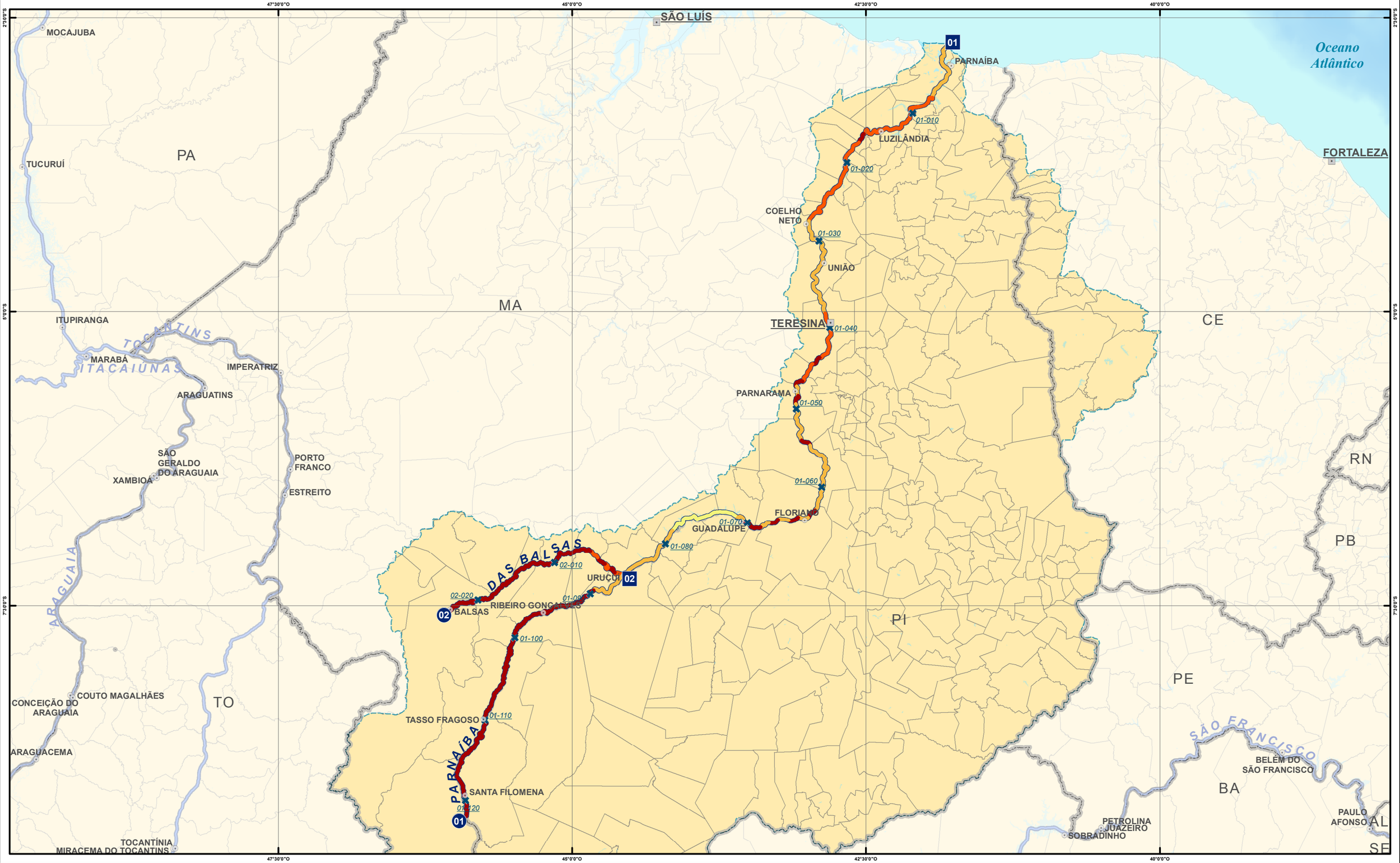
The analyses and studies carried out to characterize the physical, social and environmental conditions of potential waterways in the Parnaíba waterway system followed the methodologies introduced in Chapter 1 – item 1.3 – Methodology of this report.

Due to the vast amount of information collected and analyzed, this chapter presents a summary of the main results and conclusions for each river studied.

The CD annexed to this report (Step C: Assessment and Diagnosis) contains a table in the .xls format that present in a more detailed way all the variables and information analysed for each river and each section studied.

The Linear Diagrams in this chapter summarize the mentioned table, following the methodologies exposed in chapter 1, item 1.3 of this report.

As the result of the final step of the Strategic Waterway Plan (Step F: Preparation of the final strategic plan) a Georeferenced Database is presented, which contains all the existing information in the table of the CD annexed to this report.



CONVENÇÕES CARTOGRÁFICAS

Referências Locacionais

- Capital Federal
- Capital Estadual
- Sede Municipal
- Limite político adm.
- Limite municipal
- Massa d'água

- X Jusante
- X Montante

- 01 01 Rio Parnaíba
- 02 02 Rio das Balsas

- Bacias do SH Parnaíba
- Trechos de 10 km (xx-yyy)
- xx: n° do rio
- yyy: n° do trecho
- km = yyy * 10

Escala de ponderação dos temas

1 - 5 (baixa - alta)

- IN - Insignificante
- BA - Baixa
- ME - Média
- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

N W E S

ESCALA GRÁFICA

0 25 50 100 km

SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA

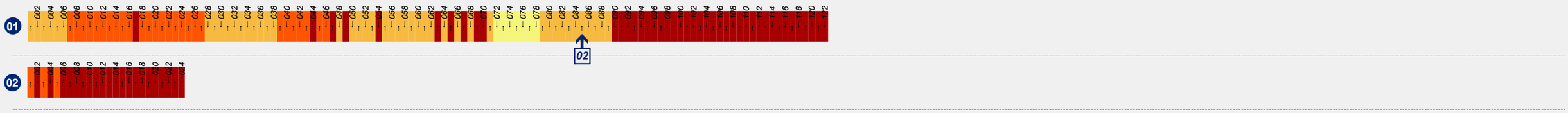
MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGNÓSTICO DE NAVEGABILIDADE

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS Logos	1:3.250.000	SH PARNAÍBA	MAI/2013



DIAGNÓSTICO DE NAVEGABILIDADE

CATEGORIAS - 5	CATEGORIAS - 4	CATEGORIAS - 3	CATEGORIAS - 2	CATEGORIA - 1
MUITO ALTO DE:	ALTO DE:	MÉDIA DE:	BAIXA DE:	
Sinuosidade; ou	Sinuosidade; ou	Sinuosidade; ou	Sinuosidade; ou	Ausência das ocorrências
Profundidade mínima; ou	Profundidade mínima; ou	Profundidade mínima; ou	Profundidade mínima; ou	
Empecilhos à navegação (construções); ou	Empecilhos à navegação (construções); ou	Empecilhos à navegação (construções); ou	Empecilhos à navegação (construções); ou	
Energia do rio; ou	Energia do rio; ou	Energia do rio; ou	Energia do rio; ou	
Leito do rio; ou	Leito do rio; ou	Leito do rio; ou	Leito do rio; ou	
Assoreamento; ou	Assoreamento; ou	Assoreamento; ou	Assoreamento; ou	
Anteparos naturais; ou	Anteparos naturais; ou	Anteparos naturais; ou	Anteparos naturais; ou	
Largura mínima do rio.	Largura mínima do rio.	Largura mínima do rio.	Largura mínima do rio.	

CONVENÇÕES CARTOGRÁFICAS

01 Rio Parnaíba
02 Rio das Balsas

X Confluências

Numeração dos trechos
n° < Jusante
n° > Montante

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

N W E S

ESCALA GRÁFICA
0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

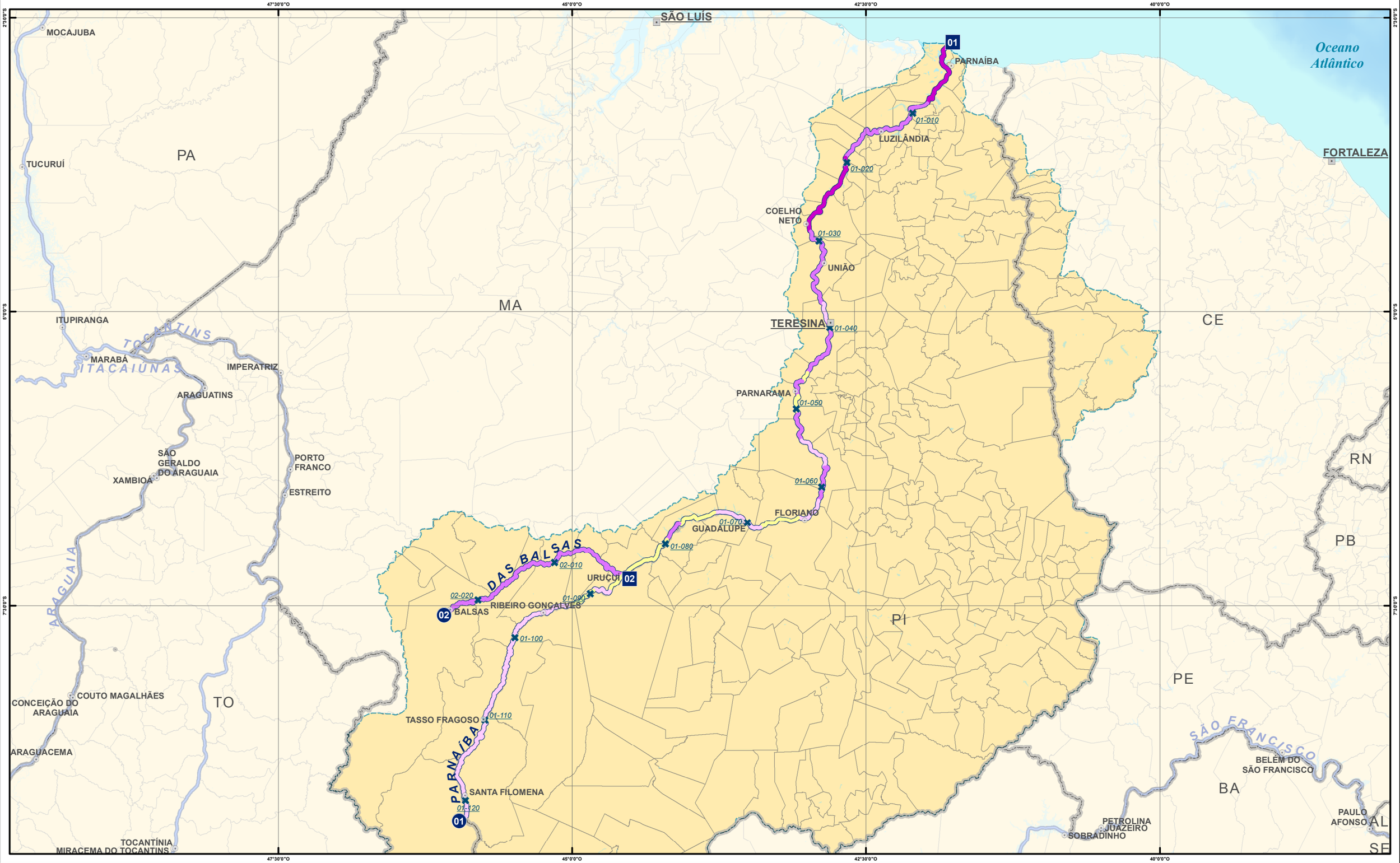
DIAGRAMA UNIFILAR DO DIAGNÓSTICO DE NAVEGABILIDADE AGRUPADO PELO SISTEMA HIDROVIÁRIO (SH)

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	SH PARNAÍBA	MAI/2013

The Parnaíba River Basin has an approximate area of 344 thousand km², partially touching the territory of 293 municipalities, 222 in Piauí, 29 in Ceará, and 42 in Maranhãom State. The total population in these municipalities is 5,119,667 (IBGE, 2010) and the most important city is Teresina, capital of the state of Piauí accounting for 15.9% of this population. The FIRJAN (2010) index ranges from 0.34 in São Felix das Balsas (MA) through 0.84 in Teresina (PI). The average is 0.54.

In the Parnaíba River basin, there are 12 Conservation Units, 9 Sustainable Use Units near the Parnaíba River mouth, and 3 Integral Protection Units, near the south part of the basin. There are also INCRA settlements throughout the basin, especially near the Parnaíba River mouth.

The main social and environmental characteristics to foster the integrated planning of possible interventions needed in the region of the Parnaíba waterway system can be seen together in the Linear Diagram diagram below.



CONVENÇÕES CARTOGRÁFICAS

Referências Locacionais

- Capital Federal
- Capital Estadual
- Sede Municipal
- Limite político adm.
- Limite municipal
- Massa d'água

- X Jusante
- X Montante

- 01 01 Rio Parnaíba
- 02 02 Rio das Balsas

- Bacias do SH Parnaíba

Trechos de 10 km (xx-yyy)

xx: n° do rio
yyy: n° do trecho

*km = yyy * 10*

Escala de ponderação dos temas

1 - 5 (baixa - alta)

- IN - Insignificante
- BA - Baixa
- ME - Média
- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 25 50 100 km

SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SIRGAS

LOCALIZAÇÃO DA FOLHA

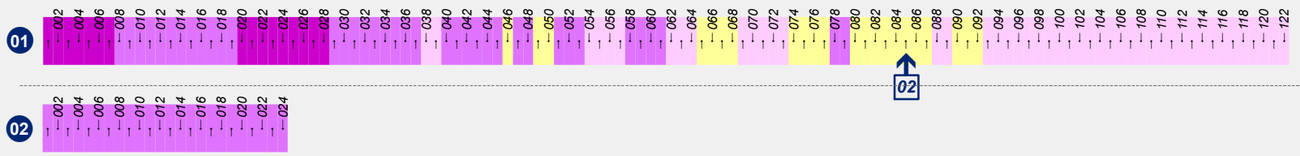
MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

VULNERABILIDADE SOCIOAMBIENTAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS Logos	1:3.250.000	SH PARNAÍBA	MAI/2013



VULNERABILIDADE SOCIOAMBIENTAL

CATEGORIAS - 5	CATEGORIAS - 4	CATEGORIAS - 3	CATEGORIAS - 2	CATEGORIA - 1
UC - proteção integral; ou	*UC - uso sustentável; ou*	*Assentamento INCRA; ou*	*APCB; ou*	*Ausência das ocorrências*
Terra indígena	*Comunidade quilombola*	*Vulnerabilidade ao desmatamento; ou*	*Mineração - Lavra e garimpo*	
		Cavidades naturais		

CONVENÇÕES CARTOGRÁFICAS

01 Rio Parnaíba
02 Rio das Balsas

X Confluências

Numeração dos trechos
n° < Jusante
n° > Montante

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

N W E S

ESCALA GRÁFICA
0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA VULNERABILIDADE SOCIOAMBIENTAL PARA POSSÍVEIS INTERVENÇÕES AGRUPADO PELO SISTEMA HIDROVIÁRIO (SH)

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	SH PARNAÍBA	MAI/2013

The diagram above shows that the Parnaíba Waterway system has no social or environmental vulnerabilities deemed too high (indigenous land or integral protection conservation units in the area surrounding the waterway). It is noteworthy the concentration of Units of Sustainable Use Concervation, as well as INCRA settlements in its initial sections, especially between the municipalities of Coelho Neto, Araioeses and Ilha Grande in Piauí.

The main characteristics of this Waterway System are described below.

3.8.1.1 Parnaíba Waterway

a) Navigability Diagnosis

The Parnaíba River basin comprises the states of Piauí, part of Maranhão and Ceará, totaling 344,112 km². The Parnaíba River originates at the confluence of the Surubim, Água Quente and Boi Pintado Rivers, whose springs are located in the Tabatinga Range, and *Chapada* (a plateau in the Brazilian highlands) of Mangabeiras, at the border of the states of Piauí, Tocantins and Maranhão, 700m above sea level. Its mouth is in the Atlantic Ocean, near the municipality of Parnaíba (PI). Parnaíba's most important tributaries are Gurgueia, Uruçuí-Preto, Canindé, Poti, Longá, and Balsas.

The average rainfall is around 1,500 mm a year. The flood period is between January and May. Parnaíba's average flow is about 800m³/s near its mouth (see Appendix VII, item 4.5.1). According to the climate change forecasts (Marengo, 2007), both the regular rainfall volume and the runoff volume of the Parnaíba basin tend to decrease.

The Parnaíba's waterway considered in this study includes the Parnaíba River, from its mouth until Santa Filomena (PI) town (section 120), about 1,200km of extention.

Generally, the Parnaíba River has poor navigation conditions, with many generalized aggradation sections, as well as rapids, rocky outcrops and shallow depths. The current navigable section is located in the Boa Esperança HPP reservoir, with no functioning locks.

The Parnaíba River, between its mouth and Teresina (sections 1 through 39), has no adequate navigation conditions. There are extense sandbanks, which results in minimal depths of about 1m during the dry season and on sinuous routes. The slopes are low (from 7 through 20cm/km) and minimal width ranges from 90 to 300m. The picture below illustrates the river's behavior on this section.

Figure 3.8.1: Aggradation in the Parnaíba River (Cabeceiras do Piauí, 2013)

From Teresina to the HPP of Boa Esperança (sections 40 through 71), with 310km length, the navigation conditions are poor and worsened by the presence of beaches, sandbanks, rocky outcrops and islands and very pronounced curves. Minimal widths vary from 50 through 200m and minimal depths may reach about 1m. The most critical section is located between Teresina (PI) and 80km upstream (section 47). Land use on the Parnaíba riverbanks, the deforestation of natural forests and the building of Boa Esperança's hydroelectric plant have led to increased sedimentation and aggradation, worsening navigation conditions.

Boa Esperança's hydroelectric plant (section 71) has 47m of head and regulates Parnaíba's flows, not improving, however, the river's navigation conditions downstream from this HPP. Besides, this plant has a set of two unfinished locks since 1982, each 50m long. They have no deadline to be finished and, therefore, navigation is interrupted at this dam.

Figure 3.8.2: Unfinished lock at Boa Esperança's hydroelectric plant (Portal Gterra, 2013)

Between Boa Esperança's dam and the surroundings of Uruçuí (PI) city (sections 71 through 85), mouth of the das Balsas River, navigation is feasible and takes place on lake conditions at Boa Esperança's reservoir, with minimum depths of 2m along its 155km. However, there is no records of adequate signaling.

Between the municipalities of Uruçuí (PI) and Santa Filomena (PI) (section 120), the Parnaíba River has about 365km of extension and poor navigation conditions. This section has very pronounced curves, sinuosity rates that reach 2, apart from having a number of sandbanks and rocky outcrops, which may make this section more sinuous than expected. Erosion on the riverbanks aggravates aggradation processes in this section. Minimum widths in this section range from 30 through 100m, with narrowings sections. Minimum depths are about 1m, during the dry season, moreover, shallower depths may be found due to the large number of natural obstacles. There are sections with rapids and waterfalls, not suitable for commercial navigation. Slopes reach about 60cm/km in some sections. There are not enough information about the dimensions of the bridges on this section, but these are visibly restrictive to navigation.

Figure 3.8.3: Parnaíba River (Fazendas Piauí, 2013)

The Parnaíba River has an approved Hydroelectric Master Plan in which falls have been divided among, apart from Boa Esperança, five other hydroelectric plants (Castelhano, Estreito, Cachoeira, Uruçuí, and Ribeiro Gonçalves). There are no construction dates for these plants and it is not known whether they will be equipped with locks. Building these hydroelectric plants may turn commercial navigation on the Parnaíba River feasible for 80km upstream from Teresina (PI) to the vicinity of Taso Fragoso (MA), should these hydroelectric plants, apart from Boa Esperança, be equipped with operating locks and in case there are no free current sections between the plants. The picture below shows how Parnaíba's falls are to be grouped.

The hydroelectric plants planned to be built on the Parnaíba River are energetically little attractive, that, associated with the pessimistic climate change scenarios for the river, make the feasibility of these plants becomes even more adverse.

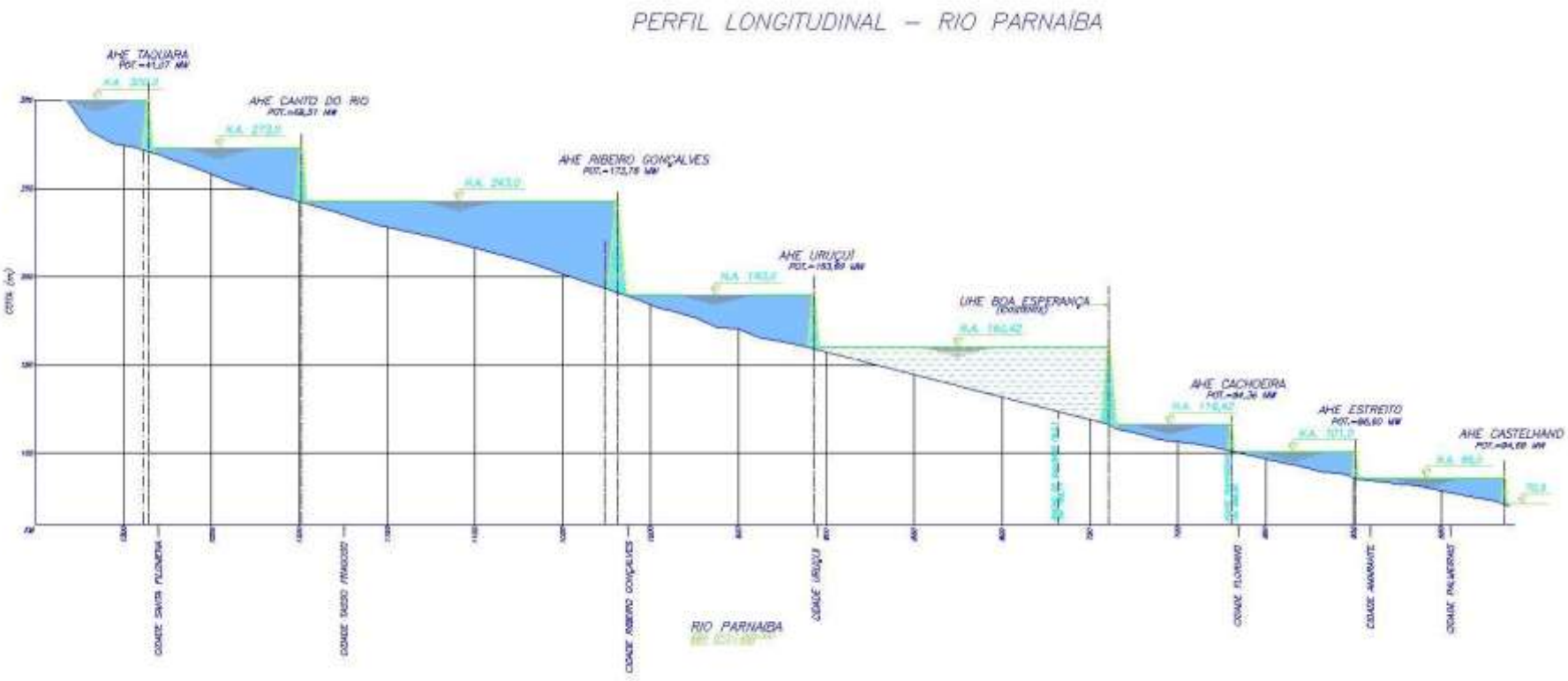
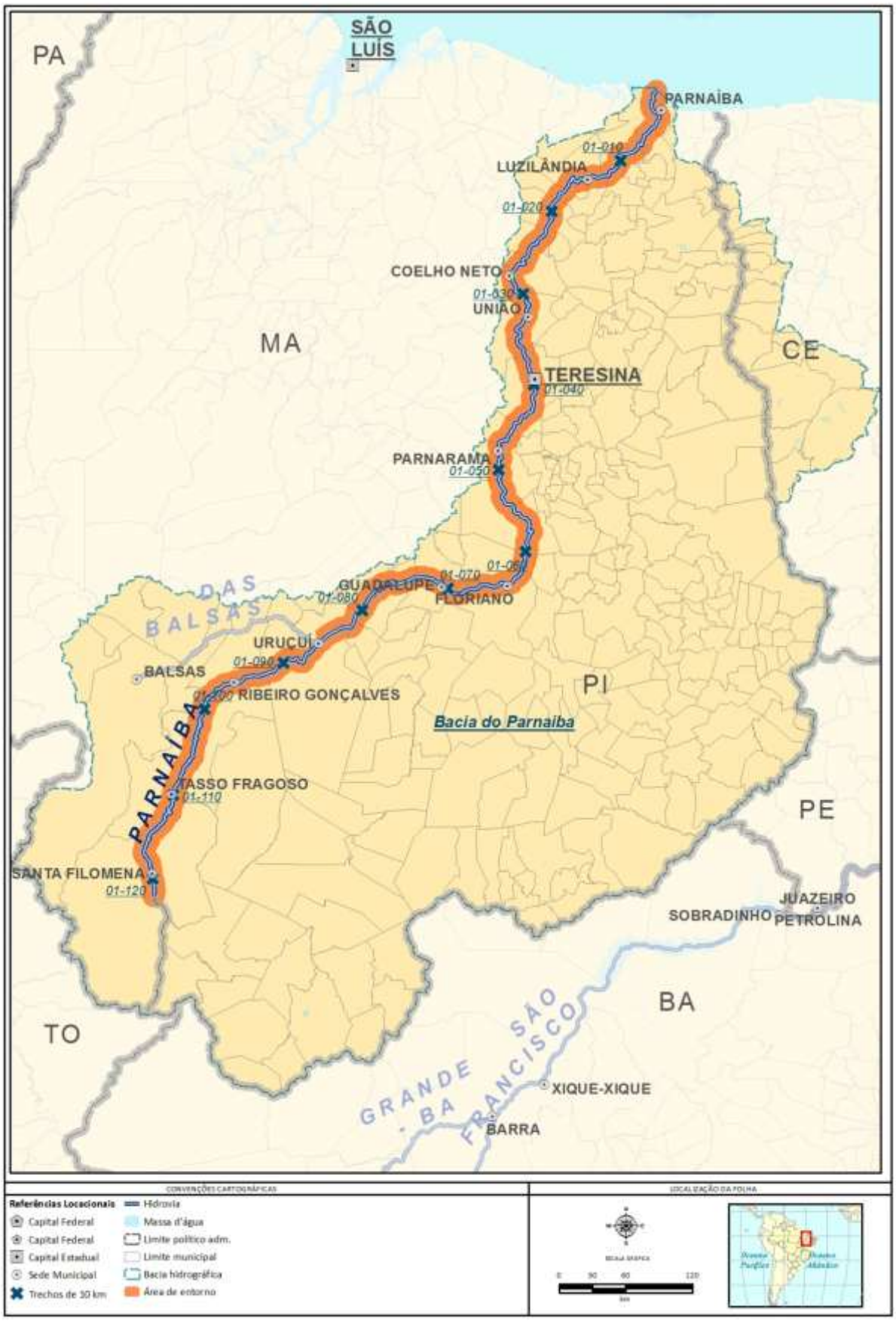


Figure 3.8.4: Longitudinal Profile of Parnaíba river (Estudos de Inventário Hidrelétrico da Bacia do rio Parnaíba, 2002)

b) Social environmental vulnerabilities

The Parnaíba Waterway is 1,211 kilometers long and crosses 54 municipalities, 30 in Piauí and 24 in Maranhão.



Map 50: Parnaíba Waterway Location

The total population in these municipalities is 2,098,482 (IBGE, 2010). Teresina – capital of Piauí state – is the most populous city, accounting for 36.83% of the total. The FIRJAN (2010) index ranges between 0.34 in São Felix das Balsas (MA) and 0.84 in Teresina (Piauí). The average is 0.54, similar to the average for the basin.

There are no critical points, from social and environmental perspectives, along the 122 sections where these waterway surroundings have been divided. The substantial presence of Sustainable Use Conservation Units is noteworthy between section 01 and 02 in the municipality of Ilha Grande (PI).

The main characteristics in terms of social and environmental vulnerabilities of the waterways comprising the Parnaíba waterway system can be seen as a whole in the Linear Diagram diagram below.

CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos
- n° < Jusante
- n° > Montante

Escala de ponderação dos temas
1 - 5 (baixa - alta)

IN BA ME AL MA

- IN - Insignificante
- BA - Baixa
- ME - Média
- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA
0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO PARNAÍBA	MAI/2013

3.8.1.2 Das Balsas Waterway

a) Navigability Diagnosis

Das Balsas is the largest tributary, on the left bank, of Parnaíba River, with about 510km of extension. It springs is located where the Chapada das Mangabeiras meets Serra do Penitente, over 700m above sea level, in the state of Maranhão. Its mouth is in the Parnaíba River, near the Uruçuí (PI) city (section 1).

Average rainfall is about 1,500mm a year. The period of floods occurs between January and May. Das Balsas river average flow, in the town of Balsas (MA), is about 100m³/s (see Appendix VII, item 4.5.2). According to climate change forecasts (Marengo, 2007), both average rainfall and run-off volume of the Das Balsas tend to decrease.

The Das Balsas Waterway considered in the following study comprises the section between its mouth and the municipality of Balsas (MA), about 240km long. Its importance is related to the possibility of integrating this waterway with the Parnaíba Waterway.

The das Balsas River is navigable only for small draft vessels, from its mouth to the municipality of Balsas (MA), specifically during the flood season.

Average slope between das Balsas River and the town of Balsas (MA) (section 24) is about 30m/km, with occasionally higher slopes sections, resulting in rapids, which make some points unfit for navigation, especially near Balsas municipality (MA).

Moreover, during dry season the river carries a large quantity of materials, which deposit in certain spots, creating occasional and alternating sandbanks as well as pebbles. Rapids and sandbanks may restrict navigation or make it unfeasible in several sections.

Minimum depth in the dry season is approximately 1.5m. The river is narrow – 80m near its mouth and about 40m near Balsas town. The sinuosity rate in some sections is about 1.9 (section 16). The presence of sandbanks may decrease the navigation channel dimensions and make it even narrower and more sinuous than expected. The picture below shows the das Balsas River.

Figure 3.8.5: Das Balsas River (Agrobalsas, 2013)

The das Balsas River was considered in the Parnaíba River basin Hydroelectric Master Plan, elaborated in 2003. According to this Master Plan's division of falls, das Balsas will be affected by the hydroelectric plant reservoir in Uruçuí, to be implemented on the Parnaíba River, up through about 140km from Balsas mouth. The Master Plan also foresees the Taboá hydroelectric plant, with 98MW Installed Power, whose backwater will reach the town of Balsas (MA). The figure below shows the approved division of falls for Das Balsas River.

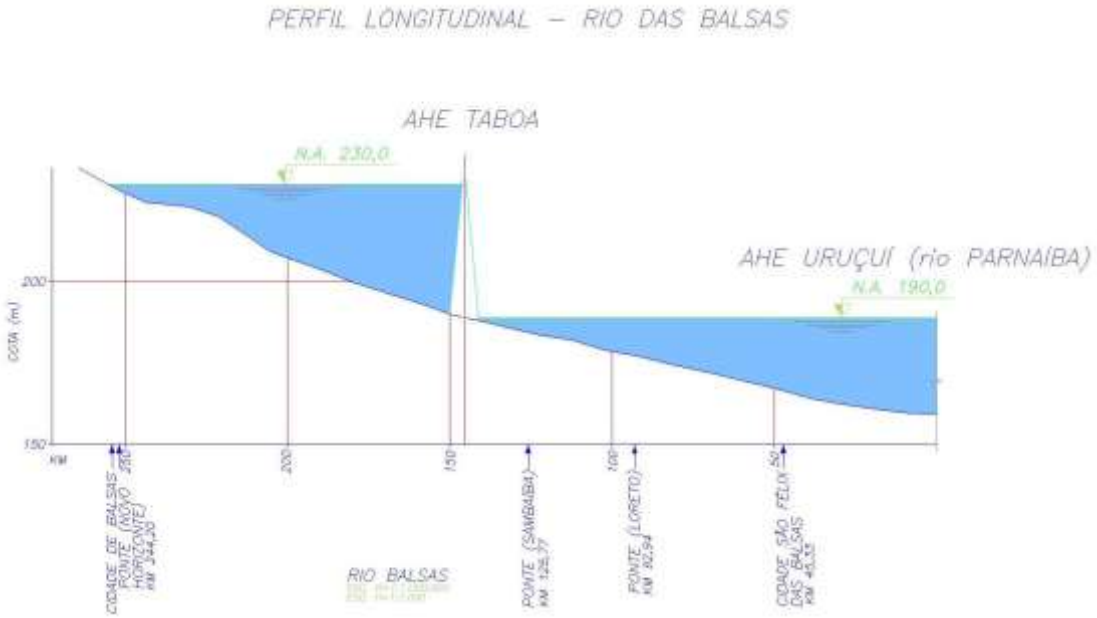
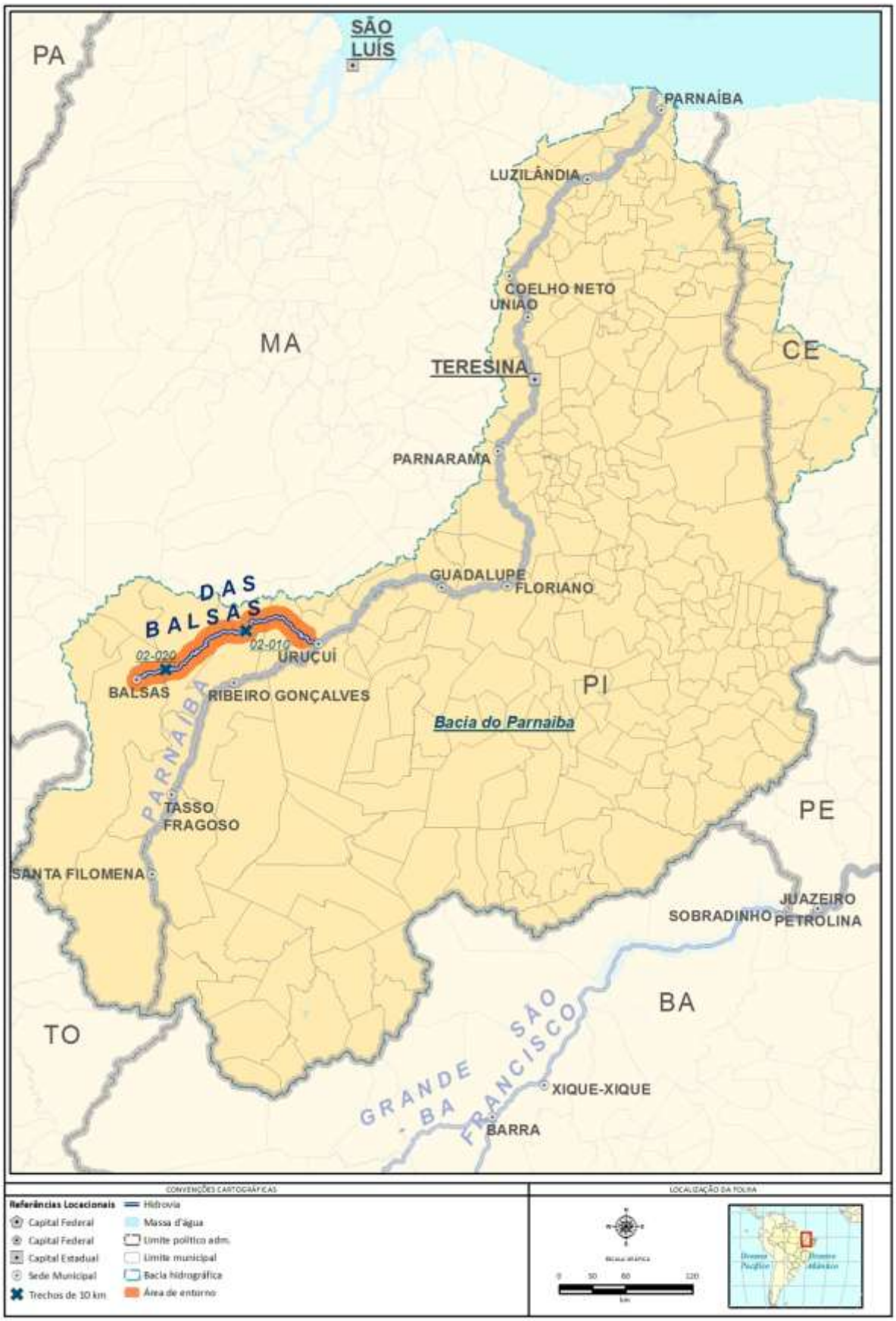


Figure 3.8.6: Division of falls approved for the das Balsas River (Estudos de Inventário Hidrelétrico da Bacia do rio Parnaíba, 2002)

In case of being constructed with locks in these hydroelectric plants, commercial navigation will be feasible with good conditions all along the das Balsas Waterway.

b) Social and Environmental Vulnerabilities

The Das Balsas waterway has 233 kilometers of extension, crossing 6 municipalities: Balsas, Benedito Leite, Loreto, Sambaíba, São Félix de Balsas, and São Raimundo das Mangabeiras, in the state of Maranhão.

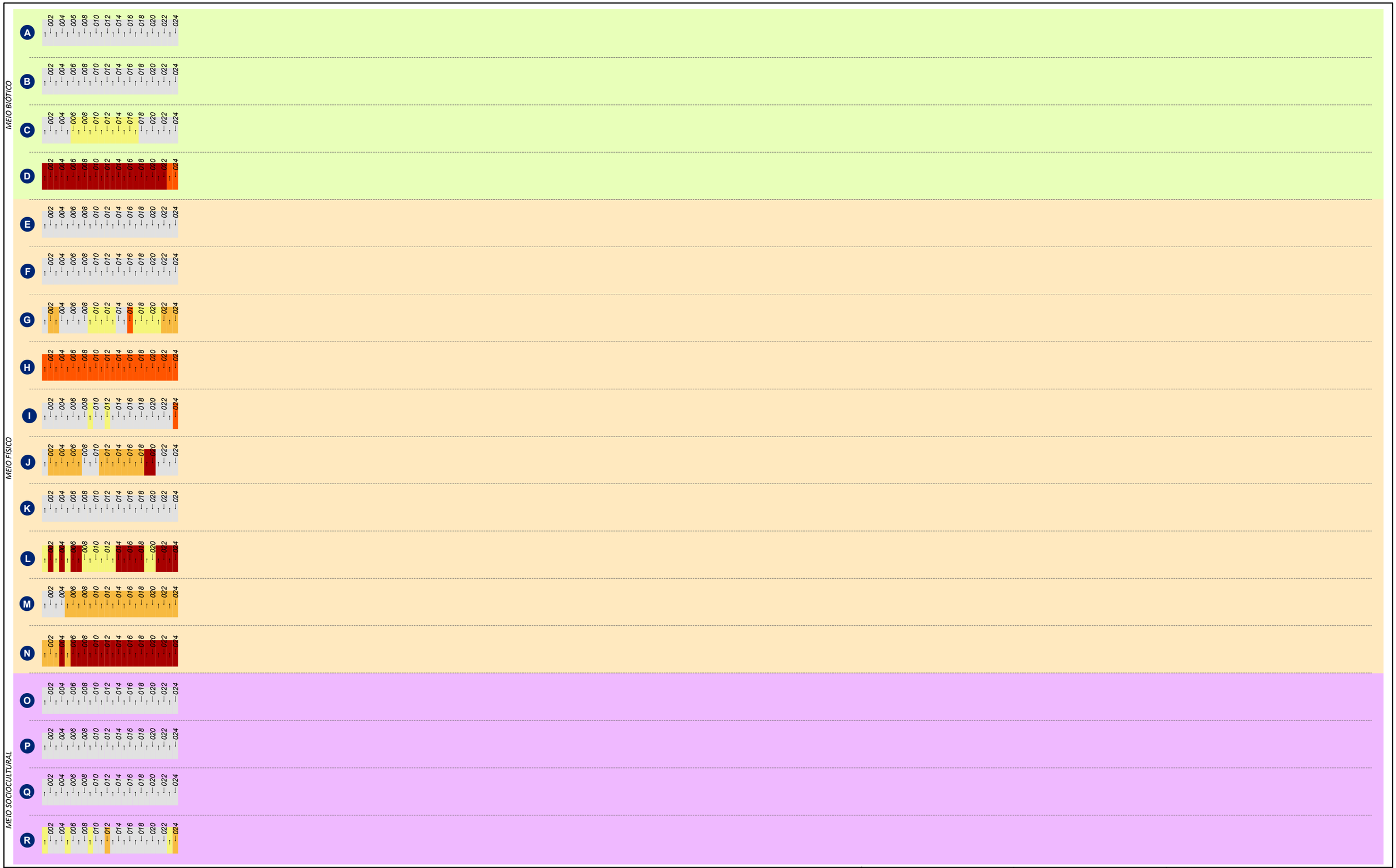


Map 51: Balsas River Location

The population in these municipalities totals 128,050 inhabitants (IBGE, 2010). Balsas is the most populated town, accounting for 65.23% of the total. The average FIRJAN (2010) index is 0.54, similar to that of the basin in general.

The area around these waterways was divided into 24 sections for social and environmental vulnerabilities assessment. It is worth noting that this river has well preserved vegetal coverage.

The main characteristics in terms of social and environmental vulnerabilities in the waterways comprising the Parnaíba waterway system may be seen in the Linear Diagram diagram shown below.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos
- n° < Jusante
- n° > Montante

Escala de ponderação dos temas
1 - 5 (baixa - alta)

IN BA ME AL MA

- IN - Insignificante
- BA - Baixa
- ME - Média
- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

N W E S

ESCALA GRÁFICA
0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO DAS BALSAS	MAI/2013

3.8.2 Economic Aspects

3.8.2.1 Current inland waterways transport

Today, navigation on the Parnaíba is limited to small vessels traveling between villages transporting soybeans, coal and sugar cane by means of ferries that take them from one bank of the river to the other, usually for local communities. Navigation along the whole river is prevented by lack of a ship lock at the Boa Esperança dam.

3.8.2.2 Planned developments

A small part of the works for the locks at the Boa Espeança dam are still pending. It is foreseen that the works will be resumed after 2015. However it is not clear when the locks will be fully operational.

If the Port of Luís Correia were built at the river mouth (partially underway), the waterway could extend to direct export. There is also the possibility of transporting the cargo by highway to Ribeiro Gonçalves, if the extension of the Transnordestina highway is built.

3.8.2.3 Future inland waterways transport

This paragraph summarizes the forecasts for inland waterway transport in the Parnaiba river basin, depending on the economic and transport projection for the states in the influence zone of the Parnaiba river basin: Maranhão, Piauí, Bahia and Tocantins.

Agricultural products like soy, soy meal, corn, cotton and fertilizers seem the most likely future prospects. Table 3.8.1 gives an overview of the projected production of the most relevant commodities in the catchment area of Parnaiba river for the period 2011 – 2031.

Table 3.8.1: Transport potential (in 1.000 tons)

	2011	2015	2023	2031
Soy	4.077	5.180	8.788	12.361
Soy meal	844	1.080	1.691	2.253
Corn	498	609	689	760
Cotton	707	741	822	900
Fertilizers	1.589	1.427	1.826	2.003
Total	**7.715**	**9.037**	**13.816**	**18.277**

Not all potential however will be realized. We assume that the share of the Parnaíba River[52] will increase with time. Table 3.8.2 gives the shares used.

[52] It was used the same assumptions for the Tocantins River.

Table 3.8.2: Shares of Parnaiba River (%)

	2011	2015	2023	2031
Share	0	30	40	50

This leads to the forecasts for the Parnaíba River in table 3.8.3.

Table 3.8.3: Forecast for Parnaiba River (in 1000 tons)

	2011	2015	2023	2031
Share	0	2.711	5.526	9.139

The main question will be whether the Parnaíba River will be the main transport route for these flows, or the Tocantins River. The location of the Parnaíba River with regard to the production zone is excellent, but there are severe drawbacks. In the first place highligt the missing locks. Perhaps even worse is the missing seaport. From Teresina, rail or road has to be used to reach Sao Luis or Fortalenza. For the moment all developments tend to favor the Tocantins as main transport axis for the Matopiba region. More detailed information is provided in the background reports concerning commodities and river basins.

3.8.3 Transport System

3.8.3.1 Transported Cargo

As seen in Chapter 3.8.2, there is no longitudinal cargo transportation today for this waterway system, only crossings. However, for 2031, potential volumes to be moved through Parnaíba Waterwai have been identified, relating to agricultural production cargo in the Matopiba region. These are shown in the table below.

Table 3.8.4: Cargo transported in the Parnaíba waterway system per year (Source: internal)

Cargo	2011	2031
Soybean	0	6,181
Soy meal	0	1,127
Corn	0	380
Cotton	0	450
Fertilizers	0	1,002
Total	**0**	**8,316**

Agricultural bulk cargoes are for exporting. Fertilizers are for importing.

3.8.3.2 Infrastructure

This item describes the current Parnaíba waterway system infrastructure, which, as explained in Chapter 3.8.1, comprises the Parnaíba and das Balsas Rivers.

a) Waterway/River infrastructure

The physical characteristics of the Parnaíba waterway system, its current dams and those that have been planned have all been described in Chapter 3.8.1.

After reviewing a number of official documents and the interviews, it was found that there is no longitudinal navigation in this system, only crossings. Besides, there are no waterway terminals operating in this system, according to PNIH's database, 2013.

Ports/Terminals

To analyze the Parnaíba waterway system, the database resulting from the PNIH was used. Information collected during the interviews or coming from recent reports was added. At this base, 13 terminals are listed, 8 of which have no status information and 5 are being planned.

Roads

This item addresses the roads that are part of the Parnaíba waterway system. It is worth noting that those described below are potential competitors or connections.

BR-020

BR-020 is a radial federal road in Brazil. Its starting point is in the city of Brasília (Distrito Federal) and it ends in Fortaleza (Ceará). It crosses the Federal District and the states of Goiás, Bahia, Piauí, and Ceará. In the states of Bahia and Piauí, it has long unpaved segments and segments that have not been built yet, being planned step, forcing drivers to use other roads to get to their destination.

From Fortaleza (CE) to Picos (PI), the road is completely asphalted, with significant quality paving, occasional holes and narrow shoulders in most of the route, despite some segments with wide shoulders. It is possible to go from Picos (PI) to Floriano (PI), on the bank of the Parnaíba waterway. With this connection, BR-020 becomes a direct competitor with the waterway and traffic flows through the road mode up to Fortaleza's port. From Picos (PI), one can take BR-407 toward Petrolina (PE), a cargo route for goods coming from the countryside of the states of Bahia, Piauí, and Pernambuco to the port of Fortaleza (CE).

BR-135

BR-135 is a road that connects Brazil's midnorth (Maranhão) and ends in Belo Horizonte (Minas Gerais). It competes with BR-040, between the two-road junction in Paraopeba, and Belo Horizonte, in Minas Gerais. This road is in a very poor state of maintenance in the north of Minas Gerais and there is still no asphalt in several parts, especially in Bahia. Because this road crosses very poor and not very developed regions (north of Minas Gerais and the whole northeastern outback), it was left in a very poor state or without paving projects in several segments and a number of times.

BR-135 may represent in a direct competition to the Parnaíba waterway, connecting the Floriano (PI) and Guadalupe (PI) region to the port of São Luis (MA). In spite of this competition, BR-135 is paved in this segment with poor maintenance and signaling conditions. Some segments have neither lines painted on the road nor paved shoulder.

BR-226

BR-226 is a Brazilian transversal road that connects the city of Natal (RN) to the municipality of Wanderlândia (TO). Throughout its route, BR-226 goes through the states of Rio Grande do Norte, Ceará, Piauí, Maranhão, and Tocantins. Its total length is 1674.6km. It crosses the municipalities of Natal, Currais Novos, Florânia, Pau dos Ferros, Pedra Branca, Cratéus, Teresina, Timon, Grajaú, Porto Franco, Estreito, Aguiarnópolis, and Wanderlândia, among others. The road has several unpaved or unimplemented segments. In the section between Porto Franco (MA) and Wanderlândia (TO), BR-226 integrates the route of the famous Belém-Brasília road, also known as Rodovia Transbrasiliana.

The most relevant segment for the study is that connecting Porto Franco (MA) to Teresina (PI). It crosses BR-135, thus forming a corridor that connects all the countryside of the state of Maranhão and the Tocantins and Parnaíba Rivers waterways to the port of São Luis (MA). Besides, its route is parallel to the Balsas Waterway and it crosses the Parnaíba waterway further on, making this a direct competitor with the first waterway. The road conditions are considerably good: single-lane, signaling, but no paved shoulder.

BR-230

In the state of Maranhão, BR-230 connects the municipalities of Estreito, Carolina, Balsas and São João dos Patos. In the state of Piauí, it connects the towns of Floriano and Picos. Since it cuts through the interior of both states, apart from providing a link between the three waterways (Tocantins, Balsas, and Parnaíba), with several roads that connect to ports further north, BR-230 is considered vital for cargo transportation in the region. It may work both as a complement to the aforementioned waterways and as a competitor, if we consider its connection to other roads. BR-230 is in good paving conditions in both states, with single-lanes with adequate signaling, without paved shoulders. In some segments, there are holes on the road. Other than that, there is no major issue for cargo transportations.

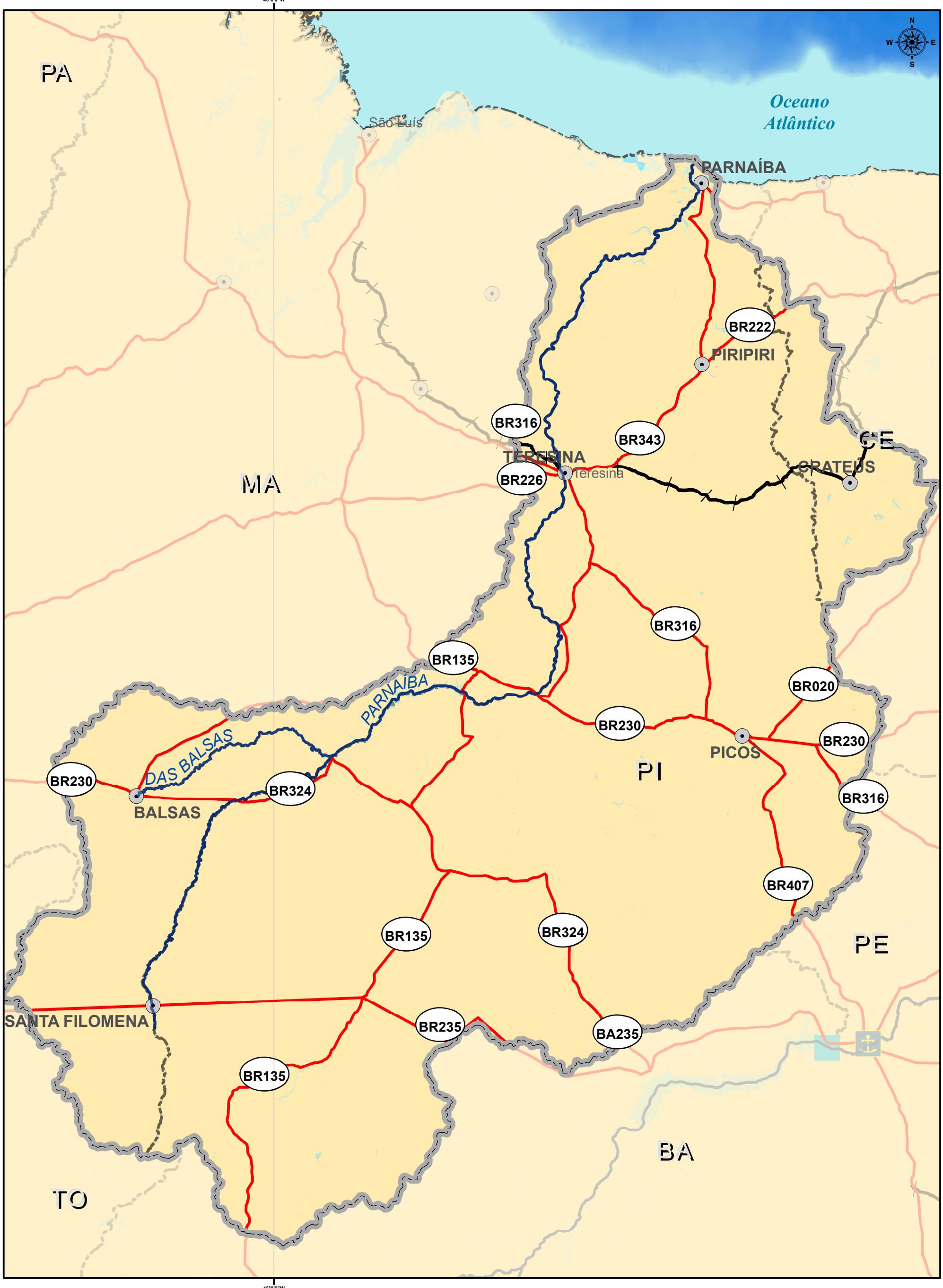
BR-316

BR-316 starts in the city of Belém, in the state of Pará, and ends in the city of Maceió, in the state of Alagoas. It goes across the states of Pará, Maranhão, Piauí, Pernambuco and Alagoas. BR-316 also cuts through well-known cities, such as Belém, Castanhal, Teresina, Picos, Maceió, and Santa Inês.

BR-316 cuts through the Parnaíba waterway in the city of Teresina (PI), and integrates with other roads into a network that competes with Parnaíba's waterway. Single lane, asphalt pavement, it is in reasonable maintenance conditions. Its shoulders are not asphalted for most of its length.

BR-343

The BR-343 is a diagonal highway of Piaui State, which connects the city of Luís Correia to Teresina. It is very important for the development of the state, as it connects the state capital (Teresina) to the coast, and connects Piauí to Ceará, in the intersection with BR-404. Its course is parallel to the downstream section of Parnaíba waterway, in a passage that difficult navigability. It is considered complementary to the Parnaíba River waterway. Asphalt paving has not too good conditions with single lane throughout the course and unpaved shoulder.



CONVENÇÕES CARTOGRÁFICAS

- Capital Estadual
- Limite político adm.
- Hidrovia
- Massa d'água
- Portos e terminais
- Cidades principais

Barragem existentes
- Barragem sem eclusa
- Barragem com eclusa

Infraestrutura de transportes
- Rodovias
- Ferrovias

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA
0 20 40 80 km

SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

TRANSPORT CHARACTARISTICS HIDROVIA DO PARNAIBA

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:3.000.000	- BRASIL -	JUL/2013

Railroads

The railroads that integrate the Parnaíba waterway system are described below. They can work as connections to the ports of Pecém and Itaqui.

EF-225

EF-225 interconnects the Parnaíba Waterway in Teresina (PI) to the ports of São Luis (MA) and Fortaleza (CE). The latter is a complement to EF-405. EF-225 is part of the Transnordestina railroad and has metric gauge. Most of the cargo transported is oil, alcohol, cement, and pig iron.

EF-405

EF-405 integrates railroad EF-225 in Cratéus (CE), to the port in Fortaleza (CE). EF-405, which is part of the Ferrovia Transnordestina (Transnortheastern Railroad), has metric gauge and most of the cargo transported over it is oil derivates, alcohol, cement, and pig iron. It is operated by CFN.

3.8.3.3 Current fleet and operative companies

a) Vessels

As mentioned before, there is no longitudinal transportation of goods – only crossings. This fleet is not adequate for inland waterway transport, because there are only 12 barges with a total static capacity of 1,427 tons. For this navigation, Pipes Empreendimentos is the main player.

Pipes Empreendimentos is a small-sized navigation company that works especially in crossing transport.

Table 3.8.5: Fleet of crossing vessels in the Parnaíba waterway system (Source: Based on ANTAQ's Statistical Yearbook, 2011).

Company	Barges' static capacity (in tons)	Number of barges	Average age (years)
Pipes Empreendimentos Ltda.	1,149	8	11,3
Comvap Açúcar E Álcool Ltda	177	1	10
Transportes G & G Ltda	50	1	12
Nordeste Navegações Ltda	42	1	6
Raimunda N Dos Santos Viana	8	1	3
Total	**1,427**	**12**	**8,5**

b) Push Boats

Push boats are also only used for crossing transports in the Parnaíba waterway system. The fleet is composed of 10 pusher tugs and Pipes Empreendimentos is the main player.

Table 3.8.6: Fleet of pusher tugs for crossing navigation in the Parnaíba waterway system (Source: based on ANTAQ's statistical yearbook, 2011).

Operating company	Number of push boats	Average age(years)
Pipes Empreendimentos Ltda.	7	16,9
Comvap Açúcar E Álcool Ltda	2	6,5
Nordeste Navegações Ltda	1	6
Total	**10**	**13,7**

3.8.3.4 River Information Management System

The Parnaíba waterway system is managed by AHINOR, whose responsibilities are signaling and dredging (for more details about competencies, see Chapter 3.8.4).

There is no information regarding the water level of the rivers that compose this system and, despite being the waterway administration duty, there is no implemented signaling in the system.

3.8.3.5 Intermodal Competition

Based on the results shown in Chapter 3.8.2, it can be concluded that the potential cargo for the Parnaíba waterway system results from the exportation of agricultural bulks from the Matopiba producing region. For this analysis, it was assumed that there would be a terminal in the area of Santa Filomena. This hypothesis will be tested and optimized in the next stage of the plan.

In this analysis, two alternatives were analyzed: multimodal, where the first segment (from productive areas to the hypothetical terminal at Santa Filomena) should be by highway, then on waterway from Santa Filomena to Teresina, and from there through the port of São Luís, by rail; the second alternative is to consider the road mode only to the port of São Luís.

The table below presents the results of these alternative analyses, the cost relationship between the multimodal transportation mode and that considering road mode only. The micro-regions chosen for the analysis were based on their production – if the micro-region production is more than 400,000 tons a year or if the micro-region includes a municipality that produces more than 100,000 tons a year, it has been included.

Table 3.8.7: Transportation cost between the Matopiba region and the port of São Luís (R$/ton).

Region	Micro-region	São Luis	São Luis	São Luis
		multimodal	road	Multimodal/road
BA+TO	Formosa do Rio Preto	148	230	64%
	Correntina	200	283	71%
	Campos Lindos	191	188	102%
MA+PI	Sambaíba	161	144	112%
	Balsas	142	154	93%
	Bom Jesus	149	150	99%
	Baixa Grande do Ribeiro	137	173	79%

The alternative using multimodal transport is not always the most competitive choice, since cargoes originating in certain micro-regions, such as Sambaíba and Campos Lindos, for example, destined to the port of São Luís, are more advantageously transported by road than by multimodal. The average ratio between the cost of multimodal transport and the road mode is 88%.

It has been concluded that the transport in producing micro-regions of Formosa do Rio Preto and Correntina has good competitiveness.

3.8.4 Governance and institutions

The Parnaíba River, which draws the border between the states of Maranhão and Piauí, has become an integrating axis between the two states over the years. This is because, despite the navigation obstacles in its course, its sinuosity, its aggradation spots or the non-conclusion of the lock at Boa Esperança, navigation is taking place, although only in the form of crossing from one riverbank to the other, transport of goods for the local trade and the transport of people.

The Parnaíba basin region does not have a wide range of roads and the existing ones do not get adequate maintenance. The nearest railroads (Carajás and Companhia Ferroviária do Nordeste – Northeast's Railroad Company) are currently absorbing cargoes that arrive in Teresina (PI) to be taken to the port at Itaqui (MA). Use of the waterway mode should be encouraged, but the navigation obstacles encountered return the demand to the roads and railroads. This is because there are sections of little depth due to alluvial deposits, the existence of rapids and some rocky outcrops, apart from Boa Esperança's dam, which impede transposition because its lock has not been concluded.

Moreover, the use of water resources for irrigation in this region is crucially important for local agriculture and also for the subsistence of the population of the semi-arid, demanding studies about the use of underground waters. Associated to the multiple uses of water there is the incompatibility between the time of harvesting the agricultural crops and the flood season of the rivers – these events do not usually take place at the same time – making vessels navigate

with reduced drafts, which makes navigation in the region even more difficult (ANA, 2006). Four hydroelectric plants are planned to be built, which inhibits investments in waterway transport in the region because, when construction works begin, navigation is interrupted on that section until completion. Another problem in the region is the irregular invasions on the riverbanks, which modifies the riparian forests and contributes to the deposits of sediments along the rivers, increasing the risk of aggradation. These invasions have also resulted in untreated sewage being added to the water, leading to pollution and to the degradation of water fauna.

AHINOR (Administração Hidroviária do Nordeste – Northeast's Waterway Administration), as well as other AHs (Waterway Administrations), have not been able to fully perform their duties with regard to the works necessary to navigation especially due to lack of financial capacity.

In spite of this, AHINOR has played an important role in articulating demands from the waterway sector in the region. With local partnerships and using its scarce resources to develop some activities in Parnaíba, AHINOR has supported some initiatives to contribute to navigability. Thus, in a partnership with Secretaria de Planejamento do Piauí (Piauí's Secretariat of Planning), for example, three spikes have been implemented as a means of avoiding the need to carry out rock demolition in this section. The possibility is being studied to create a system of spikes and dikes for self-dredging, minimizing environmental impacts. Moreover, AHINOR has been pruning the riverbanks upon request of ICMBio (Anexo I) and IBAMA (Anexo I) and implementing floating quays so ICMBio can perform the environmental monitoring.

The table below shows the partnerships AHINOR has built, presents a synthesis of the main players in waterway and port management for the Parnaíba and relates their priority activities. It is worth pointing out that such responsibilities reflect the contents of the legal text that defines them and in some cases this does not reflect the actual activity. Each player's activities and their interaction will be explained below.

Table 3.8.8: Matrix of Formal Attributions of the Parnaíba Waterway Players

	Port administration	Inspection	Waterway maintenance	Licensing Process	Regulation
Waterway Administration (AW)- AHINOR			■		
Port Company of Piauí		■			
Docks Company-CDP	■				
Environmental Secretariats				■	
DNIT/DAQ			■		■
ANTAQ		■			■
IBAMA				■	■
Other Agents**				■	

*Realização de dragagem, derrocagem, sinalização.
** Esse bloco engloba todos agentes consultados pelo IBAMA no proesso de licenciamento (Fundação Palmares, FUNAI, INCRA, IMCbio, IPHAN, Minst. Público)
Fonte: Consórcio Arcadis Logos, 2012

AHINOR is supported by Piauí's Port Authority in guiding and inspecting water signaling (Annex I). To guide the environmental licensing process, consultation is carried out with IBAMA. In 2002, when IBAMA was questioned about the need to license for routine maintenance service rendering in the Parnaíba Waterways, including the clearing of the riverbed by rock demolition (removing trunks and branches), depth maintenance service for the preferential navigation route, beaconage – where applicable – riverbank signaling, cleaning and fixing the banks on the aforementioned waterway (IBAMA, 2002), they said such services were considered mere preventive maintenance and were free of environmental impacts. Thus, maintenance work has been carried out without the need to obtain licenses, always informing IBAMA and getting authorization. Larger works, such as building ports or terminals, go through the conventional licensing process and are guided by IBAMA, which consults other bodies such as the Agência Nacional das Águas (National Agency of Waters, Annex I), the state Secretariats for the Environment, the Comitês de Bacias Hidrográficas (River Basin Committees), RESEX, ICMBio, and INCRA (Annex I), because there are rural settlements in the region often in Environmental Protection Areas.

3.8.5 SWOT Parnaíba Waterway System

Strengths	Weaknesses
• Central location with regard to the new agriculture borders (MATOPIBA region). • The Parnaíba River is navigable at Boa Esperança's Reservoir. • AHINOR has been authorized by IBAMA to carry out maintenance works: these were considered works of low environmental impact.	• Parnaíba has a number of rapids, rocky outcrops, and sandbanks from Santa Filomena through Uruçuí. The existing bridges in this section do not make navigation easier. • Downstream from Teresina, Parnaíba presents shallow waters. There are sandbanks and it is very sinuous. • The Boa Esperança dam has an unfinished lock system. • Using the waterway for cargo transport destined to sea ports requires/creates a complex transport chain: – Road (from the production area through Santa Filomena), inland waterway (from Santa Filomena through Teresina) and railroad (from Teresina through São Luís). – The multimodal alternative is not always the most competitive one because for the cargo originating in some micro-regions, such as Sambaíba and Campos Lindos, for example, destined to the port of São Luís, the road mode is more advantageous than the multimodal one. The average ratio between the multimodal cost and the road cost is 88%. • AHINOR is having difficulties to perform its activities, due to the lack of access to financial and human resources (due to the covenant signed between DNIT/DAQ and CODOMAR).

Opportunities	Threats
• Potential cargo in 2031 – Soybean → 6 million tons – Soy meal → 1 million tons – Others → 0.9 million tons • Building the dams defined in the Inventário do Parnaíba (Parnaíba Master Plan) will make navigation possible on many sections of the river, in case of being built locks. • Upon conclusion of the construction of Boa Esperança lock, a navigation connection will be made possible from the Boa Esperança reservoir through downstream sections. • Promoting regional development around the waterway, with the support of local institutions and other bodies such as CODEVASF.	• In case of constructing the planned dams (Castelhano, Estreito, Cachoeira, Uruçuí, Ribeiro Gonçalves) without locks, navigation will continue to be difficult. • Even after the dams are concluded, there will be sections of the river where navigation will be difficult. • The intensified use of the waterway may bring about greater human occupation on the riverbanks, which may affect the quality of the water. If this is not done with adequate public planning, it may also increase the sedimentation process in the Parnaíba River.

3.9 SÃO FRANCISCO WATERWAY SYSTEM

3.9.1 Physical system of the river and social and environmental aspects

The São Francisco Waterway System (SH) comprises four waterways, all of them within the São Francisco rive basin, namely, the Corrente, Grande, Paracatu e São Francisco rivers waterways which are altogether 2,527 km long and cross the territory of 105 municipalities in the states of Minas Gerais, Bahia, Sergipe, Alagoas and Pernambuco. These municipalities together have a population of 2,821,659 inhabitants (IBGE, 2010). Among the major urban centers is the state capital city of Belo Horizonte (MG), besides Contagem (MG) and Montes Claros (MG), Petrolina (PE), Barreiras (BA) and Arapiraca (AL).

The São Francisco River has good navigation conditions between Ibotirama (BA) and Juazeiro (BA) /Petrolina (PE). In this segment, the main difficulties remit to the erosion and silting up formation processes, isolate stone outcrops, besides the need to combine the waterway and the Brazilian Electrical Industry interests, which differ as to water use. This segment has already installed and measured infrastructures of designed and underway improvements.

The other stretches of the São Francisco River under analysis have bad physical conditions from the commercial navigation point of view and/or are unfeasible for commercial navigation.

The Grande, Correntes and Paracatu Rivers have limited capacity as to commercial convoy traffic and are navigable on some stretches, especially at the flood season.

The analyses and studies conducted for the characterization of the physical and social-environmental conditions of the potential waterways of the São Francisco Waterway System obeyed the methodologies presented in Chapter 1 – item 1.3 – Methodology, of this report.

Due to the large volume of collected and analyzed information, we present in this chapter the summary of the main results and the conclusions arrived at for each river under study.

In the CD attached to the present report (Step C: Assessment and diagnosis) a table in the.xls format containing all analyzed variables and more detailed information is presented for each river and each stretch under study.

The Linear Diagrams contained in this chapter synthesize the above mentioned table, obeying the methodology exposed under Chapter 1, item 1.3 of this report.

As a product of the Strategic Waterway Plan final step (Step F: Preparation of the final strategic plan) a data base is presented with georeferenced data containing all the information existing in the table of the CD attached to the present report.

The main characteristics as to navigability physical conditions of the waterways composing the São Francisco River SH can be checked together with the one-line diagram presented below.

CONVENÇÕES CARTOGRÁFICAS

Referências Locacionais
- Capital Federal
- Capital Estadual
- Sede Municipal
- Limite político adm.
- Limite municipal
- Massa d'água

- X Jusante
- X Montante

- 01 Rio São Francisco
- 02 Rio Grande - BA
- 03 Rio Corrente
- 04 Rio Paracatu

Bacias do SH São Francisco

Trechos de 10 km (xx-yyy)

xx: n° do rio
yyy: n° do trecho

*km = yyy * 10*

Escala de ponderação dos temas

1 - 5 (baixa - alta)

- IN - Insignificante
- BA - Baixa
- ME - Média
- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

N W E S

ESCALA GRÁFICA
0 30 60 120 km

SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA

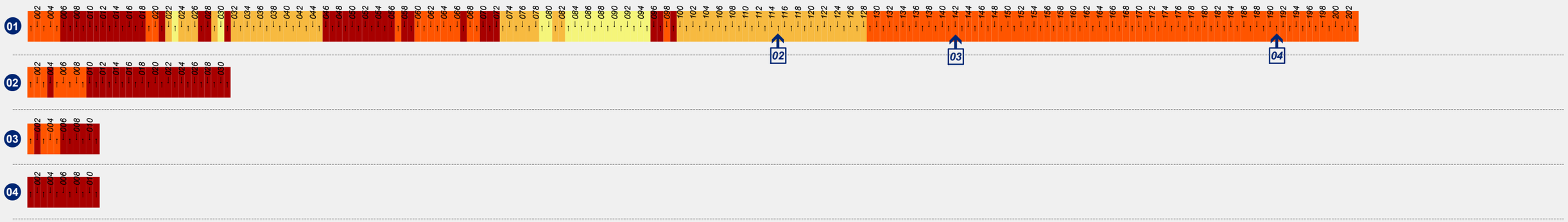
MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGNÓSTICO DE NAVEGABILIDADE

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:4.250.000	SH SÃO FRANCISCO	MAI/2013



DIAGNÓSTICO DE NAVEGABILIDADE

CATEGORIAS - 5	CATEGORIAS - 4	CATEGORIAS - 3	CATEGORIAS - 2	CATEGORIA - 1
MUITO ALTO DE:	ALTO DE:	MÉDIA DE:	BAIXA DE:	
Sinuosidade; ou	Sinuosidade; ou	Sinuosidade; ou	Sinuosidade; ou	Ausência das ocorrências
Profundidade mínima; ou	Profundidade mínima; ou	Profundidade mínima; ou	Profundidade mínima; ou	
Empecilhos à navegação (construções); ou	Empecilhos à navegação (construções); ou	Empecilhos à navegação (construções); ou	Empecilhos à navegação (construções); ou	
Energia do rio; ou	Energia do rio; ou	Energia do rio; ou	Energia do rio; ou	
Leito do rio; ou	Leito do rio; ou	Leito do rio; ou	Leito do rio; ou	
Assoreamento; ou	Assoreamento; ou	Assoreamento; ou	Assoreamento; ou	
Anteparos naturais; ou	Anteparos naturais; ou	Anteparos naturais; ou	Anteparos naturais; ou	
Largura mínima do rio.	Largura mínima do rio.	Largura mínima do rio.	Largura mínima do rio.	

CONVENÇÕES CARTOGRÁFICAS

01 Rio São Francisco
02 Rio Grande - BA
03 Rio Corrente
04 Rio Paracatu

Confluências

Numeração dos trechos
n° < Jusante
n° > Montante

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA
0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DO DIAGNÓSTICO DE NAVEGABILIDADE AGRUPADO PELO SISTEMA HIDROVIÁRIO (SH)

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	SH SÃO FRANCISCO	MAI/2013

The territorial dimension of the São Francisco river basin is 634,000 km², covering 504 municipalities in the states of Bahia (BA), Minas Gerais (MG), Pernambuco (PE), Alagoas (AL), Sergipe (SE), Goiás (GO) and Federal District (DF), totalling a population of 12,823,013 inhabitants (IBGE, 2010). It is worth noting that the course of the São Francisco River is commonly divided into Upper, Medium, Sub-Medium and Lower São Francisco.

With regard to conservationism, the basin is inserted in the Caatinga bioms, with 40% of the total area, 57% in the Cerrado and 3% in the domains of the Atlantic Forest. Within the basin limits there are 1,974 cases of mining works, 7,932 cases of natural cavities (CECAV, 2010), 53 Integral Protection Conservation Units (UCPI) and 32 Sustainable Use Conservation Units (UCUS). 89 Biodiversity Conservation Priority Areas (APCB) with extreme or high action priority are found there. According to the INCRA (2012), 16 Maroon Community areas and 647 rural settlements were found there. The Indigenous Lands account for 29 cases in the area of the above mentioned basins (FUNAI, 2012).

All the main social-environmental characteristics worth to stress in order to foster the integrated planning of occasional interventions needed in the region where the São Francisco River SH can be checked together in the one-line diagram presented as follows.

CONVENÇÕES CARTOGRÁFICAS

Referências Locacionais
- Capital Federal
- Capital Estadual
- Sede Municipal
- Limite político adm.
- Limite municipal
- Massa d'água

- X Jusante
- X Montante

- 01 Rio São Francisco
- 02 Rio Grande - BA
- 03 Rio Corrente
- 04 Rio Paracatu

Bacias do SH São Francisco

Trechos de 10 km (xx-yyy)

xx: n° do rio
yyy: n° do trecho

*km = yyy * 10*

Escala de ponderação dos temas

1 - 5 (baixa - alta)

- IN - Insignificante
- BA - Baixa
- ME - Média
- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

N W E S

ESCALA GRÁFICA
0 30 60 120 km

SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA

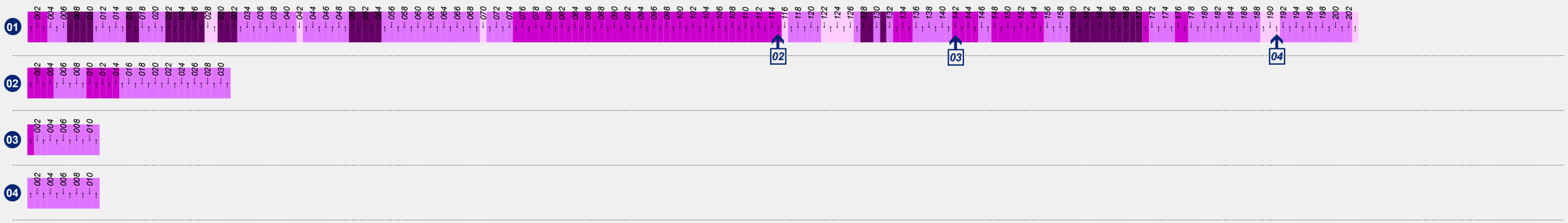
MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

VULNERABILIDADE SOCIOAMBIENTAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:4.250.000	SH SÃO FRANCISCO	MAI/2013



VULNERABILIDADE SOCIOAMBIENTAL

CATEGORIAS - 5	CATEGORIAS - 4	CATEGORIAS - 3	CATEGORIAS - 2	CATEGORIA - 1
UC - proteção integral; ou	*UC - uso sustentável; ou*	*Assentamento INCRA; ou*	*APCB; ou*	*Ausência das ocorrências*
Terra indígena	*Comunidade quilombola*	*Vulnerabilidade ao desmatamento; ou*	*Mineração - Lavra e garimpo*	
		Cavidades naturais		

CONVENÇÕES CARTOGRÁFICAS

01 Rio São Francisco
02 Rio Grande - BA
03 Rio Corrente
04 Rio Paracatu

Confluências

Numeração dos trechos
n° < Jusante
n° > Montante

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA
0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA VULNERABILIDADE SOCIOAMBIENTAL PARA POSSÍVEIS INTERVENÇÕES AGRUPADO PELO SISTEMA HIDROVIÁRIO (SH)

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	SH SÃO FRANCISCO	MAI/2013

By observing the one-line diagram of this Waterway System it can be seen that the São Francisco waterway is the one that concentrates the most vulnerable stretches from the social-environmental point of view, where the Integral Protection Conservation Units cases stand out, concentrated between the stretches 22 (in the municipalities of Piranhas/AL and Canindé do São Francisco/SE) to 27 (in the municipalities of Delmiro Gouveia/AL and Paulo Afonso/BA), in addition to stretches 160 (in the municipalities of Manga/MG and Malhada/BA) to 170 (in the municipalities of Januária/MG and Pedras da Maria da Cruz/MG).

In addition to the stretches where the Integral Protection Conservation Units are, the segments considered the most vulnerable from the social-environmental point of view are those where there are Indigenous Lands; in the case of this SH, they spread out between the stretches 07 (in the municipality of Porto Real do Colégio/AL) and 54 (in the municipalities of Cabrobró/PE and Curaçá/BA) and at some points in the stretches 128 (Ibotirama/BA), 131 (Muquém de São Francisco/BA) and 165 (São João das Missões/MG).

Another factor that deserves to be stressed is the recurrent presence of INCRA settlements at the São Francisco River banks, especially between the stretches 03 and 67 (between the municipalities of Petrolina and Brejo Grande in Pernambuco) and between the stretches 128 and 166 (between the municipalities of Manga/MG and Xique-Xique/BA), something that may generate conflicts because of the use of the banks at those points, should it be necessary to build structures in support of navigation there.

The main characteristics of the waterways composing this Waterway System are described below.

3.9.1.1 São Francisco Waterway

a) Navigability Diagnosis

The São Francisco River basin has around 640,000 km² and covers the states of Minas Gerais, Bahia, Pernambuco, Alagoas and Sergipe. Its source is at the Serra da Canastra, in the state of Minas Gerais. The São Francisco River runs for more than 2,750 km, starts in the state of Minas Gerais, crosses the state of Bahia and divides it from the state of Pernambuco. After being the border between the states of Sergipe and Alagoas it runs into the Atlantic Ocean. Its most important tributaries are the following rivers: Pará, Verde, das Velhas, Indaiá, Jequitaí, Paraopeba, Urucuia, Abaeté, Carinhanha, Paracatu, Corrente and Grande, the last three of which are the analyzed for navigation purposes in this study.

At the headwaters, the São Francisco River basin rainfalls reach 1,800 mm per year. At the semiarid the rain levels decrease going downstream and rainfalls vary between 800 and 600 mm as the annual average at the intermediate river course. The minimum values are reached in the area of Cabrobó (PE) (stretch 52). The drier period goes from May to October, and the flood period goes from December to April. According to climatic change forecasts (Marengo, 2007), the runoff volume tends to decrease in the São Francisco River basin.

The São Francisco River is morphologically stable and does not have large modifications in its bed over the time. It crosses the long depression nestled between the Atlantic Plateau and the Chapadas of Central Brazil until it goes through a transition segment (where a number of hydroelectric plants - UHE - were implemented) and arrives at a coastal plain region.

The river bed is dominantly sedimentary, from the São Francisco River mouth to the vicinity of the city of São Brás – AL (stretches 1 to 9) and the Itaparica lake upstream (stretches 33 to 203). The bed of the intermediate stretch has rocky characteristics, typical from the transition region of the Depressão of the São Francisco to the coastal plain region.

Between Juazeiro (BA) and the upstream segment (stretches 73 to 203) soils are sandy, loose, more or less acid and little differentiated, having a thin surface horizon with a small accumulation of organic matter at the utmost. They include sand from dunes and other geologic formations that are more ancient. Even with dominantly sandy formations, some relevant rock outcrops appear in some stretches.

The São Francisco waterway, as considered in this analysis, consists of the stretch between its mouth, on the Atlantic Ocean, and the city of Piropora (BA), and is about 2030 km long. The navigable stretch consists of the segment between Ibotirama (BA) and Juazeiro (BA) / Petrolina (PE), about 570 km long.

Along the stretch under study, the São Francisco River presents various physical chracteristics that make it navigable in some stretches and inadequate to navigation in other stretches. The flood period takes place between December and April, but it may undergo some small changes while running along the basin. The average flow rate is in the order of 800 m^3/s at Pirapora (stretch 202), 2,400 m^3/s at Ibotirama (stretch 129) and 2,600 near the mouth (see Appendix VII, Item 4.6.1).

From the São Francisco River mouth to the municipality of Piranhas (AL) (stretch 21), about 210 km long, the river has an average slope in the order of 5 cm/km and is considered navigable; it was formerly visited even by cabotage vessels that reached the river port of Penedo. Until the 80s, navigation on the Lower São Francisco was pretty significant and vessels could count with a minimum depth of 2,50 m along the entire stretch, even at the period of low waters. Facilities built for power generation on the upstream stretch deeply changed flow conditions on this long stretch where commercial navigation virtually disappeared. This navigation ceased as a result of the intense silting up that took place at the mouth where depths are nowadays in the order of just 2 m.

On the segment between Pirapora and the Sobradinho lake, the São Francisco river undergoes intense erosion processes at the banks, mainly due to soil fragility (over 50% of sand content), quick variations in the discharges of the Três Marias Hydroelectric Plant (UHE), the emptying of the reservoir of the Sobradinho Hydroelectric Plant, the anthropic activities on the river banks and the absence of riparian vegetation on many stretches of the banks. These erosions enhance silting formations, many of which are mobile, impacting navigability conditions.

Upstream the municipality of Piranhas – AL (stretches 21 to 46) the São Francisco River has a number of hydroelectric uses, which take advantage of the existing differences in level and

canyons along the São Francisco River in this stretch. The Xingó Hydroelectric Plant (stretch 21), the Hydroelectric Complex of Paulo Afonso (stretch 27) and the Itaparica Hydroelectric plant (stretch 32) stand out. Navigation is possible on the reservoir stretches of theses plants, however none of the theses facilities has lock systems, making vessel transposition impossible. The figure below illustrates in a schematic manner the division of falls on the São Francisco River and shows the existing UHEs and the currently navigable stretch.

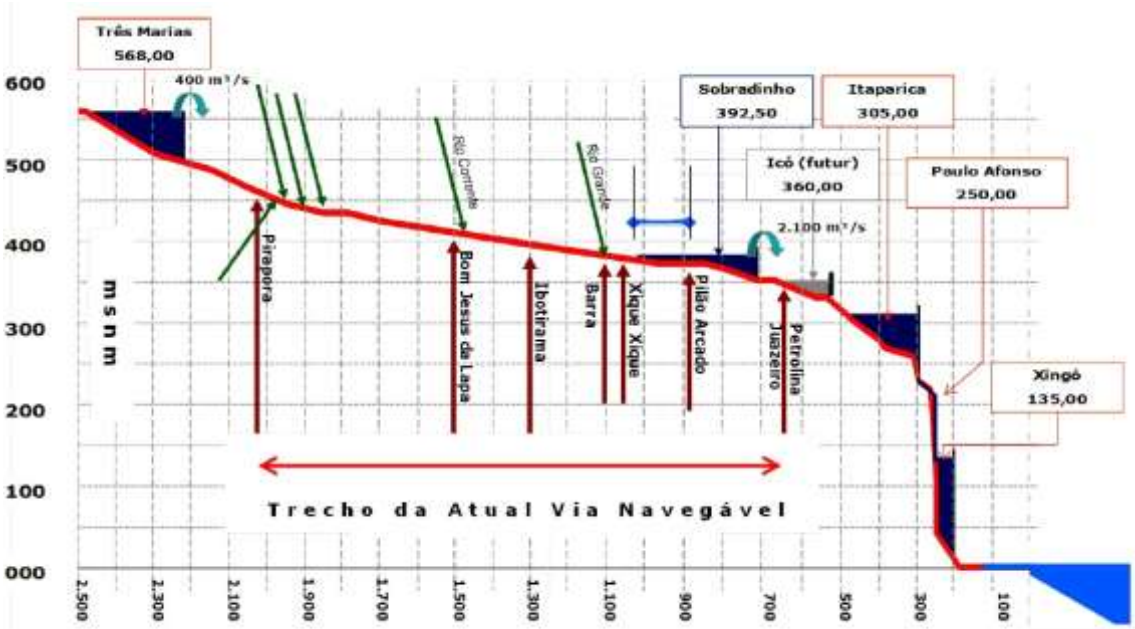


Figure 3.9.1: Schematic division of falls on the São Francisco River (CODEVASF, 2011)

On the stretch between the end of the Itaparica UHE reservoir (stretch 46) and Petrolina (PE)/Juazeiro (BA) (stretch 073), approximately 170 km long, the São Francisco River has bad navigability conditions due mainly to the great number of stone outcrops, floating islands and sandbanks, which take place at low depths during the drought period, in addition to the existence of very sinuous stretches and the lack a safe navigation channel. On some stretches the average slope reaches 40 cm/km. Recent studies, aiming at hydroelectric use, mention the possibility of building the Riacho Seco and Pedra Branca dams, whose reservoirs do not reach the cities of Juazeiro (BA) / Petrolina (PE).

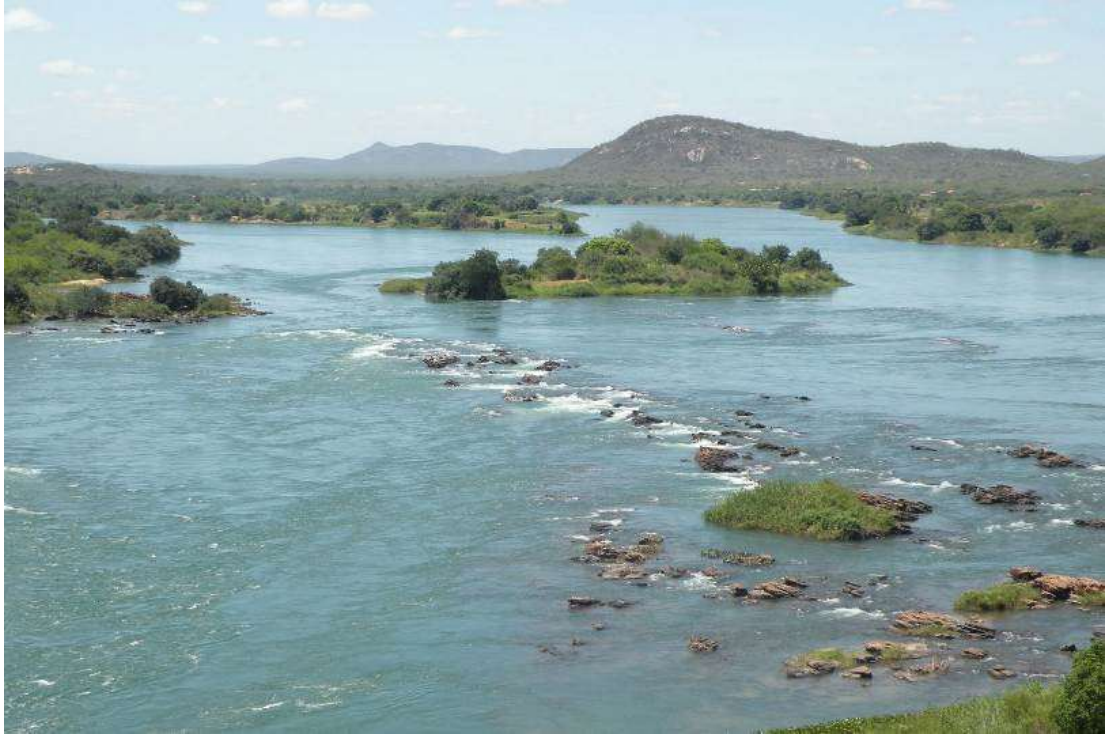


Figure 3.9.2: Rock outcrops on the São Francisco River (stretch 56) (My Old Chico, 2010)

Between Petrolina-PE/Juazeiro (BA) (stretch 73) and the Sobradinho Dam (stretch 77) the minimum depth is 1.4 m at the drought period and depends on the discharges of the Sobradinho UHE (stretch 77). According to the AHSFRA, the rock excavation of the stretch was performed in 1988, guaranteeing a 2.0 m depth for a 1,500 m^3/sec flow at the Sobradinho Dam and an average down flow at Sobradinho of 2050 m^3/sec and daily variations between 1,300 m^3/sec and about 4,000 m^3/sec. The effect of depth variations are noted up to 15 km downstream the Sobradinho Dam. Downstream to this point the variations are smaller, reaching less than 30 cm on the ruler at the Ilha do Fogo, monitored at real time by the ANA. The river bed is formed of granite and gnaiss, with many rocky crests along the stretch. The rock excavation performed to date on this stretch did not overcome the problems. In addition to the rocky formations there are also sand and gravel deposits on the segment.

Figure 3.9.3: Rock outcrops on the São Francisco River (stretch 74) (Panoramio, 2013)

The Sobradinho Dam has a 120 m long and 17 m wide lock that allows vessels to overcome the difference in level of 32.5 m.

At the Sobradinho reservoir (stretches 77 to 96), navigation is lacustrine and does not have restrictions to the navigation of commercial convoys. The route is determined by the DGPS.

The Sobradinho reservoir operates in a way that different multiple water uses (urban supply, power generation, navigation) are considered. However, during the drought season it is not possible to meet the multiple functions of the reservoir.

This reservoir shows a marked depletion that can reach 12 m, mainly due to power generation. Due to the fact that it is interconnected with the National Interconnected System (SIN), the Sobradinho power plant (UHE) tends to generate large quantity of electricity during the drought period in the Southeast region (April to October), causing large depletions and generating potential conflicts between the possible uses of the reservoir water.

At the end of the reservoir of the Sobradinho UHE (stretches 97 to 99) reservoir depletion can cause the appearance of a large quantity of sandbanks, stone outcrops and floating islands, causing the course of the São Francisco river to become a delta.

Figure 3.9.4: Final of Sobradinho reservoir (stretch 97 to 99) (MMA, 2013)

Between Pilão Arcado (BA) (stretch 99) and Ibotirama (BA) (stretch 129), about 300 km long, the São Francisco River is currently navigable on free current, with minimum depths of about 2.0 m, at the drought period. The sinuosity rate is about 1.2, the slope is in the order of 10 cm/km and the minimum width is about 300 m. The stretch has silting problems at some sections, which moves over the time. There are restrictions to navigation at: Passagem (stretch 108), Amarra Couro (PK 108), Torrinha (PK 121), Baixio do Meleiro (PK 124) and Limoeiro (PK 127).

On the stretch between Ibotirama (BA) (stretch 129) and Pirapora (MG) (stretch 203) the São Francisco River has rather different conditions between the rainy season and the dry season. At the rainy season it is long and regular, with long navigation distances, except at the mining area, where there are regions with countless islands and the river is slightly sinuous. At the dry season, the minimum depth is 1.7 m and (it) depends on the operation of the Três Marias UHE, which is located over 100 km upstream of the waterway end. The river bed is movable, made of fine sand and clayey silt, and also with scattered and short rock outcrops. The average declivity of this long stretch is about 10 cm/km and the water speed ranges from 0.6 and 1.1 m/s. The main stone outcrops existing in the segment are located on the stretches 156 to 166, being the main ones: Cachoeira de Carinhanha (stretch 156), Roncador (stretch 160), Umburana (stretch 163), Correnteza (stretch 164) and Ressaca (stretch 166), that must receive signaling and beaconage to ensure safe navigation. On the stretch between Pirapora (MG) and Bom Jesus da Lapa (BA) the river shows a progressive degradation state due to bank erosion, deforested prevailingly though anthropic/man-made action. There are some continuous rock outcrops, mostly of limestone, and many sandbanks. Sediments are prevailingly sandy.

Figure 3.9.5: Bank erosions on the São Francisco river (source: CODEVASF, 2011)

b) Social-environmental vulnerabilities

The São Francisco Waterway, which is 2,015 km long – for the purposes of the present analysis, it was divided into 203, 10 km-long stretches – inserts in the São Francisco River basin (already described). Along its course the Grande River – on stretch 015 -, Corrente River – on the stretch 142 - and Paracatu River – on the stretch 191 – waterways connect with it.

Map 52: Location of the São Francisco Waterway

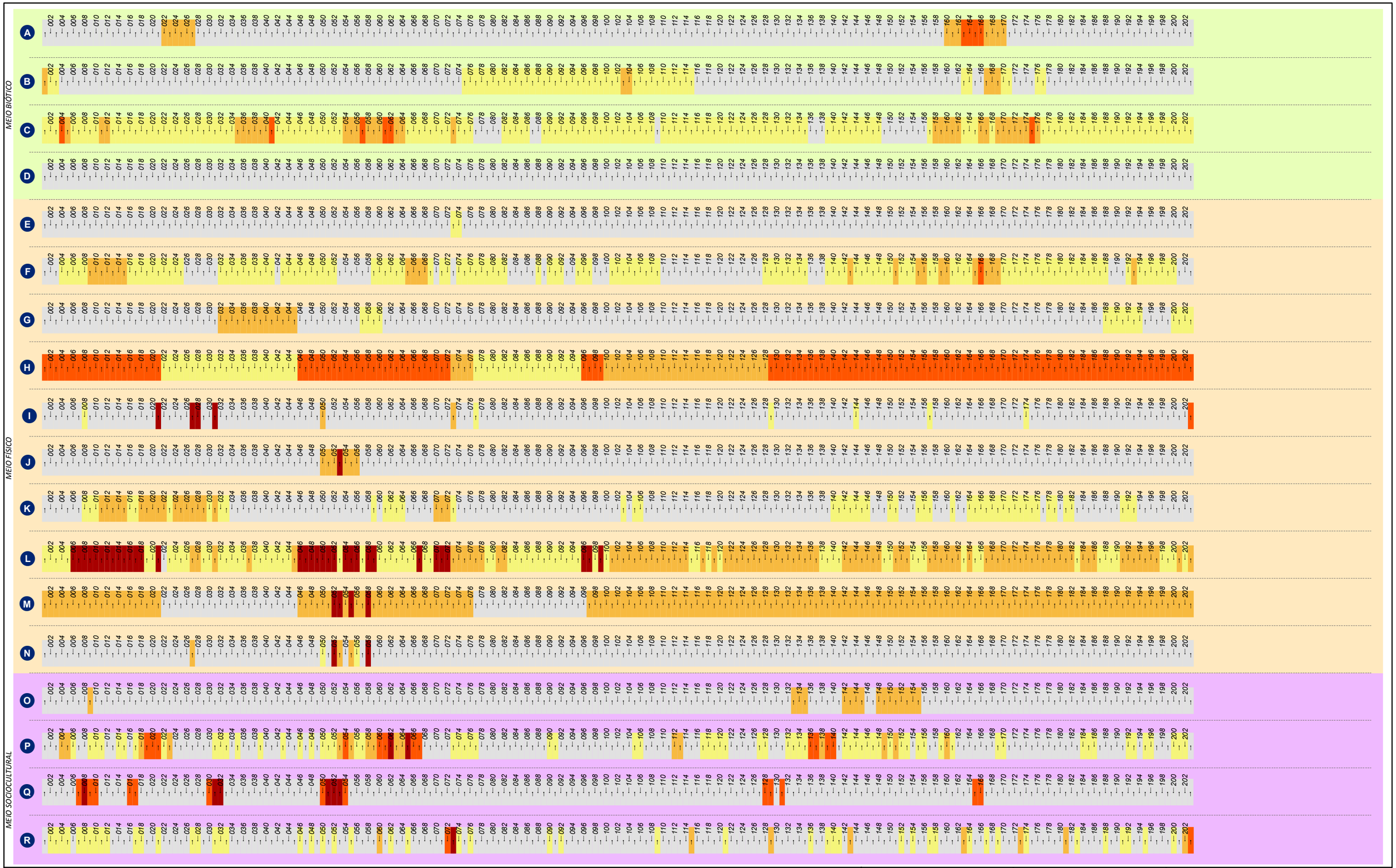
This waterway intercepts the territory of 91 municipalities in the states of Minas Gerais, Bahia, Sergipe, Alagoas and Pernambuco. Among the main urban centers, Petrolina (PE) and Juazeiro (BA) stand out. These municipalities, together, represent a population of 2,399,311 inhabitants (IBGE, 2010). The FIRJAN (2010) Index mean is 0.55 at the basin region, with the smaller rate appearing in the municipality of São João das Missões (MG) with 0.42, and the greater, 0.75, in Petrolândia (PE).

With regard to the social-environmental vulnerability analysis, Integral Protection Conservation Units (UCPI) can be found on stretches 22 to 27 (Natural Monument of the São Francisco River) between the municipalities of Paulo Afonso (BA), Canindé de São Francisco (SE), Olho d'Água do Casado and Delmiro Gouveia (AL) and on stretches 160 to 170 between the municipalities of Jaíba, Matias Cardoso, Januária and Pedras de Maria da Cruz, all of them in Minas Gerais. On stretches 01 to 03, between the municipalities of Penedo (AL) and Brejo Grande (SE), 75 to 115, from the municipalities of Petrolina (PE) to Xique-Xique (BA) Sustainable use Conservation Units (UCUS) can be found.

Along the entire waterway there are APCBs with very high or extreme action priority, excepting stretches 75 to 81, 87 and 88, 109, 136 to 138, 149 to 156, approaching the municipalities of Petrolina (PE) and Juazeiro (BA) to the municipalities of Carinhanha and Malhada in Bahia.

The most vulnerable stretches are those where there are Indigenous Lands, located on stretches 07 to 10, between the municipalities of São Brás and Porto Real do Colégio (AL), 16 and 17 in the municipality of Porto da Folha (SE), 30 to 33 between the municipalities of Jatobá, Petrolândia and Tacaratu in Pernambuco and the municipality of Glória, in Bahia, 50 to 54, between the municipalities of Cabrobó (PE), Curaçá and Abaré (BA), 128 to 131 in Muquém de São Francisco (BA) and 165 to 166 in the municipality of São João das Missões (MG).

On stretches 62 – municipality of Santa Maria da Boa Vista in Pernambuco - and 65 – municipality of Lagoa Grande – there is greater vulnerability from the social-environmental point of view due to the concentration of INCRA settlements.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
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- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

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- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

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DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO SÃO FRANCISCO	MAI/2013

3.9.1.2 Rio Grande Waterway

a) Navigability Diagnosis

The Grande River is one of the major tributaries of the São Francisco River and is located in the state of Bahia. Its drainage has around 75,170 km². Its source is located in a semi-humid tropical region where abundant rains ensure the perennial flows all over the year. The medium and eastern part of the basin is located in a semi-arid climate, characteristic of the region containing the medium course of the São Francisco River, where scarce rains contribute very little to river flows. The Grande River mouth is in the São Francisco River, in Barra (BA) (stretch 115). The São Francisco River shows geologic characteristics typical of river and/or river-lacustrine plains and the bed is prevailingly sedimentary, with islands and sandbanks.

The Grande River flows in the southwest-northwest direction, receiving its major tributaries through the left bank, like the das Fêmeas River, the Ondas River, the Branco River and the Preto River; through the right bank it receives: the São Desidério River, besides the Tamanduá and the Boa Sorte Rivers.

The rainfall regime takes place between November and April, when river flows are greater. The average flow is around 270 m³/sec at the Boqueirão station (See Appendix VII, Item 4.6.2). The drought flows have been decreasing over the last years due to enhanced irrigation, especially at the tributaries.

The Grande Waterway that is considered in this analysis consists of the stretch between its mouth and Barreiras (BA), the main city covered by the waterway, which is about 310 km long.

The Grande River has good navigation conditions for small commercial vessels, although navigation is incipient. The current use of the river for transport navigation has specific commercial purposes, being practiced by vessels known as “Regatão” (large regatta), providing freight services for the transport of cattle, flours, sacked goods and other articles; or for the commercialization of articles badly needed by the riparian inhabitants on rudimentary vessels or self-propelled boats.

There are no relevant obstacles to navigation. The river has an average slope of 5 cm/km and rather uniform widths, as a result of the low water contribution of the tributaries of the waterway. However, two major narrowings stand out, namely: Estreito (stretch 4), about 40 km from the Grande River mouth on the São Francisco River, and Boqueirão (stretch 10), near the Preto River mouth. At these points the bed is strangled and runoff speed increases, a fact that may bring difficulties to navigation. The river does not have rapids or small falls.

The greatest restrictions to navigation consist of the small curvature radii and small widths, which make the safe maneuver of a river convoy difficult, especially near Barreiras. Minimum depths are in the order of 1.5 m, and take place at the dry season on the upstream stretches.

The Grande River has two characteristic stretches from the navigation point of view:

On the stretch between the Grande River mouth to Boqueirão, near the Preto River mouth, the river, and about 100 km long, has good navigation conditions for vessels of the same size as those that navigate on the São Francisco River. Widths are constant, in the order of 100 m.

The existing stone outcrops do not represent greater risk to navigation. In terms of depth, an effective beaconage and improvement projects need to be implemented. On several points of the stretch underwater tree trunks and branches can be noted, which although representing a risk to navigation can be easily removed. Still, there are some curves that might restrict the size of the vessel-type to be established.

Figure 3.9.6: Rio Grande (stretch 10). (Brasil das Águas, 2007)

On the stretch that goes from the Preto River mouth to the city of Barreiras, about 210 km, the river presents greater difficulties to navigation. Depths still favor navigation, but the river becomes gradually sinuous and many curves appear, impairing the navigation of greater size convoy. Minimum widths reach 30 m (stretches 21 to 31). There is the occurrence of stone outcrops. The most critical stretches correspond to the last 40 km upstream stretches of the waterway, where river width and the sequence of curves make vessel crossover unfeasible.

Figure 3.9.7: Rio Grande and the city of Barreiras (BA). (Brasil das Águas, 2007)

The existing bridges do not represent restrictions to navigation. The Grande River doe not have hydroelectric vocation due to the low slopes and the vast potentially flooded areas.

b) Social-environmental vulnerabilities

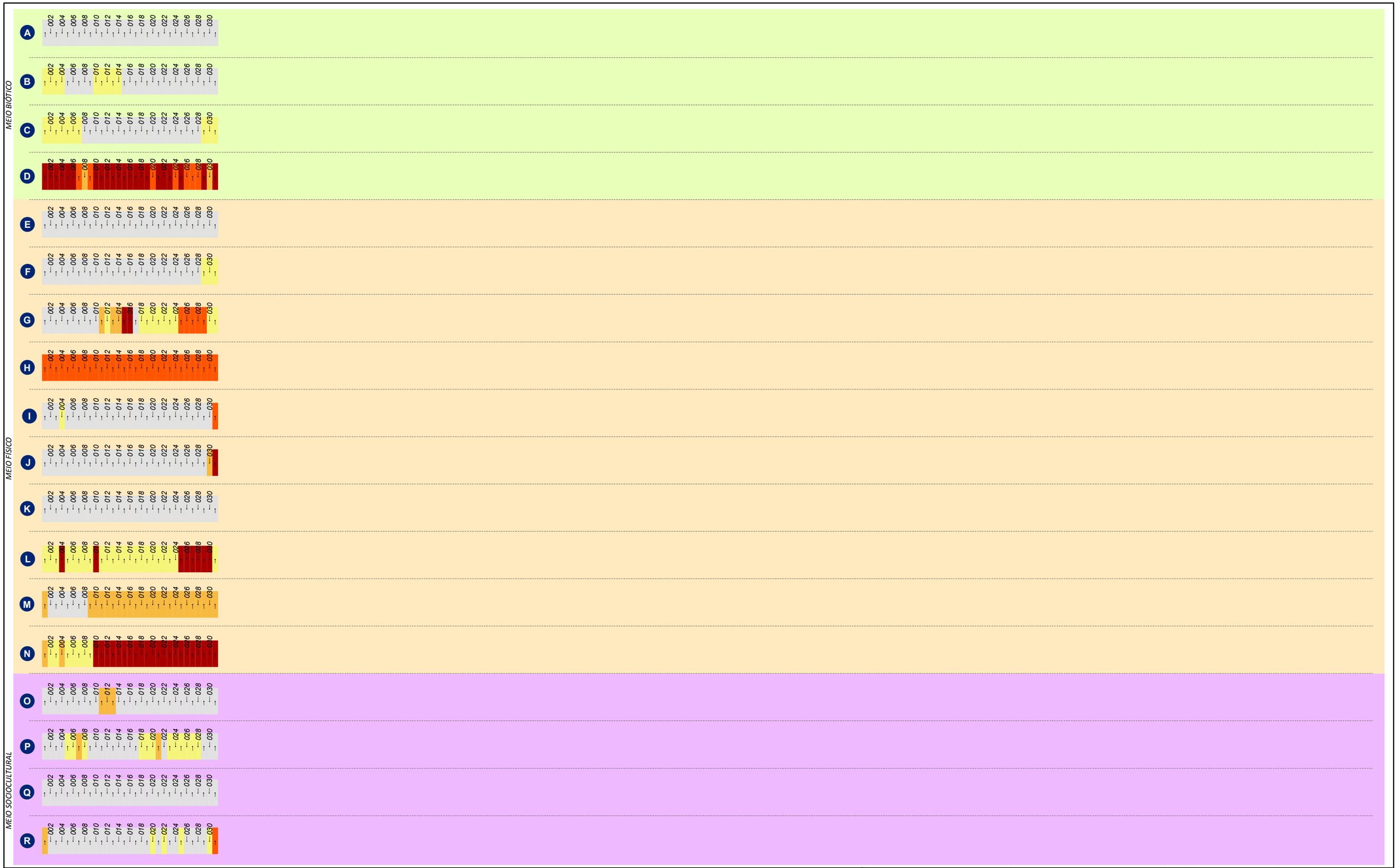
The Grande Waterway is 305 km long and inserts in the São Francisco River basin, which has already been characterized. This waterway connects to the São Francisco River near the municipality of Barra (BA) and was divided into 31 10km-long stretches for analysis purposes.

Map 53: Location of the São Francisco Waterway

The waterway goes through seven municipalities in the state of Bahia and amounts to 261,475 inhabitants (IBGE, 2010). The FIRJAN (2010) index ranges from 0.47 in the municipality of Cotegipe to 0.56 in the municipality of Wanderley.

With regard to the social-environmental vulnerability analysis, it can be seen that on the stretches 01 to 07 in the municipality of Barra (BA) there is an extremely or very high Biodiversity Conservation Priority Area (APCB's). Along the entire waterway at least 70% of the vegetal coverage is preserved. The stretches 11 to 13 in the municipality of Wanderley are in areas of Maroon Lands and have Sustainable use Conservation Units (UCUS), and the stretches 07 at Barra and 21 at Cotegipe have three INCRA settlements.

Stretches having UCPI's and Indigenous Lands were found in this waterway.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
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- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos
- n° < Jusante
- n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

- IN - Insignificante
- BA - Baixa
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- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
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- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

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3.9.1.3 Corrente Waterway

a) Navigability Diagnosis

The Corrente River is one of the major tributaries of the São Francisco River and is located in the Southeast of Bahia. It is approximately 120 km long and its drainage area is about 35,230 km². The Corrente River is formed by the confluence of the Formoso and Correntina (or das Éguas) Rivers, that start at altitudes between 800 and 900 m between Bahia and Goias, on the Espigão Mestre and meet near the city of Santa Maria da Vitória (BH). its mouth is at the São Francisco River, 15 km downstream the city of Bom Jesus da Lapa (BA). The Corrente River is inserted in an ancient alluvial deposits region and sedimentary formations so that the river bed is prevailingly sedimentary.

The climate is semi-humid tropical with high temperatures and rainfalls concentrated from October to April, when it rains on average 93% of the total of the year.

The Corrente Waterway that was considered in this analysis consists of the stretch between its mouth and the city of Santa Maria da Vitória (BA) (stretch 10), the main city covered by the waterway, and is 110 km long.

The Corrente River flows are highly regular along the stretch under study, consequently navigability conditions are also regular. This condition comes from the regularity of the river discharge in the headwaters region, reaching average values in the order of 210 m³/s (see Appendix VII, Item 4.6.3), with the flood period taking place between December and April. Widths are virtually constant, around 80 m, and the average slope, on average lower than 12 cm/km, is favorable to navigation. According to the AHSFRA, the Corrente River does not present significant obstacles to navigation.

Under free current conditions the Corrente River has good navigability conditions for small commercial vessels along the entire alignment of the waterway. The Corrente River receives vessels navigating on the São Francisco River and simple formation of convoys of the state-owned company. Forty ton self-propelled boats that are up to 40 m long navigate with no restrictions, even in curves, provided there is no surpassing at these points.

Minimum depths are about 1.5 m at the lowland and minimum widths are in the order of 40 m (stretches 6 to 11). Rock outcrops are rare.

The Corrente River has greater sinuosity and smaller width at the canal between Porto Novo (BA) (stretch 6) and Santa Maria da Vitória (BA), about 40 km long. The most restricting point to navigation on the Corrente Waterway is on stretch 8, where depth can reach only 1.20 m when waters are at their lowest level.

Figure 3.9.8: Corrente River at Porto Novo (BA) (stretch 6) (Panoramio, 2013)

The existing bridges (stretches 1 and 10) do not represent difficulties to navigation.

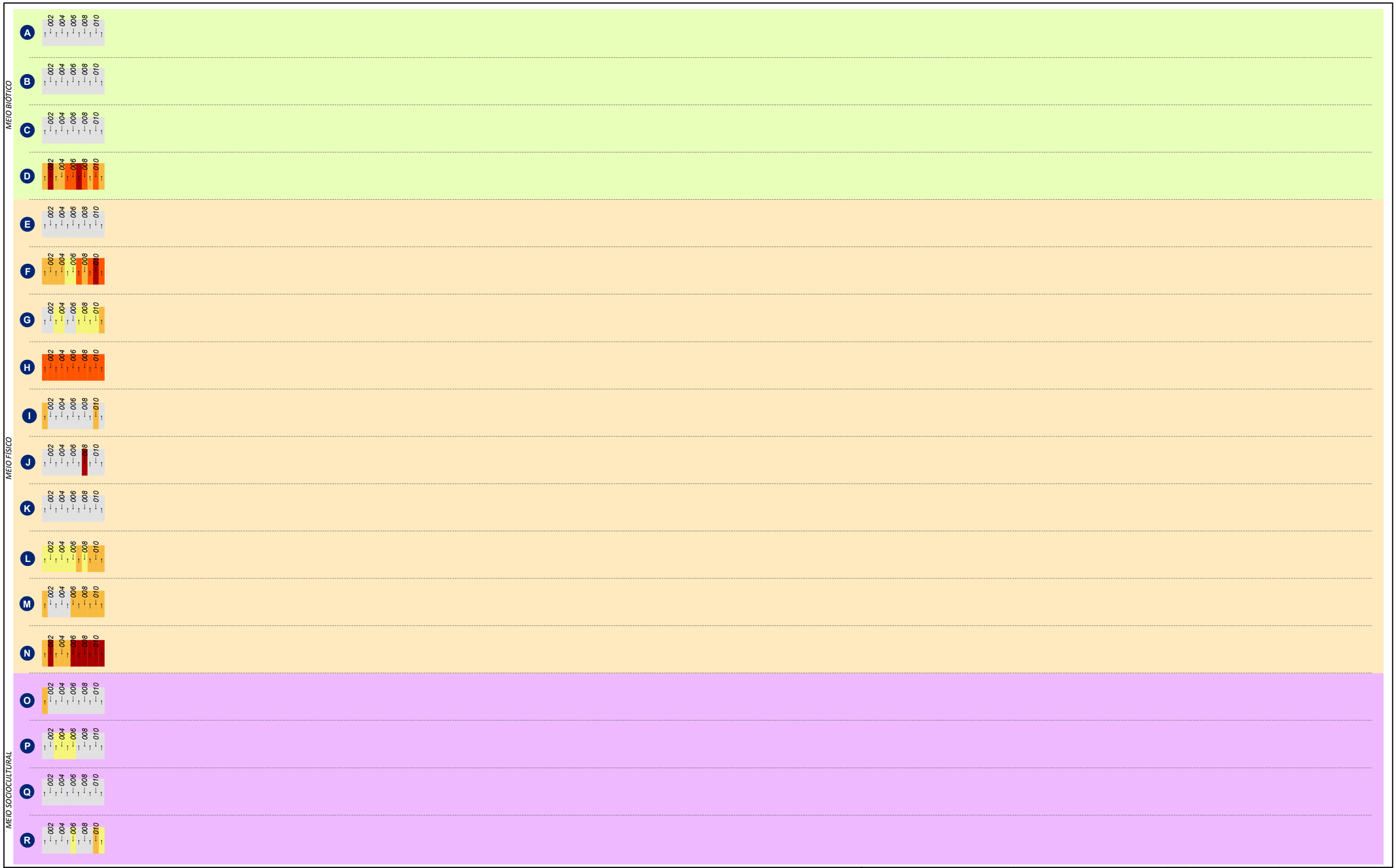
Figure 3.9.9: Footbridge on the Corrente River (stretch 10). (Panoramio, 2013)

b) Social-environmental vulnerabilities

The Corrente Waterway is 103 Km long, inserts in the São Francisco River basin (already described) and connects to the São Francisco River near the municipalities of Sítio do Mato and Bom Jesus da Lapa (BA). The area surrounding this waterway crosses the territory of eight municipalities in the state of Bahia and has altogether 208.555 inhabitants (IBGE, 2010). The FIRJAN (2010) index ranges from 0.56 in the least inhabited municipality, Jaborandi, to 0.47 in the municipality of São Félix do Coribe, but averages 0.51 in the municipalities of the surrounding area of the waterway.

Map 54: Corrente Waterway location

Stretches with Indigenous Lands or Integral Protection Conservation Units were not detected along the 11 stretches that the waterway is divided into. It is worth stressing the significant occurrence of natural cavities along the surroundings of the waterway, which are more frequent on the stretches 07 to 11, between the municipalities of Santana and Coribe in Bahia. With regard to vegetal preservation along the entire area surrounding the waterway, about 50% of the vegetal coverage is preserved, but the stretches 02, in the municipality of Sítio do Mato (BA), and 05 to 07, in the municipality of Santana (BA) should be enhanced for having preservation vegetal coverage of over 70%.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
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- D Desmatamento do trecho

FÍSICO
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N° dos trechos

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n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

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- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

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3.9.1.4 Paracatu Waterway

a) Navigability Diagnosis

The Paracatu river is one of the major tributaries of the São Francisco River and is almost entirely located in the state of Minas Gerais, with only a small part in the state of Goiás. Its drainage area is 45,280 km². Its source is located between the spurs of the Chapada da Ponta Firme and the Serra do Garrote, which are the watersheds with the Paranaíba River at altitudes higher than 1,000 m. It only receives the name of Paracatu near Pontal, 364 km upstream from its mouth. The mouth is located on the left bank of the São Francisco River, about 130 km downstream from Pirapora (MG). Its major tributaries are the Preto and Escuro Rivers on the left bank and Prata and Sono Rivers on the right bank. The Paracatu River geology characterizes by ancient alluvial deposits and sedimentary formations and the river bed is prevailingly sedimentary, with silting problems.

The variability of the climate of the basin is associated with the transition form humid tropical to arid tropical. The annual average temperature is in the order of 27°C and the annual thermal amplitude is low, characteristic of inter-tropical regions. The average annual rainfall of the basin is 1,036 mm. The rainiest quarter goes from November to January, contributing with 55% to 60% of the annual rainfall, while the driest period goes from June to September. The average evapotranspiration is high, of about 896 mm/year. The Paracatu River average flow is 460 m³/séc at the Porto Alegre station (see Appendix VII, item 4.6.4).

The Paracatu Waterway considered in this analysis consists of the stretch between its mouth at the São Francisco, River and the mouth of the Sono River (stretch 11), about 110 km long.

The Paracatu River does not have currently good navigability conditions for middle and large size commercial convoys, especially at the dry season.

The waterway has low average declivities along its course (in the order of 15 cm/km), constant minimum widths of about 100 m and minimum depths of about 1.5 m at the dry season. The average sinuosity is in the order of 1.5. Moreover, the Paracatu River has obstacles to navigation, such as silting, sandbanks, shores and floating islands along the river, which can make several stretches more sinuous, narrow and shallow than the expected.

There are no bridges representing difficulties to navigation.

Figure 3.9.10: Sandbank on the Paracatu River (stretch 2). (Panoramio, 2013)

There are studies prepared by CEMIG, which are not yet concluded, for the implementation of hydroelectric facilities on the Paracatu River. Among them the Paracatu UHE, 93 km from the mouth and with an installed power of 75 MW, stands out. Should it be implemented with a lock system, navigation would be possible from its mouth to about 360 km upstream.

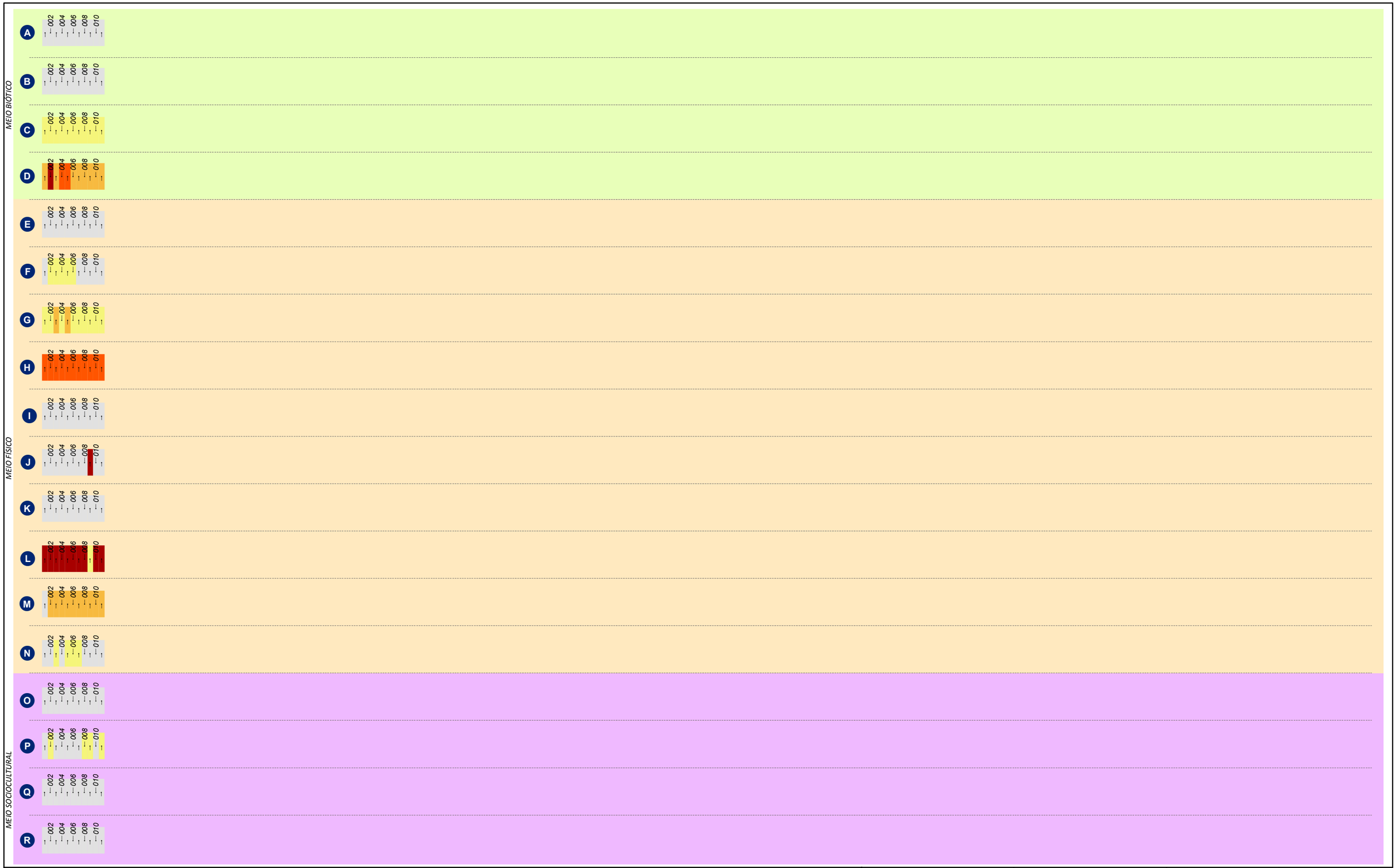
b) Social-environmental Vulnerabilities

The Paracatu Waterway is 103 km long, inserts in the São Francisco River basin (already described) and connects to the São Francisco River at the border of the municipalities of Santa Fé de Minas and Buritizeiro in Minas Gerais.

Map 55: Paracatu Waterway location

The waterway goes through five municipalities in Minas Gerais, which represent a population of 94,342 inhabitants (IBGE, 2010) altogether. The FIRJAN (2010) index ranges from 0.53, in the municipality of Santa Fé de Minas to 0.67 in the municipality of Brasilândia de Minas.

With regard to the social-environmental vulnerability, of the 31 stretches the waterway is divided into only stretch 03 – between the municipalities of Buritizeiro and Santa Fé de Minas in Minas Gerais – are worth to be mentioned as they preserve most part of their vegetal coverage (around 83%). It is also to be enhanced that along the entire length of the waterway there are Biodiversity Conservation Priority Areas (APCB's) with extreme and very high action priority.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

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PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO PARACATU	MAI/2013

3.9.2 Economic Aspects

3.9.2.1 Current inland waterways transport

Currently, there is only one company operating on the São Francisco River. Between Petrolina and Ibotirama approximately 50 thousand tons/year of cotton seeds are being transported annually. On the stretch between Pirapora and Ibotirama (732 km) currently no waterway transport exits. This stretch currently has a minimum draft of 1.20 m during the most critical periods of drought. Between Petrolina and the mouth of the river there is also no inland water transport. On this stretch, the Sao Francisco River suffers from river sand banks, rock formations and dams.

3.9.2.2 Planned developments

Sao Francisco transposition project

The federal Sao Francisco transposition project started in 2007 and has been partially stopped for about a year. The transposition project includes digging two channels to take water from the São Francisco river to 12 million people in 390 cities in Pernambuco, Ceará, Rio Grande do Norte and Paraíba by 2025. This may influence (potential) shipping activities on the river itself.

Figure 3.9.11: São Francisco River Transposition Project

Ports

The ports of Ibotirama and Petrolina (managed by Comtrap) each have one terminal which is in use by Icofort for transportation between these cities. The ports of Pirapora and Juazeiro are currently in no condition to operate. The equipment is outdated and the buildings are dilapidated. The port of Pirapora is out of function since 1998. Furthermore no seaports are connected with the São Francisco.

Trade flows hinterland Sao Francisco

Total export of the states in the hinterland, the influence area of the Sao Francisco river was in 2011 and 2012 approximately 200 million ton. Four main groups of exported commodities can be distinguished:

- Agricultural: soy beans, soy meal, sugar and cotton;
- Ores and metals: Iron ore, iron and steel
- Wood related: Pulp;
- Oil related: Petroleum oils.

Agricultural products like soy beans, soy meal and sugar seem to gain importance in the influence region of the Sao Francisco. The exports of iron ore is handled in the ports of Rio de Janeiro and Vitoria. This is part of a logistic system with dedicated rail tracks. Hence, Sao Francisco River will not be likely be able to play a role in the exports of these commodities. Petroleum oils are handled in the port of Aratu. The Sao Francisco cannot play a role in this transport flows, as this port is not connected to the river system. The wood related transport (pulp and paper) is concentrated in Bahia. The export is handled in the Port of Salvador. Here too, the Sao Francisco will not be able to play a role. The conclusion is that, based on the export analyses, only the exports of agricultural commodities are potential flows for the Sao Francisco.

Concerning imports, two main groups of commodities can be distinguished:

- Fuels and basic materials coal, cokes petroleum oils and gases
- Agriculture: Fertilizers

Only the imports of fertilizer are potential flows for the Sao Francisco.

3.9.2.3 Future inland waterways transport

The transport forecast for the Sao Francisco River is somewhat different from other forecasts because at the moment virtually no transport takes place on this river. Current transport only takes place between Petrolina and Ibotirama (cottonseeds).

From the trade analyses agricultural products come forward as potential commodities for exports (soy, soy meal, corn) or imports (fertilizers). However Sao Francisco River lacks good seaport facilities. All commodities mentioned in the previous chapter are exported or imported. This makes it a necessity to transport these commodities to a seaport for exports or from a seaport in case of imports. If a seaport cannot be reached directly by IWT (as in the case with Santos) terminal facilities for transshipment to other modes like rail or road should be available. This logistic infrastructure is currently lacking and neither are we aware of any developments to improve this logistic bottleneck.

Another question is whether domestic flows can be found that could be transported by IWT. Some small flows exist (cottonseeds), but few other flows could be found. Currently the only

navigable part is the stretch between Petrolina and Ibotirama. Further expansion in southern direction to Pirapora would increase the possibilities because at Pirapora a rail connection with seaports (Rio de Janeiro). It is still hard to see for which flows this might be an advantage. Especially because the importance of Northern ports is increasing and the export of agricultural products from and imports of fertilizers to West Bahia will probably use Vila do Conde or Itaqui as seaport (by rail or via the Tocantins River).

The current transport flow (cottonseed) might grow because of the growth expectations for cotton (+ 15% in the period 2011 – 2022 in Bahia). This leads to the following forecasts:

Table 3.9.1: Cotton transport on São Francisco (in 1.000 tons)

	2011	2015	2023	2031
Cotton	50	53	58	61

In view of the (lack of) infrastructural and logistic developments as described above, we do not see a market for other commodities for transportation on Rio Sao Francisco in the future.

In other studies however the future cargo flows on Rio Sao Francisco are estimated far higher, leading to projections of around 15 mn. tons in 2030. Also the development of a multimodal São Franciso corridor is seen as suitable instrument in view of regional economic development. The difference in transport volumes compared to our estimates originates from:

- A much wider range of products, judged to be suited for transport by IWT;
- Assuming navigability on a large stretch of São Francisco River from Pirapora to Juazeiro;
- Taking into account commodities for export as well as internal (Brazilian) markets;
- The (cost) competitiveness of São Francisco compared to other waterway systems, sharing (partly) the same hinterland (e.g. Tocantins-Araguaia) and export sea ports.

In our Diagnosis study we retain our – cautious - approach concerning the potential transport volume for Rio São Franscisco in order not too overstretch demand projections. However in the Strategy and Plan Phase attention should be paid to interlinking with the ongoing studies and programs for this river basin.

3.9.3 Transport System

3.9.3.1 Transported Cargo

Today, the São Francisco Waterway system is only navigated between Petrolina and Ibotirama, and in 2011 only 50,000 tons of cotton pies were transported. For the horizon of the project large cargo volumes to be moved were not identified.

3.9.3.2 Infrastructure

This item describes the existing infrastructure in the waterway system that, as stated in Chapter 3.9.1, comprises the Corrente, Paracatu, Grande and São Francisco rivers.

a) Waterway/River infrastructure

The physical characteristics of the waterway complex of the São Francisco River, as well as the existing and planned dams, have been mentioned in Chapter 3, item 3.9.1. Thus, only ports/terminals and the existing lock will be described.

Ports/Terminals

For the analysis of the São Francisco Waterway System terminals the database resulting from the PNIH was used, and information collected during the interviews and those coming from recent reports were aggregated. 21 terminals are listed in this base, 10 of which do not have information as to their status and 2 are operative. The number of terminals per status can be seen in the table below.

Table 3.9.2: Status of the ports of the São Francisco Waterway System (source: Developed from PNIH database, 2013).

Status	Quantity	Percentage
Not in operation	2	9,5%
In operation	2	9,5%
Planned	7	33,3%
No information	10	47,6%
Total	**21**	**100%**

The analysis of the current status was made based on the data of the terminals classified as “Operative”, the remaining terminals were not considered.

The table 3.9.3 shows the two ports that are in operation in the region, as well as the rivers where they are located and land connections.

Table 3.9.3: Relation of the major operative Ports/Terminals (source : Developed from PNIH database, 2013).

Port/Terminal	Type	Location	Land Connections
Ibotirama	Public Port	São Francisco River	BA-160 BR-242
Petrolina	Public Port	São Francisco River	BR-407 BR-128

During the interviews it was verified that these terminals are operated by private companies, the CONTRAP (Paraguaçu Transportes e Operações Portuárias Ltda). Both handle cotton pies, lints, cotton oil and biodiesel from the only company that makes transports on the São Francisco, the ICOFORT.

The ports of Pirapora and Juazeiro, which are not listed, are today in unreliable conditions for the operation, according to what was reported by the interviewed who work in the region.

Locks

The São Francisco waterway system has only one lock, whose characteristics are described in the table below.

Table 3.9.4: Characteristics of the Sobradinho lock (source : AHSFRA).

Lock	Operator	Dimensions (length x width x nappe)	River
Sobradinho	AHSFRA	120m x 17m x 4m	São Francisco

This lock was dimensioned for the convoy of the shipping company FRANAVE, that no longer exists. The convoy is 120 m long, 16 m beam, draft of 1.5 m and capacity ranging from 1,800 ton to 2,200 ton.

According to the document “Relatório das Hidrovias Brasileiras” (report on Brazilian waterways) of 2008, the time to fill the lock is 18 minutes at the utmost; however, ICOFORT pointed out that the time to pass through the lock can reach 4 hours, with cases where this time was exceeded in function of the wait for flow release from the hydroelectric operator.

According to the document “Normas e Procedimentos da Capitania Fluvial do São Francisco”tandards and procedures of the São Francisco River authority), vessels must inform lock administration 48 hours in advance their intention of using the lock within the established days and timetables: from Monday to Friday, from 08:00 a.m. to 12:00 and from 2:00 to 6:00 p.m. In case the transport in the São Francisco waterway system intensifies, these restrictions in time may be altered, as it has already occurred in the Tietê-Paraná system.

Highways

The highways that are part of the São Francisco waterway complex are described below.

BR-030

The BR-030 is a radial Federal highway in Brazil. Its starting point is in Brasília (DF) and the end point is in Maraú (BA). It passes through the Federal District and the states of Goiás, Minas Gerais and Bahia. The highway has also several not built streches in Minas Gerais and Bahia, where the stretch between Mirante (BA) and Boa Nova (BA), crossing the BR-116, does not exist. With regard to the fianal stretch, between Aurelino Leal and Barra Grande, it is being implemented. The highway is 1158,0 Km long (including the not yet built stretches).

In the stretch from Cariranha (BA) to the junction with the BR-407, the BR-030 is a paved road, single roadway, with narrow shoulders e slightly sinuous alignment. In spite of the evident lack of investments in structure in the region, the quality of the pavement is good. The highway crosses various eolic energy generation parks on its way, a fact that attracts some investments in roadway maintenance.

BR-135

The BR-135 is a highway connecting the middle of Brazilian Northern region (Maranhão) and ending in Belo Horizonte (Minas Gerais), competing with BR-040 between the junction of both highways in Paraopeba and Belo Horizonte, in Minas Gerais. Its conservation status is very bad in Northern Minas Gerais, and so far it is not paved on various stretches, especially in Bahia. Being a highway that goes through poor and poorly developed regions in Brazil (Northern Minas and the Northeastern outback), it has been left in a vary bad conservation status or with no paving design on various stretches. When it is concluded it may be a competing route for the São Francisco Waterway, but there is no time limit for this to occur.

BR-235

The BR-235 is a Brazilian transverse highway connecting Aracaju, in Sergipe, to the Brigadeiro Velloso Proving Grounds in Novo Progresso, in Pará. It crosses the states of Sergipe, Bahia, Pernambuco, Piauí, Maranhão, and Tocantins, in addition to Pará, along its course.

It is one of the most complicated highways in Brazil, as most of the highway is not paved and various stretches do not exist. Basically, it is paved only in the state of Sergipe, betwen the cities of Petrolina (PE) and Remanso (BA), and on the stretch between Guaraí (TO) and Santa Maria do Tocantins (TO).

The BR-235 could represent high competition to the São Francisco Waterway, as it would be connecting two large regional hubs, Petrolina (PE) and Juazeiro (BA), to the port of Aracaju (SE) on a virtually straight alignment. The paving works are under way, but their conclusion is not anticipated.

BR-242

The BR-242 is a Brazilian transverse highway. BR-242 is the main access road to the ecotouristical region of the Chapada Diamantina in the state of Bahia. it is 2.311,7 Km long and connects the following cities, some of which are the major producers of agricultural bulks: Itaberaba (BA), Lençóis (BA) (just 11 Km far from the highway), Seabra (BA), Barreiras (BA), Luís Eduardo Magalhães (BA) and Salvador, and is complemented by a small stretch of the BR-116

and BR-324 highways. The main crossing of this highway within this system is the São Francisco River in Ibotirama.

in the state of Bahia, the only non-paved stretch is located in the municipality of Luís Eduardo Magalhães, between the junction with BA-460 and the Tocantins border. This stretch is just 49 Km long. With a new design, the intentions of extending the highway are being discussed. The BR 242 would have its new route connecting Salvador to its ground Zero in the port, crossing the Baía de Todos os Santos, connecting Itaparica island to São Roque do Paraguaçu in the municipality of Maragogipe. This stretch also is in unreliable conditions up to Eduardo Magalhães, inside the Industrial Center in the town, where holes and lack of shoulder impair the passage of vehicles. It must be remembered that this stretch is the main means of locomotion for trucks transporting cargo (soybean, corn and cotton) from the producing regions in Western Bahia.

BR-324

The BR-324 is a Brazilian federal highway that starts in Balsas, Maranhão and ends in Salvador (BA). it has an important function, that of interconnecting the highway junction in Feira de Santana to Salvador, becoming one of the major highways in the state of Bahia. Between Feira de Santana and Salvador it has two roadways. After that, the highway is paved until the Jacobina region. The stretch that connects Feira de Santana to Salvador was privatized and is under concession of the Via Bahia. It has two toll stations, the first of which is in the municipality of Amélia Rodrigues.

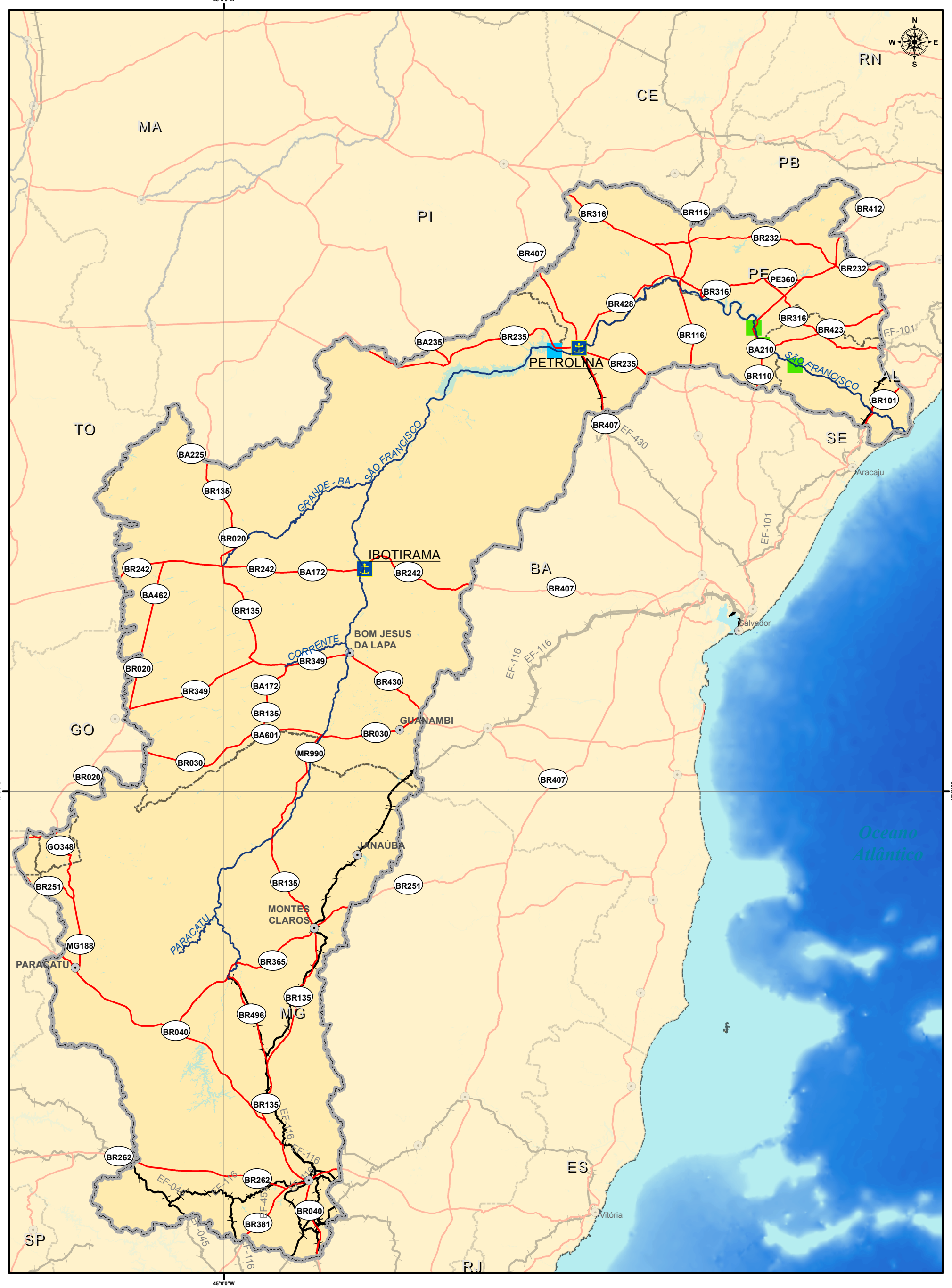
BR-407

The BR-407 is one of the greatest connection highways in Brazil, is 1,482.6 km long, and cuts three states: Bahia, Pernambuco and Piauí. It starts in Vitória da Conquista, then goes through the Chapada Diamantina region and later through municipalities such as Senhor do Bonfim. The bridge on the São Francisco River, which divides the cities of Juazeiro and Petrolina, is one of the busiest bridges in Brazil.

Its alignment cuts the state of Bahia from northwest to south, connecting cities like Juazeiro to the port of Ilhéus, which is complemented by the BR-415 highway. On this stretch the BR-407 is composed of two single roadways, with narrow shoulders at both sides.

BR-415

The BR-415 is a Brazilian federal highway located in Southeastern Bahia. it connects Vitória da Conquista to the Costa do Cacau (Ilhéus and Itabuna). Nevertheless, on the stretch comprised between Ilhéus and Itabuna the movement is intense due to many double-train trailer-trucks the unload soybean from Western Bahia in the port of Ilhéus. On its way, the BR-415 is basically composed of two single roadways with narrow shoulders and very good quality paving.



CONVENÇÕES CARTOGRÁFICAS	REFERÊNCIAS	LOCALIZAÇÃO DA FOLHA
Capital Estadual Limite político adm. Hidrovia Massa d'água Portos e terminais Cidades principais Barragem existentes Barragem sem eclusa Barragem com eclusa Infraestrutura de transportes Rodovias Ferrovias	Fontes: - Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010 - ANA, 2010 - PNTL, 2010 ESCALA GRÁFICA 0 35 70 140 km SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69	

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

TRANSPORT CHARACTARISTICS HIDROVIA DO SAO FRANCISCO

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:5.000.000	- BRASIL -	JUL/2013

Railways

The railways that are part of the São Francisco waterway complex are described below.

EF-025

The EF-025 interconnects the EF-116 to the city of Salvador (BA), but the design connects it to Brasília (DF). The EF-025, named Ferrovia Centro - Atlântica S.A. [center Atlantic railway] has a metric type gauge and the main cargo transported are oil products, cement, limestone, soy meal, wheat and soybean. It is operated by the Vale company. Its importance results from the connection of the port of Salvador to the EF-116, that cuts the entire upstream region of the São Francisco Waterway.

EF-116

The EF-116 will be a longitudinal railway connecting Ceará, Pernambuco, Bahia, Minas Gerais, São Paulo, Paraná and Santa Catarina. The EF-116 forms today the north stretch of the Transnordestina railway between Salgueiro and the Port of Pecém, in Fortaleza's metropolitan region, and the stretch between Belo Horizonte (MG) and Iaçu (BA), where is the junction with EF-025.

The EF-116, named Ferrovia Centro - Atlântica S.A. [center Atlantic railway] has a metric type gauge and the main cargo transported are oil products, cement, limestone, soy meal, wheat and soybean It is operated by the Vale do Rio Doce company.

EF-430

The EF-430 connects Campo Formoso (BA) to the EF-101 in Alagoinhas (BA), which connects ahead to the port of Salvador (BA). The EF-430, named Ferrovia Centro - Atlântica S.A. [center Atlantic railway] has a metric type gauge and the main cargo transported are oil products, cement, limestone, soy meal, wheat and soybean. This railroad connects from Senhor do Bonfim to Juazeiro.

EF-101

The EF-101 connects the port of Salvador (BA) to the EF-430 in Alagoinhas (BA). After Alagoinhas (BA) the EF-101 continues the alignment towards the Brazilian extreme north, interconnecting the cities of Maceió (AL), Recife (PE), João Pessoa (PB) and Natal (RN). The EF-101, named Ferrovia Centro - Atlântica S.A. [center Atlantic railway] has a metric type gauge and the main cargo transported are oil products, cement, limestone, soy meal, wheat and soybean. It is operated by the Vale company.

3.9.3.3 Characteristics of the existing fleet and the operating companies

a) Vessels

Currently, the only navigation company operating in the São Francisco Waterway System is Icofort. It has five barges that amount to a 2,000 ton capacity. As it has already been mentioned, navigation takes place only on the stretch between Petrolina and Ibotirama. The table below shows the characteristics of the vessels.

Table 3.9.5: Characteristics of the vessels operating on the São Francisco waterway system (source : Icofort).

Company	Total static capacity (in tons)	Minimum nominal capacity of the lighters (in tons)	Maximum nominal capacity of the lighters (in tons)	Quantity of lighters	Maximum beam (m)	Maximum nominal draft (m)	Average age (years)
Icofort - Agroindustrial Ltda	2.000	400	750	13	11	1,40	N/D

Although the maximum nominal draft is 1.40 m, it is only possible from mid November to March. From July to October the draft is 1.10 m and the capacity of the lighter is reduced to 214 tons; at the beginning of November the draft is 1.25 m and the capacity is 357 tons.

The company indicated that uses two different types of convoy formation, with six and seven barges. The figure below presents the one with seven, which was the only one that further information could be found. For the pushboat dimensions, data available on the ANTAQ Statistical Yearbook of 2011 was used, the push boat with the highest power was considered. However the width of this was not available, so it was assumed to be the same as the others (4 m).

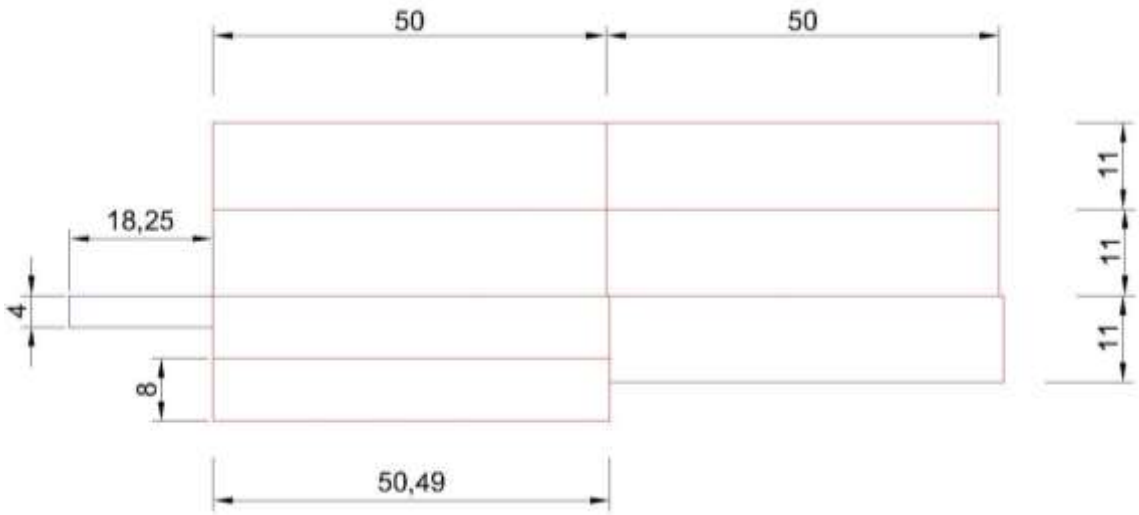


Figure 3.9.12: ICOFORT train with 7 flat, measured in meters (Elaborated from company data and photo obtained from another source [53]).

[53]http://www.novoeste.com/index.php?page=regionais&op=readNews&title=Dragagem+beneficia+transporte+hidrovi%E1rio+no+Rio+S%E3o+Francisco

b) Pushers

The characteristics of Icofort's pusher fleet are shown in the table below. As indicated by the company, the maximum cargo capacity is 6,000 tons.

Table 3.9.6: ICOFORT convoy with 7 barges, in meters (Based on ICOFORT data and on photos from other sources)

Company	Maximum Potency	Minimum Potency	Maximum Potency	Quantity of pushers	Average age (years)
Icofort - Agroindustrial Ltda	286	176	500	3	25

3.9.3.4 River Information Management System

The São Francisco waterway is under AHSFRA administration, which is responsible for the maintenance of the waterway (more details of AHSFRA assignments can be found in Chapter 3.9.4).

Information referring the signaling system along the waterway was not found. It exists only in the area where the lock is implemented. It was said that there is no entity in charge of measuring water level and remitting the information to the shipping company

In order to guarantee some safety level to navigation, the company has its own outlines, but even so various problems related to accidents and running aground occur.

3.9.3.5 Intermodal Competition

In function of the low cargo volumes transported, there is no intermodal competition today. As pointed out in Chapter 3.9.2, a significant growth in cargo volumes is not expected, therefore the analysis of intermodal competition was not made.

3.9.4 Governance and institutions

The São Francisco River is born in Minas Gerais, at the Serra da Canastra, is 2,700 km long, and runs into the Atlantic ocean, at the border between Alagoas and Sergipe. As already described, the waterway has two long navigable distances, the first of which is located between Pirapora –MG and Petrolina-PE/ Juazeiro-BA and the second between Piranhas-AL and its mouth. Other river stretches, with correct interventions may also become navigable. According to information from the Waterway Administrator (AHSFRA), the São Francisco behaves as a very young river, in constant change, making the mapping of the points where dredging is necessary difficult, not to speak of the volume to be dredged.

The navigation history on the São Francisco goes back to the end of the 19th century, with steam navigation. Since then this type of navigation and, more recently, diesel navigation, has been occurring on the middle course of the river and its tributaries. The "Gaiolas", old steam

boats with a wheel, remains from the Mississipi, traveled until the mid 70s. Today there is only one of these ancient “Gaiolas” left, the Benjamim Guimarães steam boat.

The São Francisco River has been occupying an outstanding place in the national waterborne transport, and has even been named the River of National Integration during the Military Regime. Due to this historical importance, various institutional actors are present on the waterway; to facilitate its view a table was created relating the main agents in water and port management of the São Francisco Waterway and their main activities. Through this table it is possible to view in a synthetic manner which institutions have the same working area. It is worth stressing that such assignments reflect the content anticipated by the legal text that defines them, not portraying, in some cases, their real work. The assignment of each of them is described in the Annex, and along the text some specific assignments will be enhanced, as well as the description of how they interact with each other.

Table 3.9.7: Formal assignment matrix of the São Francisco Waterway agents

	Port administration	Inspection	Waterway maintenance	Licensing Process	Regulation
Waterway Administration - AHSFRA	■		■		
São Francisco River Captaincy		■			
DERBA	■				
Environmental Secretariats				■	
DNIT/DAQ			■		■
ANTAQ		■			■
IBAMA				■	■
Other Agents**				■	

*Achievement of dredging, rock excavation, signaling.
** This block encompasses all the agents consulted by IBAMA within the licensing process (Fundação Palmares, FUNAI, INCRA, IMCbio, IPHAN, Public Ministry

Source : Arcadis Logos Consortium, 2012

The São Francisco Waterway lies under AHSFRA (Administração da Hidrovia do São Francisco) responsibility, a federal agency responsible for waterway and port infrastructure linked to CODOMAR through a covenant, but technically and budgetary to the DNIT. Its main competence is providing maintenance services to and improving navigability conditions of the São Francisco River and its navigable tributaries, keeping them in full conditions for the achievement of commercial navigation. Seated today in Pirapora, it keeps the maintenance of the facilities of the Port of Pirapora, besides being responsible for the fixed signaling of the banks and floating beaconage; dredging to remove silt in the navigation channel; operation and maintenance of the Sobradinho-lock (BA); topobathimetry for the definition of a navigation channel; monitoring water conditions of the São Francisco River and its tributaries; monitoring and environmental management of the maintenance activities in the waterway,

among other activities. No duty is charged by AHSFRA for the use of Sobradinho lock, since AHSFRA is a public company.

Even having great historical importance, the São Francisco Waterway is about to have its navigation interrupted by lack of maintenance works on the waterway. In 2011, only two points were dredged, and none in 2012. Today only the stretch between Ibotirama and Petrolina (610 Km) is operative, transporting soybean, soy meal, corn, and cereal husks. Such facts result from the difficulty for AHSFRA to obtain grants, being not possible to carry out its assignments. The conditions become even more critical at the time of the river drought, that takes place simultaneously with the period of greater grain production, thus resulting in greater flow and therefore greater demand through the waterway. In order to solve such deadlock it is necessary to make dredging interventions to remove silt, as well as to invest in grain storage terminals, enabling to dispose of them in flood periods.

In addition to the bad quality of the waterway itself, in the ports built on its course (Port of Petrolina, Port of Juazeiro, Port of Pirapora and Port of Ibotirama) only the Petrolina and IbotiramTerminals are operative, being the latter a private terminal. There is also an institutional problem, since the ports belonging to the DNIT are leased and they do not know to whom to respond, whether to the DNIT or CODOMAR.

The Port of Pirapora, under AHSFRA responsibility, was built in 1978, at the beginning of the waterway, and is now not operative, but its facilities are well preserved and can be used should it be necessary to meet possible demands. While the port of Juazeiro was built ten years ago, never was operative and is still disabled. This port is currently undergoing works aiming at its recovery, requalification, dredging and urbanization of the area, under the responsibility of the Departamento de Infraestrutura de Transportes da Bahia (DERBA) [department of infrastructure of transports], and as soon they are concluded ANTAQ shall classify the Port (public with private right of operation) and the tender document will be issued..

The Port of Petrolina, linked to the Secretaria de Desenvolvimento Econômico [economic developments secretariat] of the State, is currently the only public port in operation on the waterway, being managed by COMTRAP, a transport and storage logistics company whose main transported inputs are: soybean, corn, cotton, oil, and resin. The company is established in the very river port of Petrolina-PE, in the area reserved to the industrial district.

The licensing of the São Francisco Waterway is made by the IBAMA, as the waterway flows in three states (Minas Gerais, Bahia and Pernambuco). The IBAMA shall consult with the Secretarias Estaduais de Meio Ambiente [environment state secretariats] to check whether the design is technically in accordance with their plans and rules Infrastructure maintenance works at specific points can be made by the secretariats themselves, just informing the IBAMA the project opening and closure and sending the generated documents. In the case of Minas Gerais, the responsible agency is the SEMAD through the Feam (fundação estadual de meio ambiente) [state foundation for the environment], in Bahia it is the SEMA and the INEMA (Instituto de Meio Ambiente e Recursos Hídricos) [environment and water resources institute] and, lastly, in Pernambuco it is the Secretaria de Meio Ambiente e Sustentabilidade [environment and sustainability secretariat] of Pernambuco.

In 2000 the IBAMA obtained the permit for rock excavation of the waterway and in 2002, the permit for dredging to remove silt, but the latter could not be reauthorized due to the new dredging act (Provisional Measure Nº 595 of December 6 of 2012.). According to AHSFRA's superintendent, the great problem the administrator is addressing is the fact that the IBAMA considers river dredging equal to sea dredging, although they are indeed very different, and this factor makes the obtainment of the permit difficult and adds to lack of continuity in the licensing processes and little specific knowledge of the relevant characteristics for the licensing of interventions in rivers. In December of 2012 a RCA/PCA [environmental report and plan] was being prepared for the licensing of dredging works to remove silt from the waterway on the stretch from Pirapora to Ibotirama.

The River Captaincy of the São Francisco inspects vessels, as well as the waterway itself, aiming at guaranteeing the safety, agility and reliability of this transport modal, having as main focus signaling standards; in case they are not being obeyed, the Captaincy informs the Administration to adjust them.

Besides AHSFRA, other institutions are interested in the São Francisco Waterway. The state of Bahia established the Secretaria Extraordinária da Indústria Naval e Portuária – SEINP (Attachment I), for the purpose of giving agility to the actions of the state government, in Bahia, when implementing projects. The SEINP looks after experiences to determine the public policies for the São Francisco Waterway by exchanging experiences with other states on waterway management. Its purpose is promoting the interconnection of the Porto Sul modal in progress to the Ferrovia Oeste Leste (Fiol) [west-east railway] and the revitalization of the São Francisco Waterway in order to enable soybean and iron ore production from the Barreiras and Luiz Eduardo at lower costs and greater capability. The SEINP maintains a direct interface and good relationship with ANTAQ with regard to exchanging information on river ports in the state.

There is also the Secretaria Estadual de Infraestrutura da Bahia – SEINFRA (Attachment I), whose assignment is transport management through the Departamento de Infraestrutura de Transportes – DERBA (Attachment I); as already presented, DERBA is making works to requalify the Port of Juazeiro. SEINFRA is interested in activating the São Francisco Waterway because they consider it an important modal for Western Bahia production flow. They see modal integration, resulting in the activation of the Estrada de Ferro da FCA and the waterway to the Port of Aratu, as a good opportunity But the SEPLAM – Secretaria de Planejamento do Estado da Bahia (Attachment I) understands that the waterway is national, that is to say, the Federal Government's responsibility, thus, do not working in this waterway.

There is the possibility of establishing covenants or agreements between the interested public institutions, such as AHSFRA and the government of the state of Bahia, but so far this matter has been very little discussed. One of the waterway fragilities is the inexistence of a technical committee formed by the states (MG, BA and PE) and AHSFRA for the specific discussion of the waterway issue.

The Comitê da Bacia Hidrográfica do Rio São Francisco – CBHSF [committee of the hydrographic basin of the São Francisco River] is the agency that addresses the basin as a whole but its nature is very extensive, trying to achieve the decentralized and participative

management of the water resources of the basin with the prospect of protecting the fountainheads and contributing to its sustainable development. The purpose of the CBHSF is to implement the water resources policy in the entire basin, to establish local behavior rules, to manage local conflicts and interests without directly acting on the waterway topic. Besides this committee, that deals with the basin as a whole, along the São Francisco waterway there are various other Committees of Hydrographic Basins, each of them composed of representatives of public agencies and entities interested in the management, offer, control, protection and use of water resources, as well as representatives of the municipalities contained within the corresponding Hydrographic basin, the users of the waters and the Civil Society, who have actions in the water resources area, all of them through their associations. Besides approving the Plano de Recursos Hídricos [water resources plan] of the basin, the purpose of such committees is to mediate conflicts on water use as first administrative instance, to establish mechanisms and suggest values to be charged for water use

Moreover, there is also the Companhia de Desenvolvimento do Vale do São Francisco, CODEVASF (Attachment I), a public company linked to the Ministério da Integração Nacional (Attachment I) [national integration ministry], that acts to promote the development of the São Francisco basin and its revitalization by using natural resources in a sustainable manner and the structuring of production activities for its economic and social inclusion. They conduct studies to come to know the potentialities of the region in order to plan the actions that promote the development of the actuation in the area related to irrigated agriculture, to fish farming stations, to the Arranjos Produtivos Locais (APLs) [local production arrangements] or to the revitalization of the hydrographic basins. Jointly with AHSFRA they are creating a partnership to conduct a study for the clearing of critical points, bank contention works, disciplining of the river course and riparian reforestation, among others.

3.9.5 SWOT São Francisco Waterway System

Strengths	Weaknesses
• CODEVASF has been conducting studies together with AHSFRA to improve navigation conditions in the region. • The Sobradinho lock is operative. • The stretch between Ibotirama and Juazeiro/Petrolina is navigablel, wirth few obstacles to navigation (sedimentation and depth near Jussara/BA)The stretch between Ibotirama and Juazeiro/Petrolina is navigable, with few obstacles to navigation (sedimentation and depth near Jussara/BA) • Most natural obstacles between Ibotirama and Juazeiro/Petrolina are well signaled.	• AHSFRA faces difficulties to work, imposed by lack of access to financial and human resources (due to the covenant signed between DNIT/DAQ and CODOMAR). • Interventions in this region must consider the presence of indigenous communities, as well as Integral Protection Conservation Units (especially around the S. Francisco River). • High level of sedimentation on the entire São Francisco River bed. • The stretch between Pirapora and Ibotirama has many physical obstacles and the maintenance of the river depth depends on the operation of the Três Marias Dam. • The stretch between Ibotirama and the Sobradinho Lake has some rocks and parts with small/little/shallow depth. • The operating regime of the Sobradinho Dam influences navigability on the stretch between the Sobradinho Dam and Petrolina. • The São Francisco River is not navigable downstream from Petrolina/Juazeiro. There are many natural obstacles: small depth and three dams without locks. • Today there is not significant cargo volume transported through the river (there is the transport of cotton pie between Ibotirama and Petrolina) nor an important casrgo prospect until 2031.

Opportunities	Threats
• Promoting regional development in the semi-arid region through integrated planning in the region.	• Intensification of the use of the waterway may bring/causeok greater anthropic/man occupation of the river banks, a fact that might affect water quality and increase the sedimentation of the river bed, in case this is not done with proper public planning.

3.10 TOCANTINS WATERWAY SYSTEM

3.10.1 Physical system of the river, its social and environmental aspects

The Hydrographic Region (HR) of Tocantins-Araguaia, the second largest in Brazil, is composed of the area of 4 hydrographic basins: Araguaia, Marajó, Pará, and Tocantins, located in the center of the country between the North and Midwest regions. Because of its longitudinal length, the HR crosses the Amazon biome (in the north and northwest) and the Cerrado biome in the other areas.

The total area of these basins is 918,243km^2, partially intercepting the territory of 5 states: Pará (PA), Mato Grosso (MT), Tocantins (TO), Maranhão (MA), and Goiás (GO), apart from a small portion of the north of the Federal District.

Six potentially navigable rivers or future waterways that will make up the Tocantins-Araguaia Waterway System (WS) are in this HR. Pará, Tocantins, Araguaia, Itacaiúnas, das Mortes, and Javaés Rivers. These rivers, apart from its upstream stretches, currently admit precarious and seasonal navigation. The privileged geographic location, however, which may be observed on Map XX, and the energy works being planned or executed have all the conditions necessary to turn them into waterways.

The analyses and studies carried out to characterize the physical, social, and environmental conditions of the potential waterways in the Tocantins Waterway System followed the methodologies described in Chapter 1 – item 1.3 – Methodology, of this report.

Due to the vast amount of information collected and analyzed, the present chapter presents a summary of the main results and conclusions for each river studied.

The CD attached to this report (Step C: Assessment and diagnosis) presents a .xls table that contains more details about all the variables and information analyzed for each river and each stretch studied.

The Linear Diagrams in this chapter synthesize the table mentioned above, according to the methodology described in chapter 1, item 1.3 of this report.

As a product of the final stage of the Strategic Waterway Plan (Step F: Preparation of the final strategic plan) a georeferenced database is presented, with all the information in the table in the CD attached to this report.

CONVENÇÕES CARTOGRÁFICAS

Referências Locacionais

- Capital Federal
- Capital Estadual
- Sede Municipal
- Limite político adm.
- Limite municipal
- Massa d'água

- X Jusante
- X Montante

- 01 Rio Pará
- 02 Rio Tocantins
- 03 Rio Itacaiúnas
- 04 Rio Araguaia
- 05 Rio Javaés
- 06 Rio Das Mortes

- Bacias do SH Amazonas

Trechos de 10 km (xx-yyy)

xx: n° do rio
yyy: n° do trecho

*km = yyy * 10*

Escala de ponderação dos temas

1 - 5 (baixa - alta)

- IN - Insignificante
- BA - Baixa
- ME - Média
- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA: 0 60 120 240 km

SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

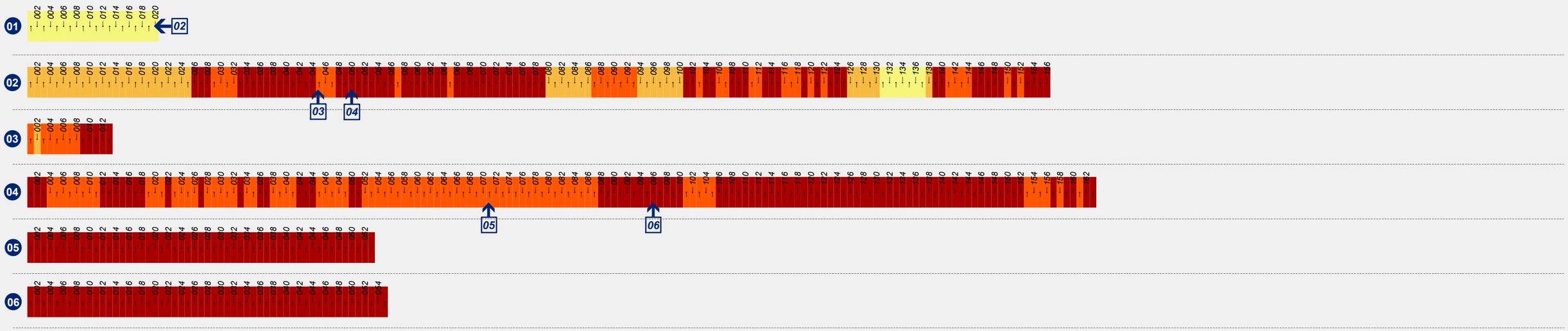
ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGNÓSTICO DE NAVEGABILIDADE

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:7.500.000	SH TOCANTINS/ARAGUAIA	MAI/2013

The main characteristics with regard to navigability conditions of the waterways that compose the Tocantins-Araguaia WS may be seen together in the one-line diagram below.



DIAGNÓSTICO DE NAVEGABILIDADE

CATEGORIAS - 5	CATEGORIAS - 4	CATEGORIAS - 3	CATEGORIAS - 2	CATEGORIA - 1
MUITO ALTO DE:	*ALTO DE:*	*MÉDIA DE:*	*BAIXA DE:*	
Sinuosidade; ou	*Sinuosidade; ou*	*Sinuosidade; ou*	*Sinuosidade; ou*	*Ausência das ocorrências*
Profundidade mínima; ou	*Profundidade mínima; ou*	*Profundidade mínima; ou*	*Profundidade mínima; ou*	
Empecilhos à navegação (construções); ou	*Empecilhos à navegação (construções); ou*	*Empecilhos à navegação (construções); ou*	*Empecilhos à navegação (construções); ou*	
Energia do rio; ou	*Energia do rio; ou*	*Energia do rio; ou*	*Energia do rio; ou*	
Leito do rio; ou	*Leito do rio; ou*	*Leito do rio; ou*	*Leito do rio; ou*	
Assoreamento; ou	*Assoreamento; ou*	*Assoreamento; ou*	*Assoreamento; ou*	
Anteparos naturais; ou	*Anteparos naturais; ou*	*Anteparos naturais; ou*	*Anteparos naturais; ou*	
Largura mínima do rio.	*Largura mínima do rio.*	*Largura mínima do rio.*	*Largura mínima do rio.*	

CONVENÇÕES CARTOGRÁFICAS

- 01 Rio Pará
- 02 Rio Tocantins
- 03 Rio Itacaiúnas
- 04 Rio Araguaia
- 05 Rio Javaés
- 06 Rio Das Mortes

Confluências

Numeração dos trechos

n° < Jusante

n° > Montante

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

N W E S

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DO DIAGNÓSTICO DE NAVEGABILIDADE AGRUPADO PELO SISTEMA HIDROVIÁRIO (SH)

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	SH TOCANTINS/ARAGUAIA	MAI/2013

As can be seen on the one-line diagram above, the Tocantins-Araguaia Waterway currently has no adequate conditions for navigation of commercial convoys along most of the waterway. Furthermore, due to the flow variation throughout the hydrological year, flows are high during the rainy season and navigation may take place satisfactorily. Dry seasons, however, restrict perennial navigation. At this time, silting makes the route sinuous and less safe.

The commercially navigable stretch is currently the stretch of the Tocantins River between its mouth, past the Tucuruí Hydroelectric plant, and the so-called Pedral do Lourenço (Lourenço's Stone Outcrop).

Pedral do Lourenço, about 45km long, prevents large-size commercial navigation between the end of the Tucuruí reservoir and the municipality of Marabá (PA) during the dry season.

Upstream from the municipality of Marabá (PA), the Tocantins River has a channeled-type bed, with a narrow flood plain and a series of elements (sandbanks and stone outcrops) which need solutions and intervention to make navigation feasible up to the Peixe region. Along its entire course, there are rapids being used for hydroelectric generation (Lajeado and Estreito hydroelectric plants, without operative lock systems) or for the future implementation of other plants (Marabá, Serra Quebrada, Tupiratins, and Ipueiras hydroelectric plants, neither of these anticipate locks). Even with the implementation of reservoirs at these hydroelectric plants, occasional intervention will be necessary, apart from the need to build lock systems and all the plants, except for Tucuruí.

The Araguaia River is currently little attractive for navigation, due to the large number of natural obstructions and the large flood plain, which prevents the implementation of dams to regulate the levels.

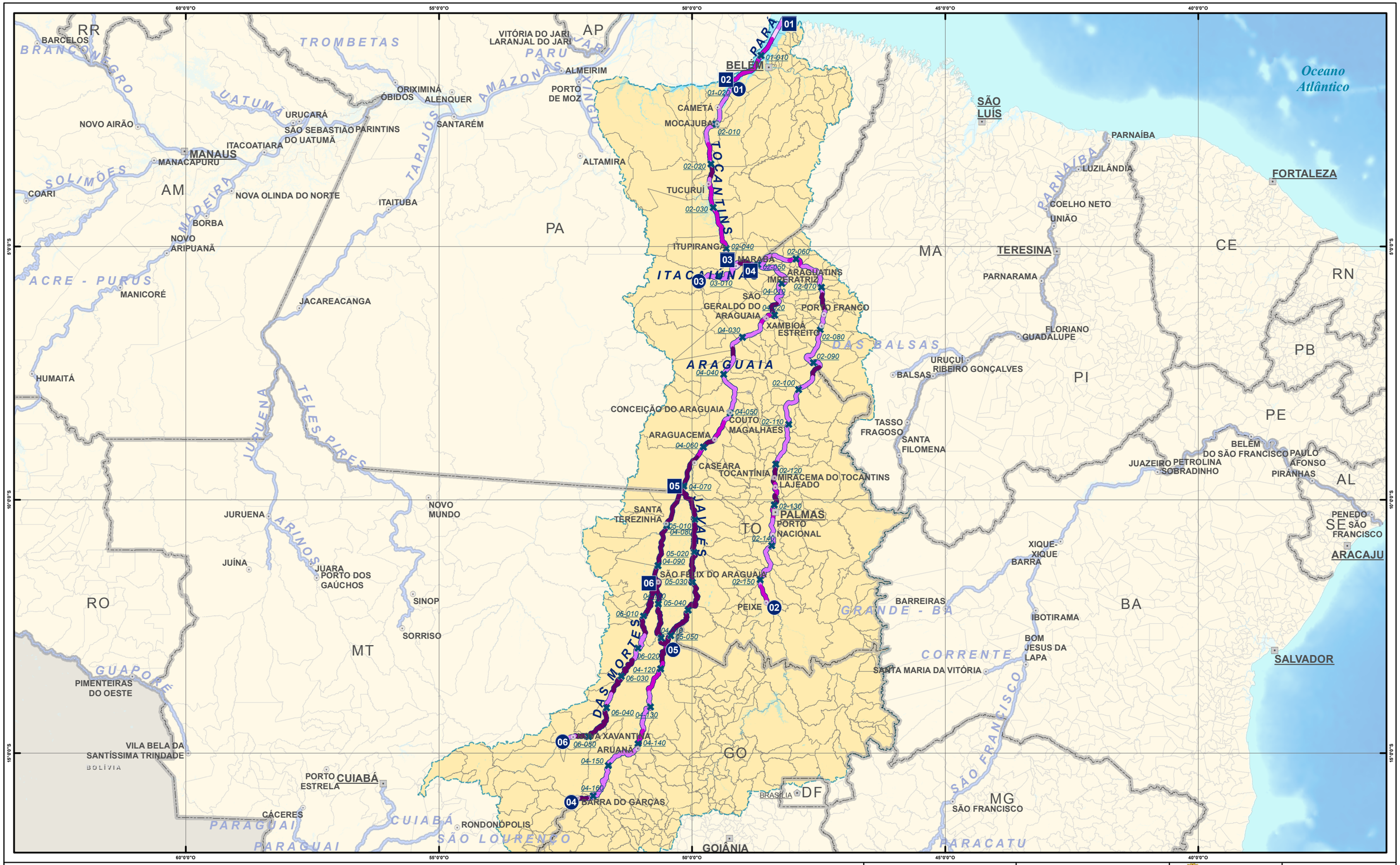
The Araguaia River has both sandy bed stretches, with a lot of sediment deposits, and rocky stretches, with stone outcrops and rocky steps, which limit waterway navigation. Noteworthy is the Bananal Island, the largest river island in the world, separating two Araguaia's arms. The smaller arm is known as Javaés River.

Hydroelectric plants are predicted on the Araguaia River (Santa Isabel and Araguanã hydroelectric plants) between the mouth of the Tocantins River and the municipality of Conceição do Araguaia (PA), with 500km in length. Should these plants be built with locks, this stretch may be made feasible for commercial navigation.

The navigability conditions on the Javaés and das Mortes Rivers are equivalent to those on the Araguaia River, with too many sandbanks, making the route narrower, shallower and more sinuous than one would expect, apart from the stone outcrops, which worsen navigation conditions even during the floods.

The Itacaiúnas River has better navigability conditions only on the downstream stretches, near Marabá, for small and medium-sized vessels. The upstream stretches have a number of rapids and stone outcrops, which prevent commercial navigation.

The main social and environmental characteristics to foster the integrated planning of possible interventions that are necessary in the region of the Tocantins WS may be seen together on the one-line diagram below.



CONVENÇÕES CARTOGRÁFICAS

Referências Locacionais

- Capital Federal
- Capital Estadual
- Sede Municipal
- Limite político adm.
- Limite municipal
- Massa d'água

- X Jusante
- X Montante

- 01 Rio Pará
- 02 Rio Tocantins
- 03 Rio Itacaiúnas
- 04 Rio Araguaia
- 05 Rio Javaés
- 06 Rio Das Mortes

- Bacias do SH Amazonas

Trechos de 10 km (xx-yyy)

xx: n° do rio
yyy: n° do trecho

*km = yyy * 10*

Escala de ponderação dos temas

1 - 5 (baixa - alta)

- IN - Insignificante
- BA - Baixa
- ME - Média
- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA: 0 60 120 240 km

SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA

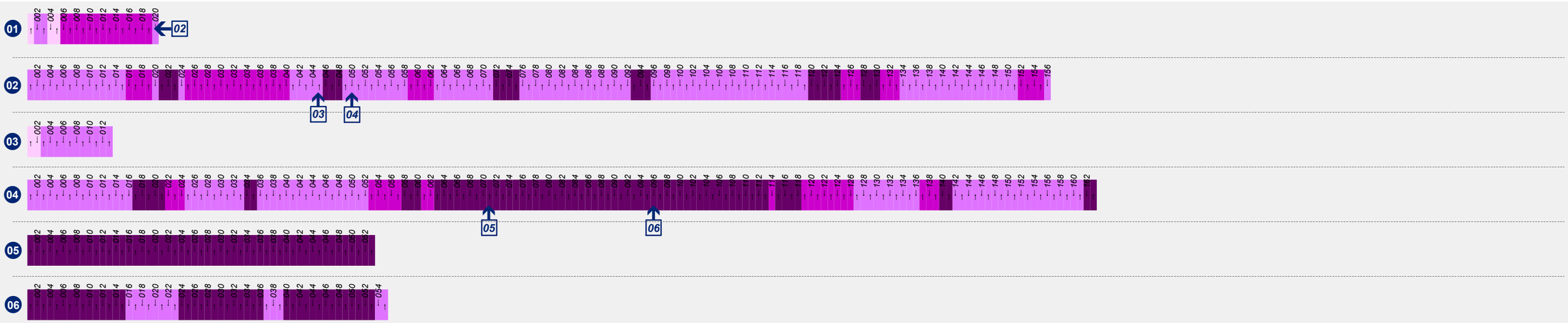
MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

VULNERABILIDADE SOCIOAMBIENTAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:7.500.000	SH TOCANTINS/ARAGUAIA	MAI/2013



VULNERABILIDADE SOCIOAMBIENTAL	CATEGORIAS - 5	CATEGORIAS - 4	CATEGORIAS - 3	CATEGORIAS - 2	CATEGORIA - 1
	UC - proteção integral; ou Terra indígena	UC - uso sustentável; ou Comunidade quilombola	Assentamento INCRA; ou Vulnerabilidade ao desmatamento; ou Cavidades naturais	APCB; ou Mineração - Lavra e garimpo	Ausência das ocorrências

CONVENÇÕES CARTOGRÁFICAS

01 Rio Pará
02 Rio Tocantins
03 Rio Itacaiúnas
04 Rio Araguaia
05 Rio Javaés
06 Rio Das Mortes

Confluências

Numeração dos trechos

n° < Jusante

n° > Montante

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA VULNERABILIDADE SOCIOAMBIENTAL PARA POSSÍVEIS INTERVENÇÕES AGRUPADO PELO SISTEMA HIDROVIÁRIO (SH)

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	SH TOCANTINS/ARAGUAIA	MAI/2013

On the one-line diagram of this Waterway System, it is possible to see that the Araguaia River and its direct tributaries (das Mortes and Javaés Rivers) have higher social and environmental vulnerabilities, due to the presence of Indigenous Lands and Integral Protection Conservation Units.

To this end, and taking into account the virtually parallel courses of the Araguaia and Tocantins Rivers, it is recommended, at least initially, to prioritize the use of the Tocantins River for commercial navigation, because environmental licensing and structural works tend to be less complex there.

The individual characteristics of the waterways forming the Tocantins-Araguaia WS are shown below.

3.10.1.1 Pará Waterway

a) Navigability Diagnosis

The Pará River is located on the Guajará Basin. It is formed by the outfall of the Tocantins River and several other smaller rivers, connecting to the Amazon River through straits and narrows, which separate the uncountable islands located between the southwest coast of the Marajó Island and the continent.

The city of Belém (PA) (stretch 11), is the main city touched by this river. It is located at the confluence of the Pará and Guamá Rivers.

The rainfall rate is about 2900mm, typical of the Amazon region. The rainy season is from January to July.

The Pará River stretch studied goes from its mouth, in the Atlantic Ocean, and the Tocantins River outfall. It is about 200km long.

This stretch has sea navigation conditions, with good navigability physical conditions. The stretch is signaled and beaconed.

The depths are influenced by the hydrological regimes of the Tocantins and Amazon Rivers and smaller tributaries, apart from being directly influenced by the tide. According to the Brazilian Navy, the depths on the stretch studied range from 10m to 40m. There may by occasional spots in the navigable channel with depths of about 6m. The tide lasts half a day and is strongly influenced by wind and rain, with maximum amplitude of about 3.7m.

Among the channels connecting the Guajará Basin to the Amazon River, previously mentioned, the Strait of Breves, currently used by vessels moving between Belém, on the Pará River, and Almeirim, on the Amazon River, stands out. On this strait, depending on the ship's draft and the time of the tide, the route may vary. The main routes are the Narrows of Limões, with depths of 7m, and the Narrows of Macaco – deeper, but more sinuous.

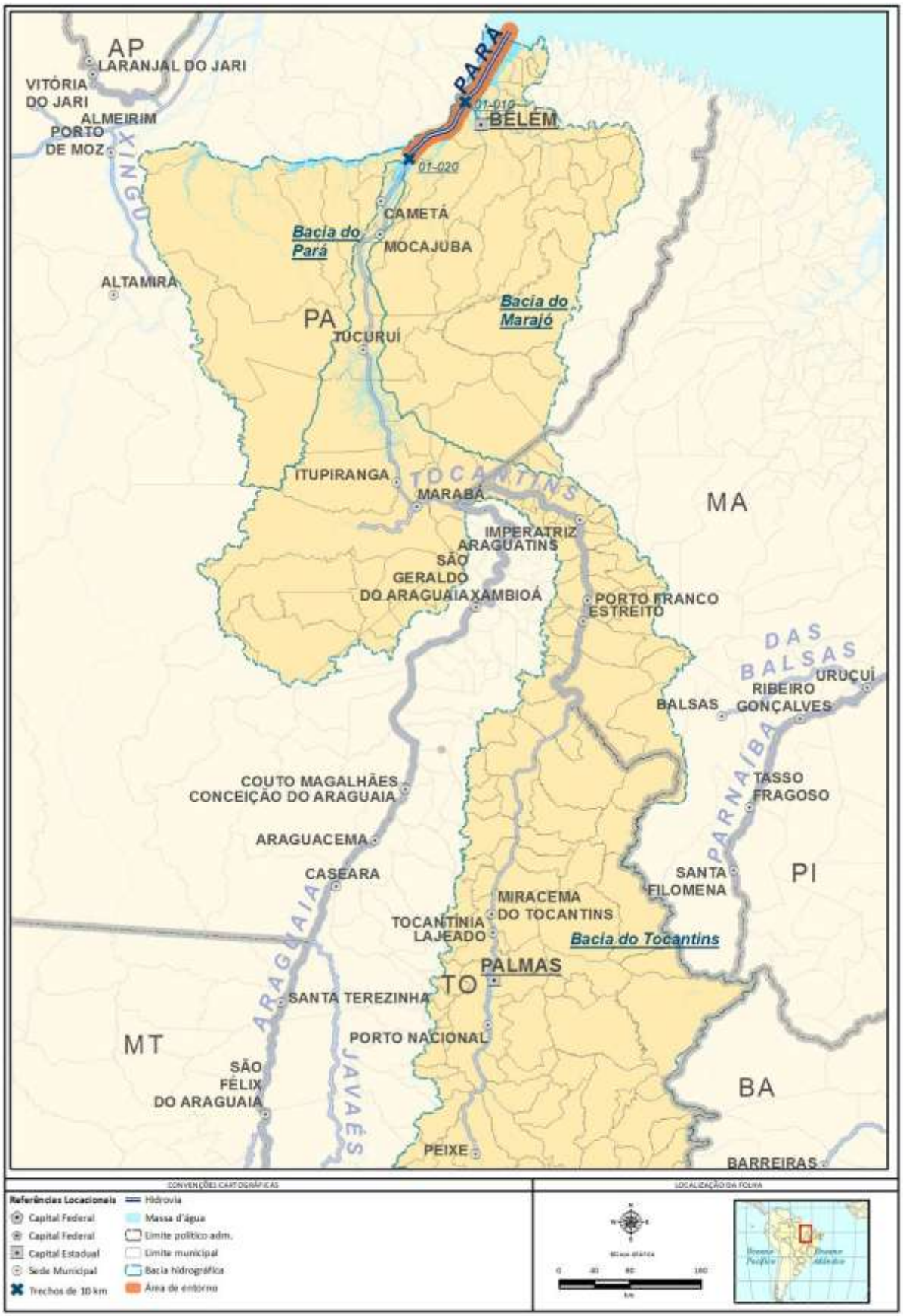
The Pará River is considerably wide – on some stretches one cannot see the banks from the middle of the river. The banks are low, with no outstanding topographic features - there are cliffs covered with thick vegetation or by flooded fields.

Because of intense geomorphological, erosive, and sediment-depositing activities on Rio Pará sandbanks may emerge, expand and move, islands may grow, the banks can be eroded apart from other phenomena. The tree trunks and the vegetation adrift, on the surface or submersed, are also caution points along the river.

The main caution points with regard to navigation, as listed by the Navy, are sandbanks, reefs and stone outcrops and submerged stones, which emerge predominantly during the low tide, resulting in shallow depth on some points. These points are, however, signaled and beaconed. On the channels that access the ports in the region, such as the port of Belém (PA), depths may be shallower than expected, and navigation needs greater attention.

b) Social and Environmental Vulnerabilities

The Pará Waterway is in the Tocantins hydrographic region, on the Pará basin, as can be seen on the figure below. It has an area of 69,702km^2, totally inserted in the Amazon biome.



Map 56: Pará Waterway Location

The basin encompasses 30 municipalities in the state of Pará, totaling 3,051,355 inhabitants (2010 Census), the FIRJAN index for these municipalities ranges between 0.78 in Belém and 0.46 in the municipalities of Pacajá and Limoeiro do Ajuru.

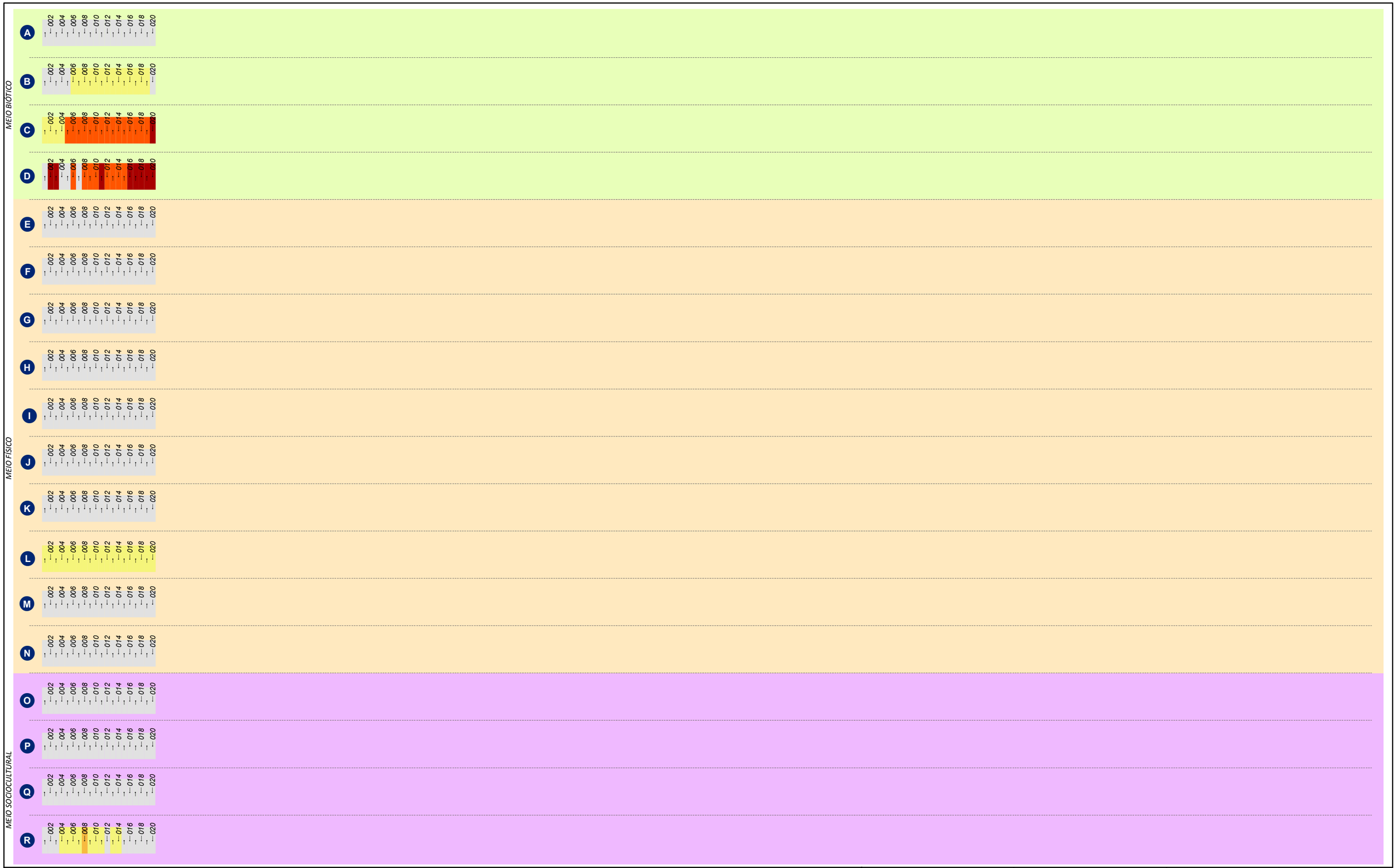
The area studied of the Pará Waterway (river axis with a 10km surrounding area from each bank) comprises 14 municipalities in the state of Pará, totaling a population of 1,942,649 inhabitants (2010 Census). The capital Belém is the most populous city and has the second best FIRJAN index in the state: 0.78, while the lowest index in the area studied is 0.46 in the municipality of Limoeiro do Ajuru.

With regard to conservationist aspects, there are two Indigenous Land areas and 47 INCRA rural settlements, apart from an Integral Protection Conservation Unit and 10 Sustainable Use Conservation Units.

The waterway considered was 191km long, which were divided into 20 stretches for the area of study. In this area, there is no record of Indigenous Lands or Integral Protection CUs. The presence of Sustainable Use CUs along stretches 5 to 19 is noteworthy. They must be considered while planning future intervention works possibly necessary to make commercial navigation feasible on this waterway.

As for plant coverage, it is worth pointing out the presence of 85-through-100-percent preserved areas on the initial stretches (2 and 3) in the municipality of São Caetano de Odivelas, and on stretches 15 through 20, between the municipalities of Muaná and Abaetetuba, also in the state of Pará.

The distribution of occurrences with regard to the variables analyzed may be better observed on the one-line diagram below.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO

- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO

- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL

- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO PARÁ	MAI/2013

3.10.1.2 Araguaia Waterway

a) Navigability Diagnosis

The Araguaia River is the main tributary of the Tocantins River. It is approximately 2,115km long from its spring. It is located on the spurs of the Caiapós Range (MT) and flows virtually parallel to the Tocantins River along its course. The Island of Bananal (the largest river island in the world) is on the plain stretches, on the mid Araguaia and there are uncountable ponds on the banks. This island is an important topographic feature on the river, located between the two arms of the Araguaia – the largest arm is known as Javaés River. During the flood season, the Araguaia River and its main tributaries: das Mortes and Cristalino Rivers, compose an enormous flooded plain. Its mouth on the Tocantins River is a region known as "Bico do Papagaio".

The hydrological regime is very defined on the basin. On the Araguaia River, the flood season is from November to May, March being its peak, one month later than the Tocantins River, due to the Bananal plain flooding. The dry season is between May and November. Its peak is in September. The average flow on the Araguaia River at the Aragatins station, near its mouth, is about 6,200m3/sec (see Appendix VII, item 4.4.2).

Along the riverbed, some stretches are predominantly sandy, forming long sandbanks, in addition to rocky outcrops, relatively regularly distributed.

The Araguaia Waterway considered in this study comprises the stretch from its mouth, on the Tocantins River, to the municipality of Barra das Garças (MT), about 1,640km long.

This waterway has poor navigability conditions, primarily due to the shallow depths of the river during the low tide, the presence of countless successive sandbanks, apart from rapids and rock outcrops, making navigation difficult or altogether impossible. Navigation takes place on isolated stretches, especially during the flood season.

The main navigability conditions are described below:

- The stretch between the mouth, on the Tocantins River, and Xambioá (TO), from stretch 1 through 22, has a number of sandbanks, stone outcrops and its main obstruction are the Santa Isabel rapids (stretch 17), with 14km in length and 13m difference in level. The figure below illustrates these rapids.

Figure 3.10.1: Santa Isabel Stone Outcrop Source: (Wikimapia, 2013)

This segment is one of the most restrictive parts of the waterway, with minimum depths of about 1.5m during the low tide (September). On the Santa Isabel rapids, minimum depths may be greater. However, due to the water speed, the narrowness of the channels, the sinuosity of the routes, and transversal currents, the stretch is too restrictive to commercial navigation.

The water level along the river on this stretch depends on the regimes of both the Araguaia and the Tocantins Rivers.

- On the stretch between Xambioá (TO) and Conceição do Araguaia (PA), from stretch 23 through 50, about 270km in length, there are a number of difficult passages that only allow small vessels. The stretch has a number of physical obstructions, most of which are isolated rocky outcrops, causing average depths of 0.7m in the dry season (for about 30, 35km). These prevent commercial navigation.

Figure 3.10.2: Rocky outcrop (stretch 42) (Panoramio, 2013)

- On the segment between Conceição do Araguaia (PA) and Barra do Garças (GO), from stretch 51 through 163, about 1,130km in length, the Araguaia River has features typical of plain rivers. It has a larger channel, where floods flow through, and a smaller channel twisting within the first, where the dry season run-off flows through. The stretch is navigable only by small and mid-size vessels, on isolated segments, during the floods. Minimum depths may reach less than 1m on may stretches, during the low tide. Between stretch 72 and 113, is the Island of Bananal. This stretch has low declivities and intense sandbank formation processes, many of which move, reducing the depths and making the route more sinuous than expected. Although this is a region of plains, there are four stretches with rapids, apart from stone and rocky outcrops, restrictive to commercial navigation throughout the year. On the sub stretch between Aruanã (GO) (stretch 141) and Barra do Garças (GO) (stretch 163), navigability conditions may be even more unreliable, with narrower widths and greater sinuosity.

Figure 3.10.3: Sandbanks and islands on the Araguaia River (stretch 42) (Panoramio, 2013)

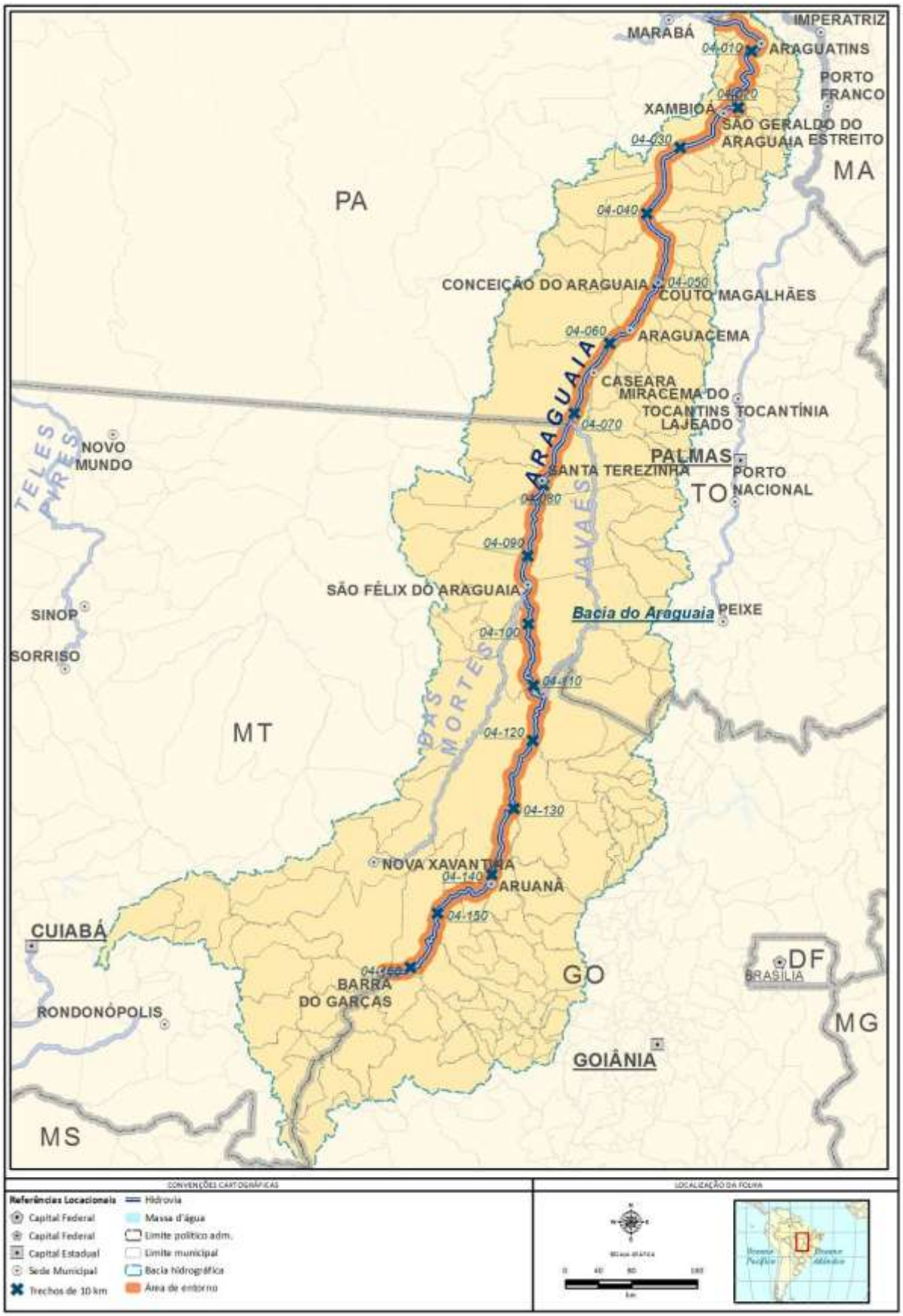
Hydroelectric plants will be implemented on the Araguaia River, on its downstream stretches. The mid Araguaia stretch, upstream from the region, is not the object of hydroelectric plants implementations because it is on a region of plains.

The plants inventoried to be implemented on the Low Araguaia River (stretch studied by this plan) are the Santa Isabel (stretch 17) and the Araguanã (stretch 25) hydroelectric plants. If they are built, they will flood a number of stretches restrictive to navigation allowing, should they have locks, navigation from the mouth of the Tocantins River to Conceição do Araguaia (PA). River integration up to the mouth of the Tocantins River will only be possible after the construction of the Marabá hydroelectric plant, on the Tocantins River, and improvements on restrictive stretches of the Tocantins River. The figure below shows the distribution of falls approved for the Low Araguaia stretch.

Figure 3.10.4: Estimated profile of the Araguaia River between its mouth and Conceição do Araguaia.

b) Social and Environmental Vulnerabilities

The Araguaia waterway is on the Araguaia River basin, as can be seen on the figure. Its area is 385 thousand km^2, of which approximately 23% are in the Amazon biome. The other 77% are in the Cerrado biome. From Conceição do Araguaia, natural forest opens forming a triangle, where the Bananal Island and the das Mortes River region is.



Map 57: Araguaia Waterway Location

The limits of this basin cross the territory of 204 municipalities, 69 in the state of Goiás, 41 in Mato Grosso, 18 in Pará, and 76 in Tocantins. The total population in the basin's municipalities is about 2.5 million inhabitants. The municipalities are usually small in terms of population. Araguaína (TO) is the most populous, accounting for 6.36% of the total. As regards the FIRJAN (2010) index, the Mato Grosso municipalities of Primavera do Leste, Alto Taquari, and Alto Garças have the best rates: 0.86, 0.77, and 0.76, respectively. The worst rate is Chapada de Areia (TO) with 0.45. The average is 0.62.

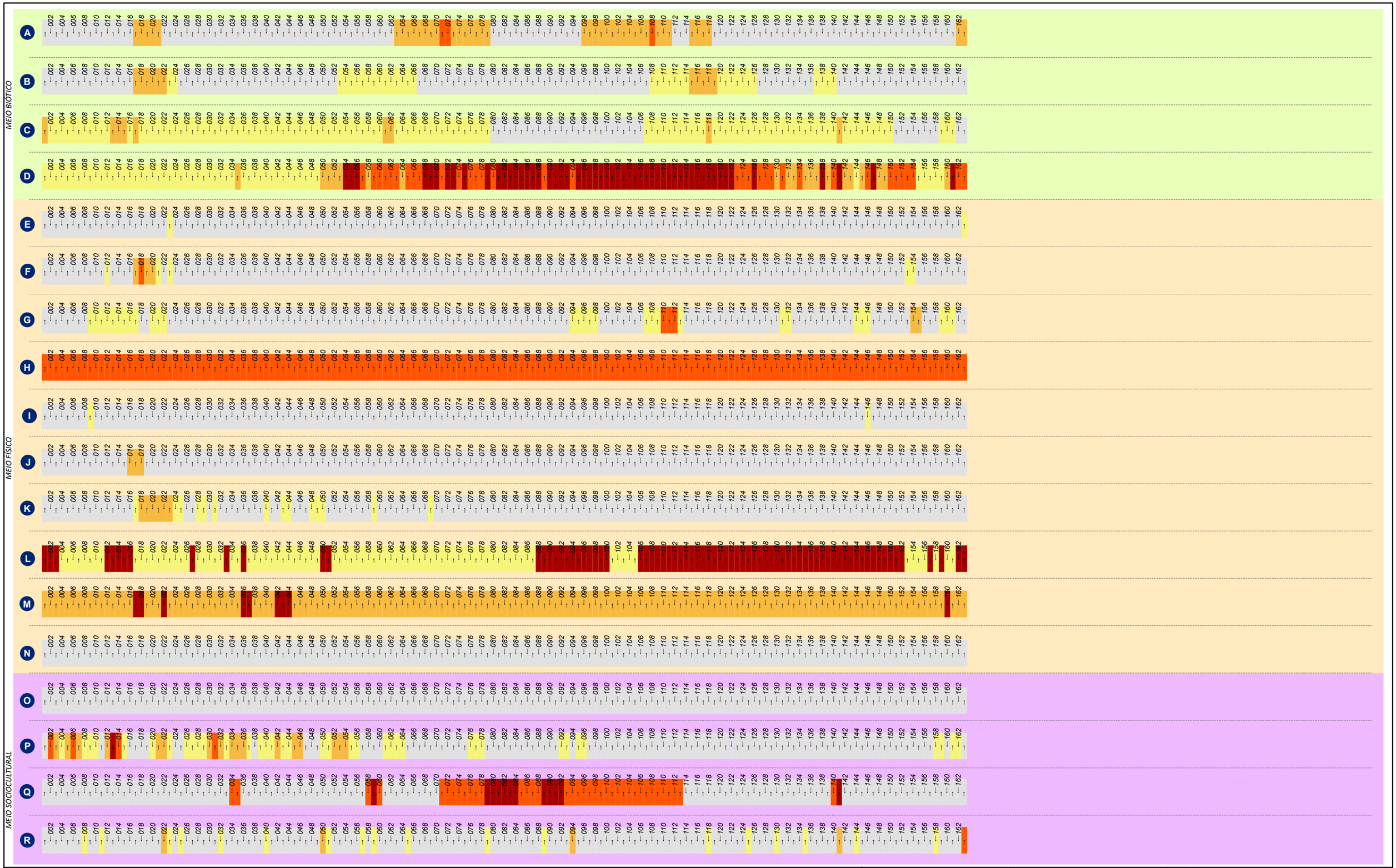
The area of study on the Araguaia Waterway crosses the territory of 48 municipalities, 8 in Goiás, 8 in Mato Grosso, 11 in Pará, and 21 in Tocantins. The total population is 766,536 inhabitants (IBGE,2010). Araguaína (TO) is the most populous and industrialized municipality, accounting for 20% of the total. As for the FIRJAN index, the average for the municipalities in the area of study is 0.59, with development rates. In terms of income/employment, health, and education they are slightly below the average for the basin.

As to the conservationist aspects of the Araguaia River basin, there are 11 Indigenous Lands territories, especially along the Javaés and das Mortes Rivers and 13 Conservation Units (7 Integral Protection and 6 Sustainable Use), especially in the center of the Araguaia Waterway near the junction with the Javaés River.

In the area of study, divided into 163 stretches, where there is a concentration of considerably vulnerable areas from the social and environmental standpoints, especially in the central stretches (stretch 58 through 118) of the waterway, on stretches cut by the headwaters and the mouth of the Javaés River, there are Integral Protection Conservation Units as well as Indigenous Lands. Specifically, there are Integral Protection Conservation Units between stretches 17 and 21, 63 and 79, 96 and 111, 115 and 118, and 162 and 163, near the municipalities of Ananás (TO), São Geraldo do Araguaia (PA), Pium (TO), Novo Santo Antônio (MT), and Indigenous Lands on stretches 34 and 35, 58 through 60, 71 through 113, and 140 through 142, in the municipalities of Pium (TO), Lagoa da Confusão (TO), Formoso do Araguaia (TO), Santa Maria das Barreiras (PA), and Santa Fé do Araguaia (TO).

The presence of well preserved areas in terms of plant coverage is outstanding in the surroundings of the whole waterway, especially between stretch 50 and 163, at the confluence with the Tocantins River between the municipalities of Conceição do Araguaia (PA), and Couto de Magalhães (TO), up to the municipalities of Barra do Garças (MT) and Aragarças (GO).

The distribution of occurrences with regard to the variables analyzed may be better observed on the one-line diagram below.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

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DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO ARAGUAIA	MAI/2013

3.10.1.3 Das Mortes Waterway

a) Navigability Diagnosis

The das Mortes River, also known as Manso River, is the main tributary on the left bank of the Araguaia River. Totally within the state of Mato Grosso, 1,017km long, the das Mortes River has its spring on the São Lourenço Range, in the municipality of Cuiabá (MT), and its mouth is by the Bananal Island, seven kilometers upstream from São Felix do Araguaia (MT) (stretch 96 of the Araguaia River). Its main tributary, on the right bank, is the São João River.

The waterway studied on the das Mortes River comprises the stretch between its mouth and the municipality of Nova Xavantina (MT), about 540km in length.

The das Mortes Rivers has low declivities, predominantly sandy bed and significant fluctuation of the water level between the flood season and low water. The floods occur between December and April and the dry season is between the months of June and October. The average flow, at the Xavantina station, is about 500m^3/sec (see Appendix VII, item 4.4.4).

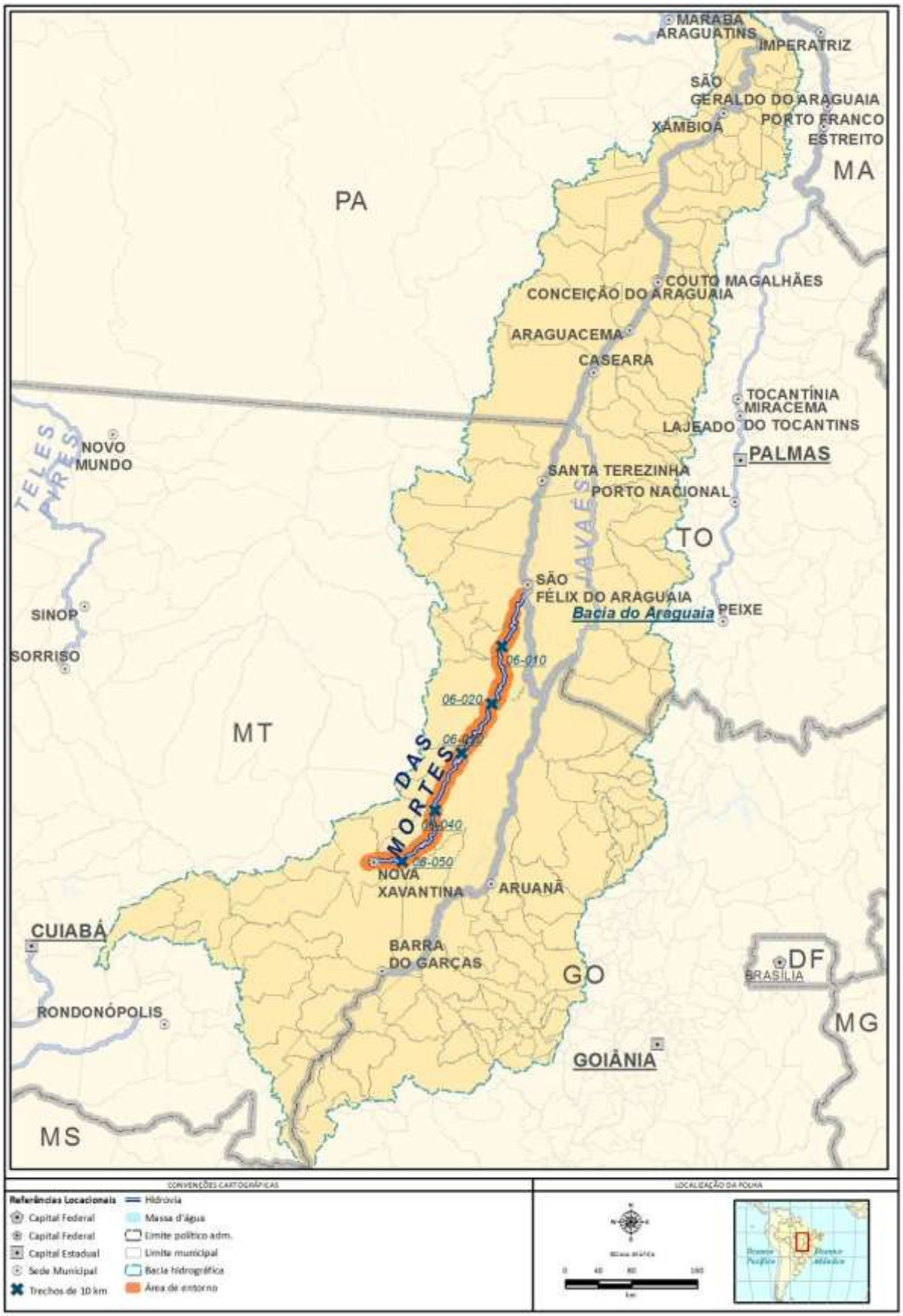
The das Mortes River has unreliable navigability conditions along the approximately 540km studied. From its mouth, in the municipality of São Félix do Araguaia (MT), stretch 1, up to Nova Xavantina (MT), stretch 54, the das Mortes River has a number of stretches with minimum depths of about 0.8m in the dry season.

The river has very homogeneous behavior, with intense silting processes along its whole course, apart from some stone outcrops, making navigation difficult. The average sinuosity rate is 1.4, with some stretches where this rate is 3. Moreover, the countless sandbanks, most of which are the result of erosions on the banks (natural or the result of human activities), may make the navigation route more sinuous than expected. In addition to the sandbanks, the straight stretch studied has critical points such as rocky passages, some of which are signaled and beaconed for the safety of the vessels. Minimum widths are about 100m, shorter on the upstream stretches (stretch 41 upstream), where declivities are higher, up to 35cm/km.

Figure 3.10.5: Das Mortes River, with erosion process on the bank. (360 Graus, 2004)

b) Social and Environmental Vulnerability

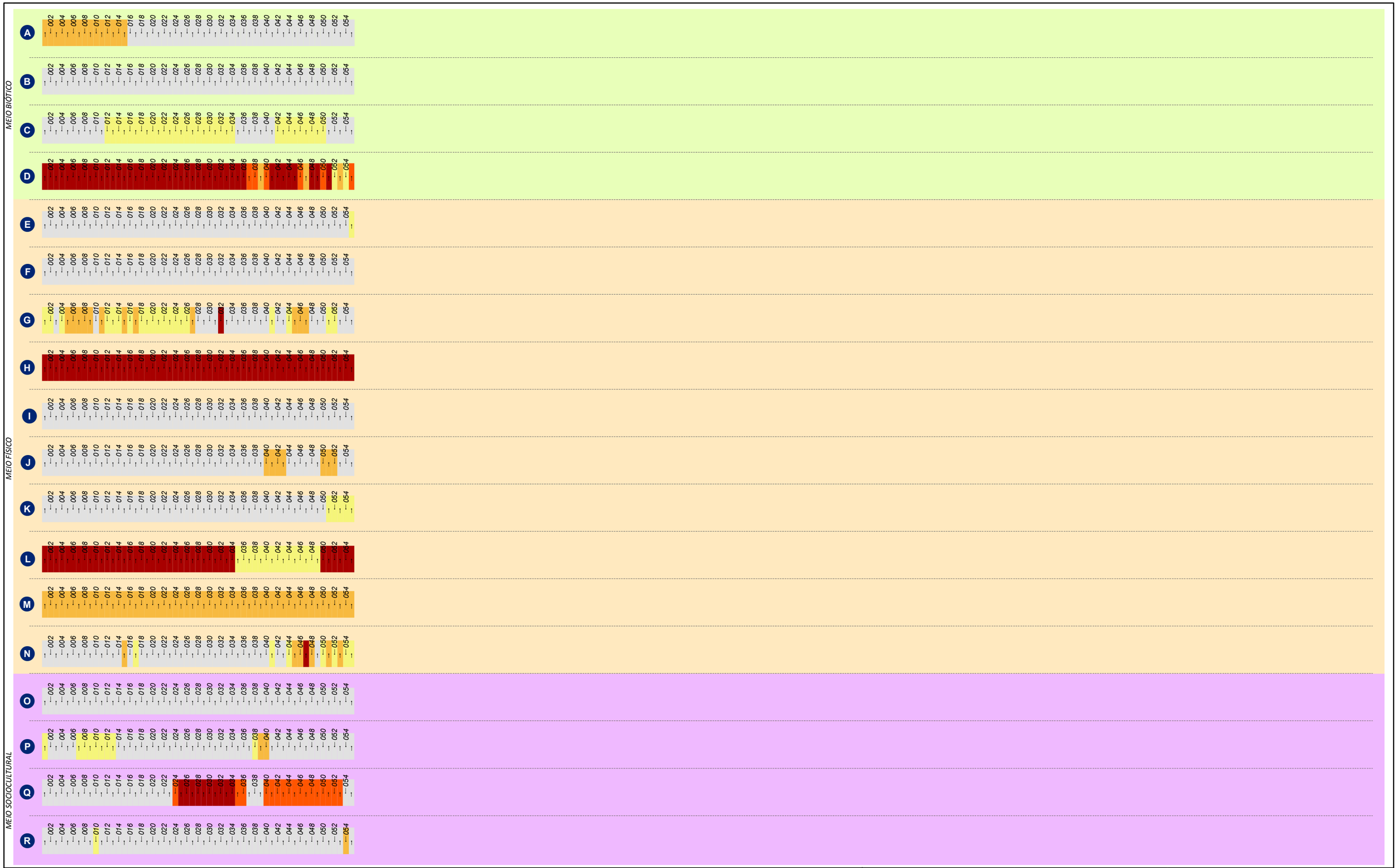
The future das Mortes Waterway is in the Araguaia River basin (previously described on this item for the Araguaia Waterway). Its location can be seen on the figure below. The future das Mortes Waterway crosses the territory of seven Mato Grosso municipalities. The total population is 68,427 inhabitants (IBGE, 2010). The municipality of Nova Xavantina is the most populous, accounting for 29% of the total. The average FIRJAN index is 0.6, similar to that of the municipalities on the basin.



Map 58: Das Mortes Waterway Location

For the vulnerability analysis, with regard to conservationist aspects, the area around the waterway was divided into 55 stretches. About 80% of the waterway surroundings contain more vulnerable areas – there are stretches where there are Integral Protection Conservation Units (0 through 15), between the municipalities of Novo Santo Antônio (MT), São Félix do Araguaia (MT), and Indigenous Lands (23 through 33, and 40 through 53) encompassing the municipalities of Cocalinho (MT), Ribeirão Cascalheira (MT), Nova Nazaré (MT), and Nova Xamantina (MT). Plant coverage is outstanding and well preserved all along the waterway surroundings. Thus, this waterway, directly linked to the Araguaia Waterway, also presents quite vulnerable stretches, which, should any future intervention be necessary, can make the licensing process more complex.

The distribution of occurrences with regard to the variables analyzed can be better observed on the one-line diagram below.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

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3.10.1.4 Javaés Waterway

a) Navigability Diagnosis

The Javaés River is an arm of the Araguaia River, when the latter splits to form the Bananal Island. Its length is about 520km. This arm receives the waters from the Araguaia River and, further on, from the Verde River, meeting Araguaia again, on the eastern limits of the Bananal Islands. It runs through the states of Goiás and Tocantins. Along its course, the Javaés River crosses the municipalities of São Miguel do Araguaia (GO), Sandrolândia (TO), Formoso do Araguaia (TO), Lagoa da Confusão (TO), and Pium (TO).

The Javaés Waterway encompasses the whole course of the river. This river has no adequate conditions for navigation, due to shallow depths and intense silting processes.

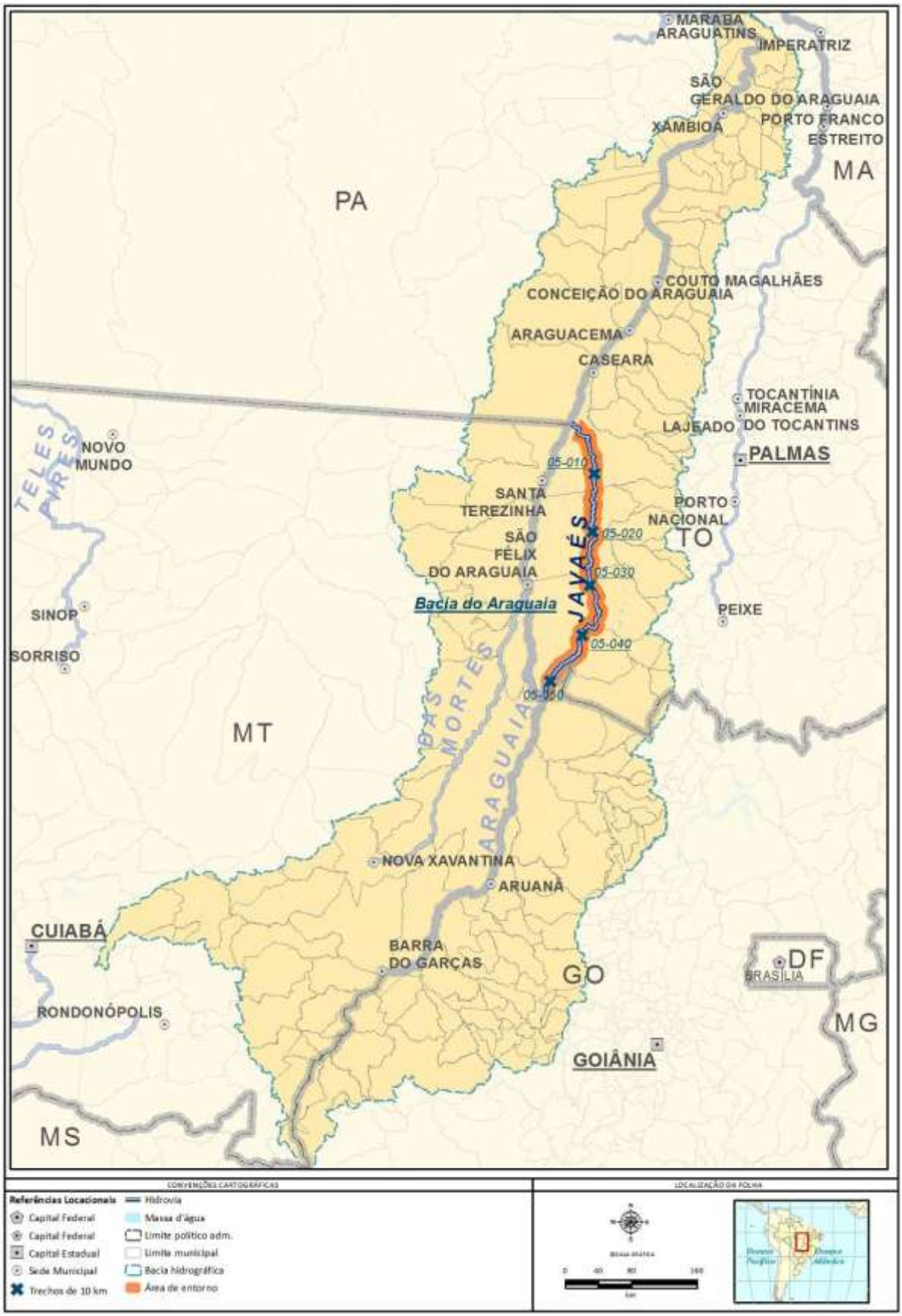
The Javaés River has morphological features similar to those of the Araguaia River. The basin in on a large river plain and the riverbed is predominantly sedimentary. The flood period is between December and May and the dry season, between June and November. During the dry season, depending on the rainfall volume on the Araguaia River basin, the Javaés River can fail to be fed by the flows from the Araguaia River and dry. During the floods, flooded areas are flat and make up long areas flooded during the rainy season. The average flow at the Barreira da Cruz station is about 600 m^3/sec and its minimum is 0 (zero) during the low water period (see Appendix VII, item 4.4.3).

Sinuosity is high, reaching 1.9, and it is even more sinuous during the low waters, on stretches with a number of sandbanks. Minimum depths depend on the time of the year and may vary more than 6m. Minimum depths are about 0.5m, when the thalweg is between sandbanks and the run-off may cease.

Declivities are low all along the river and there are stretches with widths restrictive to navigation, about 30m.

b) Social and Environmental Vulnerabilities

The future Javaés Waterway is on the Araguaia River basin (previously described in this item for the Araguaia Waterway). Its location can be seen on the figure below. The area of study of the Javaés Waterway cuts through the territory of five municipalities, four in Tocantins (TO) and one in Goiás (GO).



Map 59: Javaés Waterway Location

The population in these municipalities is 60,940 inhabitants (IBGE, 2010) and the municipality of São Miguel do Araguaia (GO) is the most populous, accounting for 37% of the total. The FIRJAN (2010) index average for these municipalities is 0.60, similar to the average of the municipalities on the basin.

With regard to the social and environmental vulnerability analysis, there are Indigenous Lands around the whole waterway, which makes the 53 stretches into which this waterway is divided vulnerable. These Indigenous Lands are located on the river plain, between the Javaés and Araguaia Rivers and are in the area of study for both waterways between the municipalities of Pium (TO), Lagoa da Confusão (TO), Formoso do Araguaia (TO), Sandrolândia (TO), and São Miguel do Araguaia (TO). In addition to Indigenous Lands, there are Integral Protection Conservation CUs between stretches 1 and 22, between the municipalities of Pium (TO) and Lagoa da Confusão (TO) on the bank.

The distribution of occurrences with regard to the variables analyzed can be better observed on the one-line diagram below.

CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
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- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
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- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

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EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
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3.10.1.5 Tocantins Waterway

a) Navigability Conditions

The Tocantins-Araguaia basin – the second largest hydrographic basin in Brazil – occupies 10.8% of the national territory and encompasses the states of Goiás, Tocantins, Pará, Maranhão, Mato Grosso, and the Federal District.

The Tocantins River is about 1,960km long, springing from the Goiás Plateau, about 1,000m above sea level, formed by the das Almas and Maranhão Rivers. Its main tributary is the Araguaia River. Its mouth is on the Pará River, near the city of Belém (PA).

The flow regime on the Tocantins River is variable along the basin, due to its continental dimensions. Generally, for the Low Tocantins (stretches 1 through 50), the flood season is between January and May and the dry season between June and December. The average flow at the Tucuruí hydroelectric plant is about 15,000m^3/sec (see Appendix VII, item 4.4.1). On the mid-High Tocantins, the flood season is between December and May and the dry season from June through November. The average flow at Miracema do Tocantins is about 2,500m^3/sec (see Appendix VII, item 4.4.1). The flow contributions from the Araguaia River are relevant – they may double the run-off volume in some periods of the year.

The Tocantins Waterway studied in this Plan, comprises the stretch between its mouth, on the Pará River, and the municipality of Peixe (TO), about 1,560km long.

The Tocantins River has generally low sinuosity rates and is wide enough for commercial vessels along its course. The main difficulties concern the long rocky stretches of the geological transition zone between the Amazon Depression and the Plateau region, besides seasonal variation of flows, resulting in the emergence of long sandbanks and shallow depths on a number of stretches of the river. The Tucuruí operation is often affected by the low flow during the dry season, even though the reservoir of the Serra da Mesa hydroelectric plant, in the state of Goiás, provides some control.

The Tocantins River bed, on the stretch studied, is predominantly sedimentary in most of its course, except for the stretches where there are rocky outcrops. With the low average declivities, susceptibility to silting is regarded as medium-high.

Commercial navigation usually takes place, in a discontinuous manner, along the approximately 1,560km studied, divided into the following segments:

- The first segment goes from the mouth of the Tocantins River to the Tucuruí hydroelectric plant dam (stretch 25), with about 250km in length, with minimum widths of about 500m and minimum depths of about 3m, apart from having low sinuosity rates. This segment has a significant number of islands, which may, however, make the route more sinuous and dangerous than expected. The regime of this long stretch is influenced by tide variation, with excellent navigability conditions for vessels with at least 2.5 draft throughout the year and larger drafts during the flood season.

  The Tucuruí hydroelectric plant has a system of two locks, 210km long, 33m wide, maximum draft 4.5m, with capacity for the transposition of large commercial vessels.

Figure 3.10.6: Tucuruí Lock (stretch 25) (Panoramio, 2013)

- The second segment extends from the Tucuruí hydroelectric plant dam (stretch 25) to the municipality of Marabá (PA) (stretch 45), about 200km long. It has three main sub segments:

  The Tucuruí hydroelectric plant reservoir, between stretches 26 and 36, has good navigability conditions for commercial convoys. There are some critical spots with stone outcrops along the reservoir.

  São Lourenço Stone Outcrop. Located between stretches 36 and 40, between the locality of Ipixuna (PA) and the municipality of Itupiranga (PA). It is the main obstruction for navigation on this segment, made up of a series of stones and rocks about 40km long. Depending on the time of the year and on the operation level at the Tucuruí hydroelectric plant reservoir, with elevation between 58m and 62m, they emerge and prevent commercial navigation. Even during the flood season the rocks may be restrictive to navigation due to the low depths on some spots and high run-off speed.

Figure 3.10.7: São Lourenço Stone Outcrop (stretches 36 through 40). (DNIT, 2010)

The stretch between the São Lourenço stone outcrop and the municipality of Marabá (PA), about 50km long, has rocky outcrops and long silting, resulting in occasional obstructions to navigation.

- On the stretch between the municipalities of Marabá (PA) and Estreito (MA) (stretch 79), about 340km long, the main obstructions to navigation are long sandbanks, stone outcrops, islands along the river, and, especially, the Santo Antônio Waterfall. These elements bring about low depths during the low water period (July through November), when some critical spots reach minimum depths of 0.9m.

Figure 3.10.8: Santo Antônio Waterfall (stretch 70) (Panoramio, 2013)

Two new hydroelectric plants are planned in the Inventory approved for the Tocantins River on this stretch: The Marabá (stretch 46) and the Serra Quebrada (stretch 68) hydroelectric plants. Building these plants will make navigation feasible on long stretches of the Tocantins River and, should they be equipped with locks, allow the navigation connection from the mouth to the municipality of Palmeirante (TO).

- Stretch between Estreito (MA) (stretch 79) and Palmeirante (TO) (stretch 101). The Estreito hydroelectric plant is on stretch 79, about 3km upstream from the municipality of Estreito. This hydroelectric plant has no lock system, preventing navigation from Marabá (PA) to locations upstream from Estreito. The Estreito hydroelectric plant reservoir is about 220km long (stretches 79 through 98) and allows good navigability conditions for 20km downstream from the municipality of Palmeirante (TO) (stretch 98).

  There is a long stretch in river regime from the end of the Estreito hydroelectric plant reservoir (stretch 98) through the municipality of Palmeirante (TO), about 20km long. It also has low-depth problems during the dry season, due to the emergence of beaches, sandbanks, and rocky outcrops. Minimum widths are about 200m and the sinuosity rates can reach 2.3. Minimum depth is estimated at 1.5m.

- Stretch between Palmeirante (TO) and the Lajeado hydroelectric plant (stretch 125), about 250km long. Similarly to the free current stretches downstream, this segment has a number of obstructions that make navigation difficult or impossible at certain times of the year (dry season), such as sandbanks and rocky outcrops.

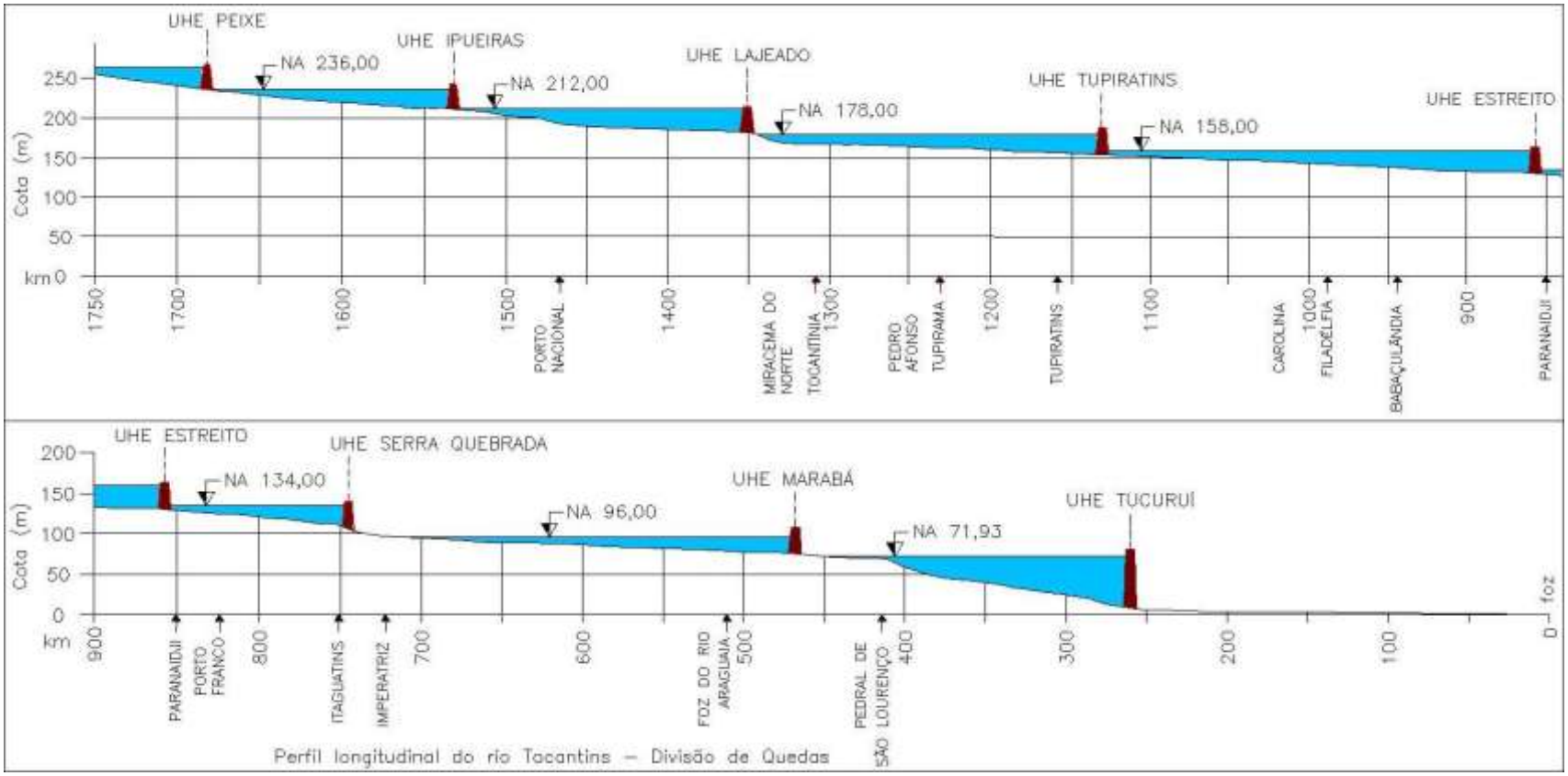
  According to the Inventory approved for the Tocantins River, a hydroelectric plant should be built in Tupirantins (stretch 106), on this stretch. Building these hydroelectric plant will make navigation feasible on a number of segments on this stretch. Should

they be equipped with locks, they will allow navigation to connect from the municipality of Palmeirante (TO) to Lajeado (TO).

- Stretch between the Lajeado hydroelectric plant and Peixe (TO) (stretch 156). The Lajeado hydroelectric plant (stretch 125), about 460km long, has minimum depths of 1.5m, during the dry season. However, it has a number of obstructions that do not ensure navigation safety or reliability, such as rocky outcrops and moving sandbanks. The Lajeado hydroelectric plant has no locks. However, its construction is now being planned and designed.

  Upstream from Lajeado (TO), navigation can be extended up to Peixe (TO), a further 260km. This stretch also has low depths during the dry season and many sandbanks and stone outcrops, which create restrictions to navigation.

  According to the Inventory approved for the Tocantins River, the Ipueiras hydroelectric plant (stretch 145) should be built on this stretch. Building this hydroelectric plant will make navigation feasible on some segments of this stretch and, should it be equipped with locks, will allow for a navigating connection between Lajeado (TO) and Peixe (TO).



Elevation (m)
Longitudinal Profile of the Tocantins River – Distribution of Steps

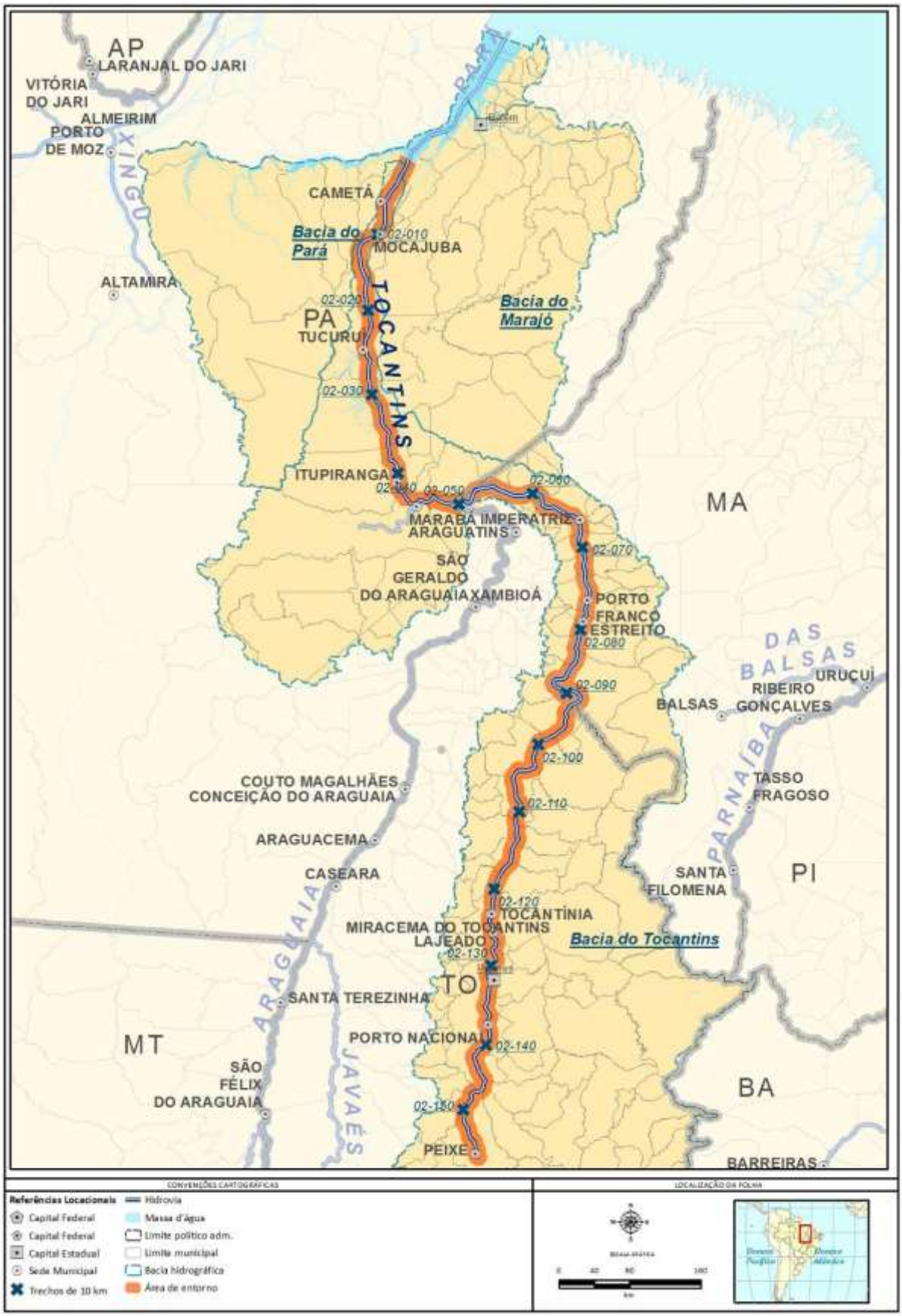
Figure 3.10.9: Longitudinal Profile of the Tocantins River

Building these hydroelectric plants and locks in Marabá, Serra Quebrada, Tupiratins, Ipueiras, and Estreito, and concluding the Lajeado hydroelectric plant lock construction will create navigation conditions along the whole stretch studied of the Tocantins River, from its mouth to the municipality of Peixe (TO). The reservoirs will flood a number of critical points that make the movement of vessels impossible. The figure below illustrates the distribution of steps approved for the Tocantins River.

However, even when the reservoirs are implemented, there will be fee current stretches between the end of the reservoir at one plant and the damming of the plant upstream, as can be seen on the figure above. These stretches have rocky outcrops and sandbanks which should be dredged and rock excavated. Moreover, making commercial navigation feasible (by ensuring adequate depths) on these stretches will depend directly on the operational regime of turbine flows and the overflow from the hydroelectric plants along the Tocantins River. Thus, the interests of the Brazilian electric sector and the agencies responsible for maintaining the navigability conditions on this river should be made compatible.

b) Social and Environmental Vulnerabilities

The Tocantins Waterway is partially on the Tocantins, Marajó, and Pará river basins. Together, its area is 533,239km^2 and its location can be seen on the figure below. The Marajó and Pará river basins are totally within the Amazon biome, while the Tocantins River basin is partly in the Amazon biome (21%) and partly in the Cerrado (79%) biome.



Map 60: Tocantins Waterway Location

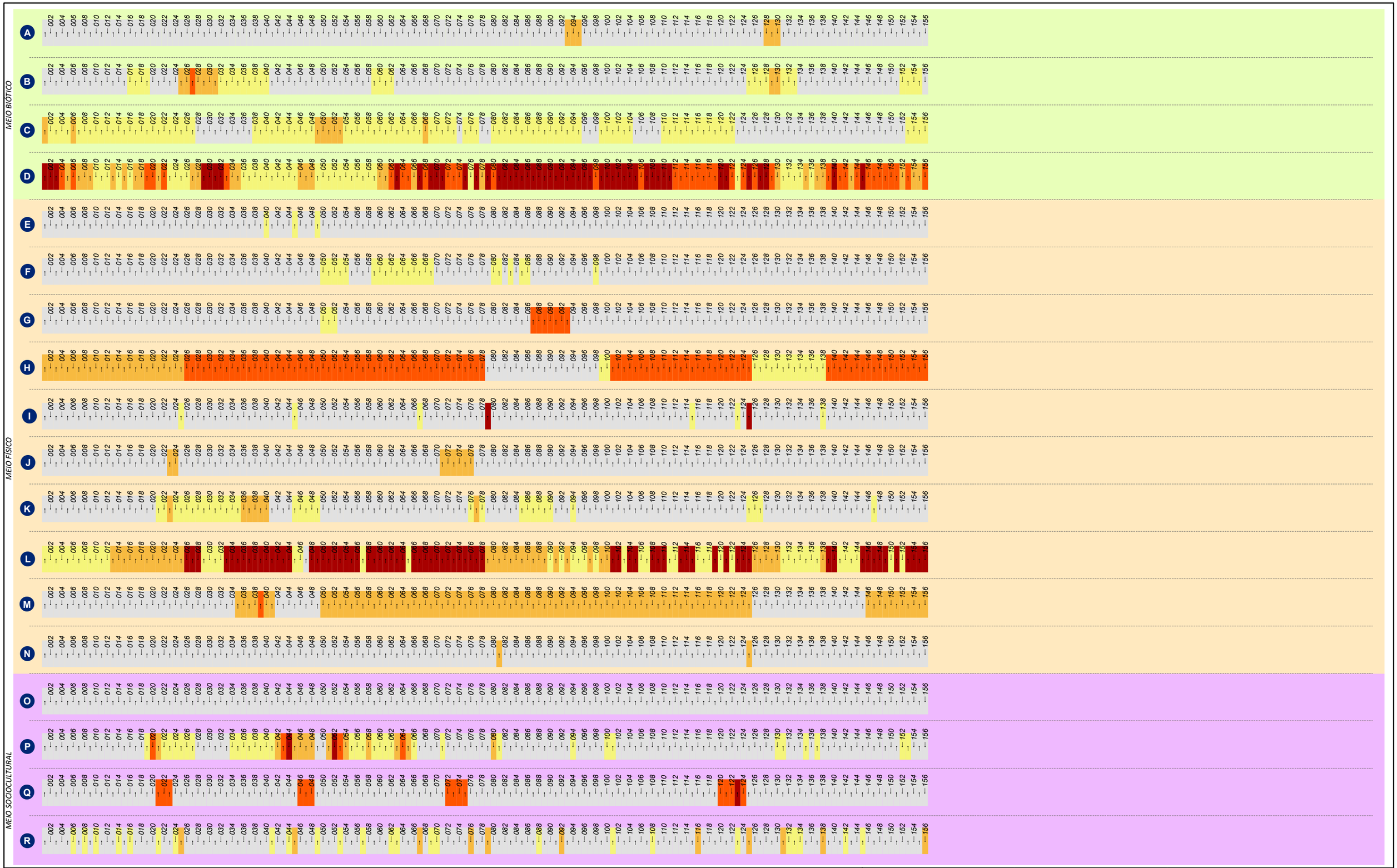
Together, these basins cut through the territory of 300 municipalities, 90 in Goiás, 95 in Pará, 115 in Tocantins, and Brasília. The total population on these basins is 11,436,000 inhabitants (IBGE,2010). The federal capital, Brasília (DF), accounts for 22.47% of the total and the state capital of Belém (PA) accounts for 12.18%.

The territory of the area of study crosses 70 municipalities, 11 in Maranhão, 18 in Pará, and 41 in Tocantins. The total population is 661,123 inhabitants (IBGE,2010) and the most populous city is the state capital, Palmas (TO), with 34.54% of the total. As for the FIRJAN index, the average for these municipalities is 0.59, the highest rate is in Palmas (TO), 0.85, and the lowest, in the municipality of Tocantínia (TO), 0.42.

On the area of these basins there are 25 Indigenous Lands territories, located especially to the north, in the states of Pará and Maranhão, and 63 Conservation Units (46 Sustainable Use and 17 Integral Protection), distributed along the territory of these basins, especially in the central portion of the Tocantins River basin, near the municipalities of São Felix do Tocantins and Mateiros, both in the state of Tocantins.

In the area of study of the Tocantins waterway, whose surroundings were divided into 156 stretches, only 13% are considered vulnerable from the social and environmental standpoints considering possible intervention during the construction of support or maintenance works, owing to the presence of vive Indigenous Lands, located especially in the north portion of the waterway (stretches 21 through 23, 46 through 48, 72 through 75, and 120 through 124) in the municipalities of Baião (PA), Bom Jesus do Tocantins (PA), Maurilândia do Tocantins (TO), Tocantinópolis (TO), Pedro Afonso (TO), and Tocantínia (TO), and two Integral Protection Conservation Units on stretches 91 through 96 (in the municipalities of Carolina-MA and Filadélfia-TO) and 128 through 130 (municipality of Palmas).

The distribution of occurrences with regard to the variables analyzed can be better observed on the one-line diagram below.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO

- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO

- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL

- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO TOCANTINS	MAI/2013

3.10.1.6 Itacaiúnas Waterway

a) Navigability Diagnosis

The Itacainúnas River is one of the left bank tributaries of the Tocantins River. Its spring is in the state of Pará, at the Serra da Seringa, and is formed by the junction of the Água Preta and Azul Rivers. The mouth is on the left bank of the Tocantins river, in the city of Marabá (PA). The importance of the Itacaiúnas River lies on the fact that it connects the Carajás region to the Tocantins River.

The Itacaiúnas River is in the region of the Depressão Amazônica [Amazon Depression], and has alluvial deposits and sedimentary rocky formations. The flow regime is typical of the Tocantins River basin, being the dry season/ the dry season being between June and November. In the stretches near Tucuruí the dry season takes place between July and December. The average flow is about 500 m^3/sec near the mouth (see Appendix VII, Item 4.4.5).

The Itacaiúnas Waterway under study comprises the long stretch of 130 km counted from its mouth, on the Tocantins River, in the city of Marabá (PA).

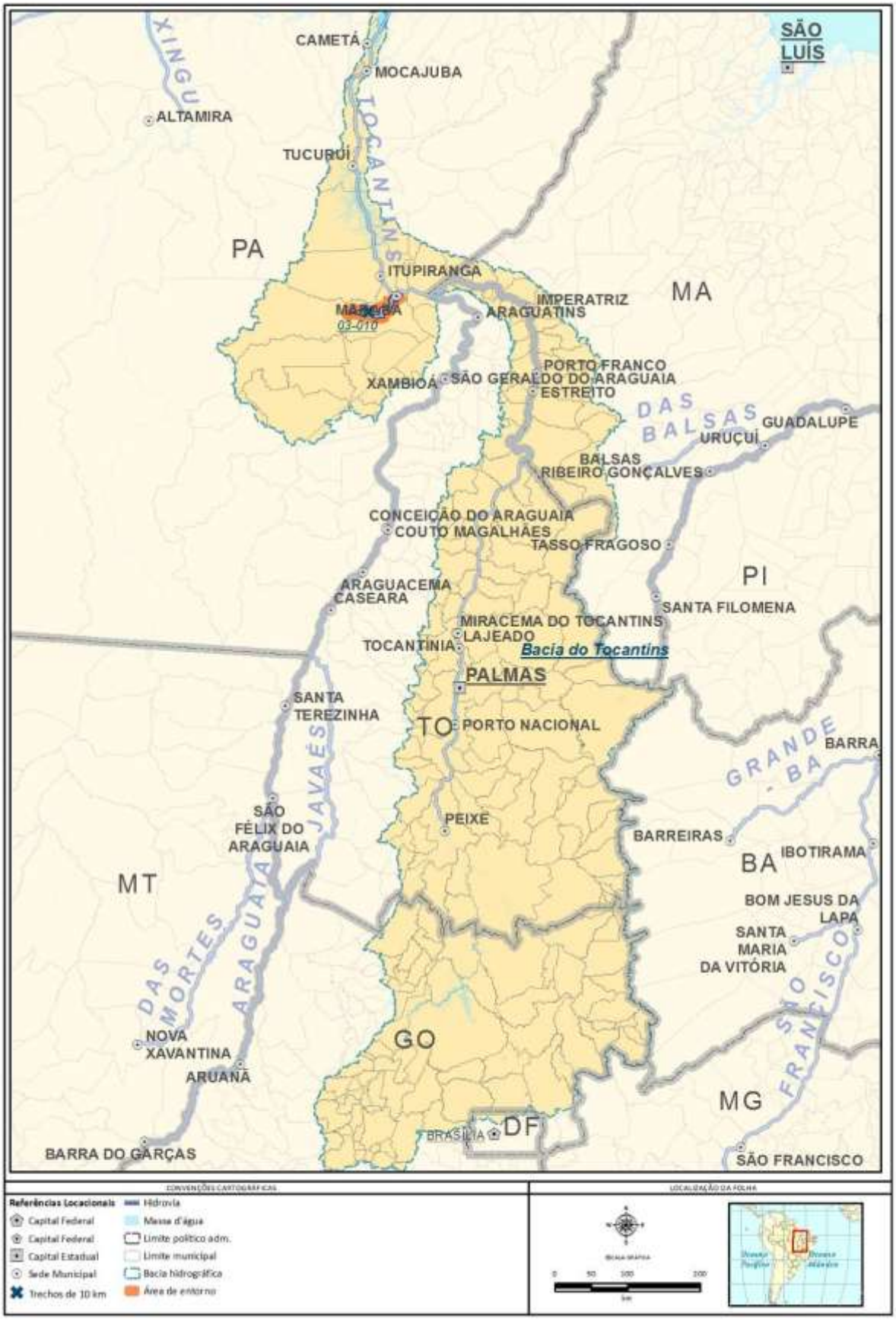
The Itacaiúnas River has poor navigability conditions for commercial vessels. It is a small-size river with a sinuosity rate of 1.9. The minimum widths are about 100m in the medium-downstream stretch (stretches 1 to 8) and about/on the order of 50m in the upstream stretches. Moreover, the river has steps/low falls and rapids in the last 50 km upstream of the waterway (stretches 9 through 13), when the declivity is about/on the order of 50 cm/km and the runoff velocity is high.

Minimum depth in the 50km downstream of the waterway (stretches 1 through 5) is about 1.5m, and is even lower going upstream.

The river also has natural obstacles such as sandbanks spread along the downstream stretches and near the mouth, besides many rock outcrops along the entire waterway.

b) Social and environmental Vulnerabilities

The future Itacaiúnas Waterway is 129 km long and, being a tributary of the Tocantins River, inserts/is integrally in the north portion of the already described Tocantins River basin, in the state of Pará, within the limits of the Amazon biome; its location can be viewed in the figure that follows.



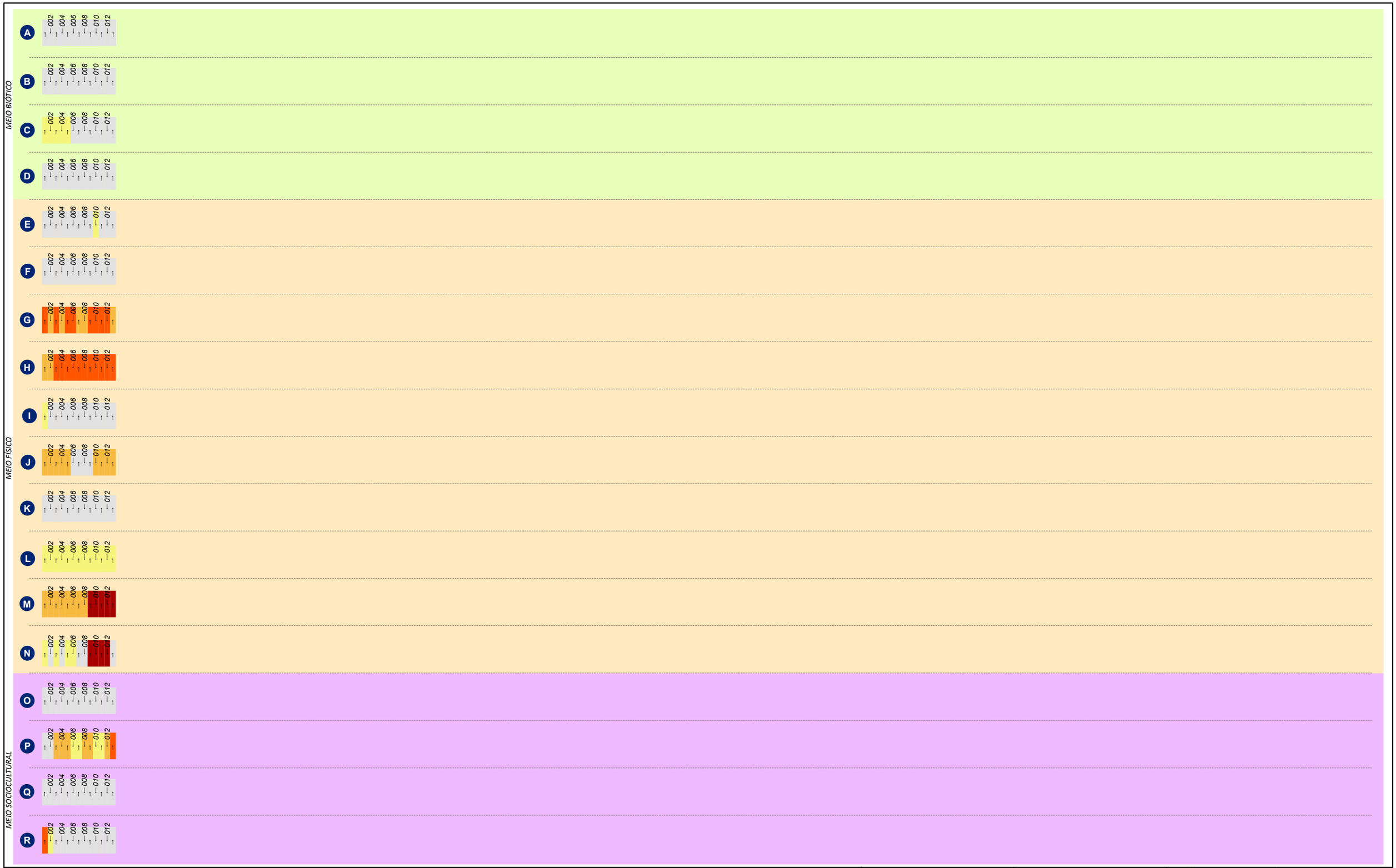
Map 61: Itacaiúnas Waterway Location

The area of the Tocantins River basin is 379,313 km², crossing 241 municipalities in four states, 90 of which are in Goiás, 29 in Maranhão, 35 in Pará and 115 in Tocantins. The total population of these municipalities is 1,256,245 inhabitants (IBGE, 2010), the most populous one is the state capital Palmas (TO) and the least populous is Oliveira de Fátima (TO), with 1,037 people. The values of the FIRJAN (2010) index are 0.42 in Tocantínia and 0.85 in Palmas, 0.58 being/being 0.58 the average index.

In the Tocantins River basin there are 15 Indigenous Lands, mainly in the state of Pará, at the north portion of the basin, and 46 Conservation Units – 32 of which are Sustainable Use and 14 Integral Protection – spread throughout the territory of the basin.

The study area of the Itacaiúnas Waterway was divided into 13 stretches for the analysis of a social and environmental vulnerabilities where there is no record of [the existence of]/existing high vulnerability points. It is worth stressing, though, that there are 71 INCRA settlements along the entire waterway, near the left bank and following the natural course of the river.

The distribution of these occurrences with regard to the analyzed variables can be better observed on the one-line diagram presented below.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

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MA - Muito alta

REFERÊNCIAS

Fontes:
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- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

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PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

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EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
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3.10.2 Economic Aspects

3.10.2.1 Current inland waterways transport

The port in the estuary of the rivers Tocantins and Araguaia consists of two parts, one at the side of Barcarena and one next to the city of Belém. Barcarena (also called Vila do Conde) is the most important seaport for the region. A large part of all exports and imports for the region are handled in this port. The port of Belem is mainly important for inland waterway transport to and from ports in the Amazon.

The share of inland waterways on rivers Tocantins and Araguaia in total transport to and from the ports of Belem en Bacarena until 2010 is almost zero. The main reason for this is the absence of navigation locks next to the Tucuruí dam. This obstacle was removed in October 2011, when the locks in the Tucuruí dam opened.

Total inland waterway transport on the Tocantins – Araguaia river basin in 2011 was about 3 million tons and 650 million ton-kilometers (TKM). Current inland water transport in the Tocantins basin only concerns transport between Belem and ports at the Amazon River and not on Rio Tocantins and Rio Araguaia themselves, because, as stated before no transport was possible on these riversbefore and during 2011. It should be noticed that beside inland waterway transport, coastal transport (cabotage) and international shipping (long course) takes place. Table 3.10.1 gives an overview of these flows.

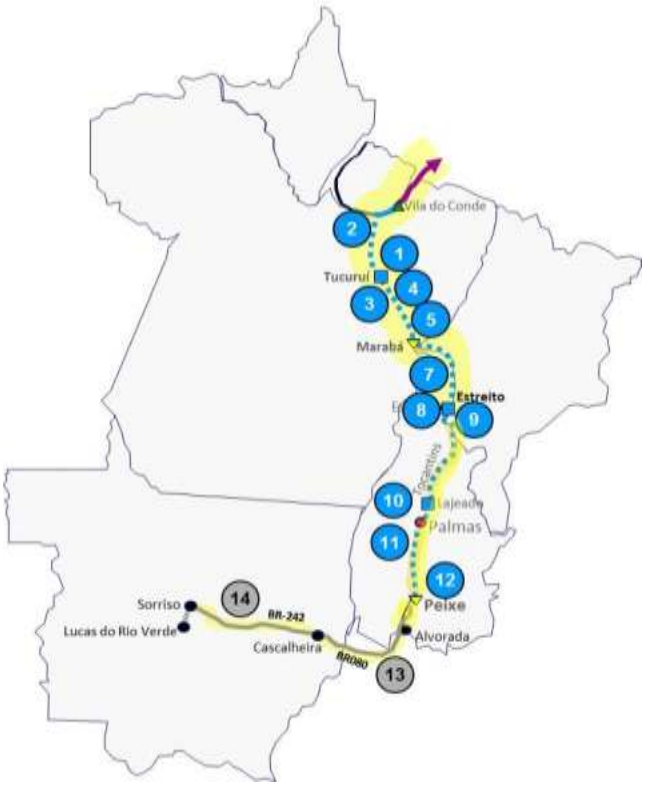
Table 3.10.1: Types of navigation in the Tocantins-Araguaia basin in 2011

Type of navigation	Tons (* 1.000)	Tkm. (* mln.)
Coastal shipping	8.677	1.369
Sea shipping	11.855	1.914
Inland waterway transport:	3.125	652
- Regional	*313*	*45*
- National	*2.812*	*606*
- International	-	-
Total		**3.934**

Regional inland waterway transport mainly consists of oil products and ro-ro transport. Oil products are transported over relatively short distances between Belem and Barcarena, Altamira and Almeirin as destinations. The ro-ro traffic is only between Belem and Santarém. National transport is mainly between Belem and Manaus and mainly concerns ro-ro transport.

3.10.2.2 Planned developments

Several projects are expected to improve transportation infrastructure in the region that will positively impact production transport across the state of Tocantins to the main ports of the country. Investments in infrastructure in the state that can be mentioned, among others, are the implementation of the North-South Railway and navigability on the Tocantins Waterway, as clarified in the following figure.



1. Locks of Tucuruí
2. Dredging waterway Tucurui to Vila do Conde
3. Remove sediments São Lourenço
4.Dredging waterway Imperatriz to Marabá
5. Intermodal platform Marabá
7.Signaling Estreito to Marabá
8.Waterway terminal Estreito
9.Locks of Estreito
10. Locks of Lajeado
11. Signaling Estreito to Peixe
12 Waterway terminal Peixe
13. BR242 Ribeirão Cascalheira to Formoso do Araguaia
14. BR242 de Sorriso até Ribeirão Cascalheira
15. Railroad integration Centro Oeste de Alvorada a Lucas do Rio Verde

Figure 3.10.10: Infrastructure investments in Tocantins state

Concerning the sea ports, major origins or destinations for inland waterway transport, for Vila do Conde (Barcarena) a master plan is developed. This master plan shows a massive increase of the cargo flows, of which especially relevant for IWT:

- Agricultural: although at the moment no soy or corn is transported via the port of Vila do Conde, the expectations are high. In 2030 almost 12 million tons are expected to be handled in the port, mainly soy and corn (exports) and fertilizers (imports). These forecasts are based on projections concerning the expected growth in agricultural production in the Tocantins catchment area.
- Ores and steel: the new steel plant in Marabá will export steel. Other products involved are coal, pig iron and manganese. The total amount handled in the port is growing from less than one million tons in 2009 to around 30 million tons in 2030.
- Aluminum: Bauxite and aluminum are already important for Vila do Conde. The growth in the coming decades is modest, from about 14 to about 19 million tons.

3.10.2.3 Future inland waterways transport

This paragraph summarizes the base case forecasts for inland waterway transport in the Tocantins-Araguaia river basin. More detailed information is provided in the background reports concerning commodities and river basins.

As stated presently virtually no inland water transport takes place except between Belem and Vila do Conde on the one hand and the Amazonas (especially Manaus) on the other hand, passing through the Tocantins-Araguaia basin. However the projected river transport, especially on the Tocantins river is expected to grow sharply.

Table 3.10.2: Forecast for Tocantins River (in 1.000 tons)

	2011	2015	2023	2031
Soy	0	2.694	5.475	9.172
Soy meal	0	879	1.584	2.468
Corn	0	1.699	3.017	4.667
Cotton	0	222	329	450
Fertilizers	0	757	1.250	1.697
Coal	0	1.999	5.248	9.371
Iron ore	0	1.615	1.850	1.976
Manganese	0	1.981	2.732	3.643
Pig iron	0	1.330	1.731	936
Steel	0	3.438	9.028	16.119
Others	0	12	17	22
Total	**0**	**16.626**	**32.261**	**50.521**

Two main groups of products can be distinguished in these forecasts. Agricultural products like soy, soymeal and corn as export products and fertilizers as imports is the first group. The second group is directly related to the steel plant of ALPA in Marabá. This requires input of iron ore (from the Carajas mines by train) and coal imported through the port of Vila do Conde. The exported products are steel and pig iron. It is of course a necessary condition that the Steel plant in Marabá will start before 2015 and the Tocantins River can be navigated without barriers.

Concerning the Araguaia River, the potential flows of agricultural commodities are equal to the potential of the Tocantins River. The influence zone for both rivers is the same (Mato Grosso / Goiás and Matopiba). The location of the Araguaia River for exports from Goiás and Mato Grosso is better, while the location of the Tocantins River is better for the exports from the Matopiba region. In the strategy faze the options will be further explored and evaluated. Refer to table 3.10.3.

Table 3.10.3: Total potential for Araguaia River (in 1.000 tons)

	2011	2015	2023	2031
Soy	0	2.694	5.475	9.172
Soy meal	0	879	1.584	2.468
Corn	0	1.699	3.018	4.667
Cotton	0	222	329	450
Fertilizers	0	757	1.250	1.698
Total	**0**	**6.251**	**11.655**	**18.454**

3.10.3 Transport System

3.10.3.1 Transported Cargo

Based on the findings presented in chapter 3.10.2, it can be concluded that there is no inland waterway cargo transport on the Rio Tocantins. In 2031 however the potential cargo for the Rio Tocantins consists on the one hand of the cargo flows generated by the future steel mill in Maraba (import of coal between Vila do Conde and Maraba and exports of steel from Maraba to Vila do Conde) and on the other hand on the export of agricultural cargoes from the Matopiba region as well as Matto Grosso. The volumes are presented in the following table.

Table 3.10.4: Volumes Tocantins river basin (excluding Belem-Amazonas flows), in 1000 tons (own forecasts)

	2011	2031
Soy	0	9.172
Soy meal	0	2.468
Corn	0	4.667
Cotton	0	450
Fertilizers	0	1.697
Coal	0	9.371
Iron ore	0	1.976
Manganese	0	3.643
Pig iron	0	936
Steel	0	16.119
Others	0	22
Total	**0**	**50.521**

3.10.3.2 Infrastructure

This item deals with the existing infrastructure of the Tocantins-Araguaia waterway system in what concerns to the river infrastructure, roadways and railways.

The rivers that are being analyzed in this basin, as well as their characteristics (e.g. depth in dry season, variation of the width, sinuosity, and obstacles to navigation) were already presented in the Chapter 3.10.1. Therefore, in this section merely the existing infrastructure (terminals/ports, locks, roads and railways) will be described.

a) River Infrastructure

Locks

On the Tocantins River there is only the Tucuruí Lock complex and some other planned locks (Estreito and Lajeado). The Tucuruí lock construction was finalized in the end of 2010. This structure will enable the transposal of the Tucuruí Hydroelectric Power Plant. This system is composed of two locks (upstream and downstream lock) separated by an intermediate channel with a length of approximately 5,5 km and minimum width of 140 m (see figure 3.10.11**Erro! Fonte de referência não encontrada.**).

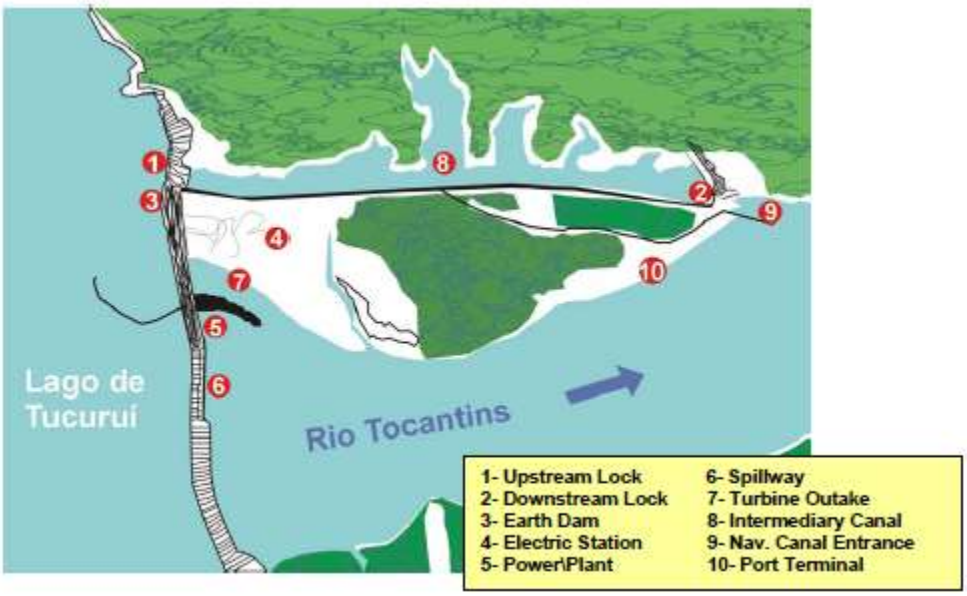


Figure 3.10.11: Tucuruí lock – birds eye view (PIANC, 2009)

The lock was designed for the typical convoy presented below (see figure 3.10.12), which has the maximum capacity of 19.100 tons. The draft is 4,5 m for the barges and 3,5 m for the push boat.

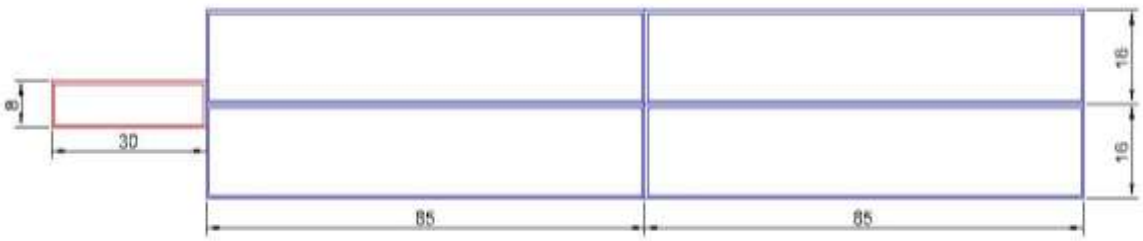


Figure 3.10.12: Typical convoy – measures in meters (adapted from Eletrobrás, 2011).

The dimensions of the locks are presented in Table 3.10.5**Erro! Fonte de referência não encontrada.**. The intermediate canal has as one of its functions to enable the emptying of the downstream lock for several times, without operating the upstream lock. It also works as a reservoir, as it empties the upstream lock and fills the downstream lock.

Table 3.10.5: Dimensions of the Tucuruí locks system (adapted from PIANC, 2009).

Dimension	Upstream Lock	Downstream Lock
Total Length (m)	210,0	210,0
Width (m)	33,0	33,0
Head (m)	36,5 (max)	35,0 (max)
Draft clearance (m)	6,0 (max) and 4,0 (min)	6,0 (max) and 3,5 (min)

The operation of the system was planned to be independent in order to increase the capacity of the system (40 million tons), as the channel located in between the locks leads to an approximate navigation time of 30 minutes.

To reduce the costs of the "canal-reservoir", the maximum channel water level variation (0,5 m) was determined based on the condition that there are differences on the lockage volumes of the locks and the downstream lock depends on the downstream river water level.

The Tucuruí lock system is operated by Eletronorte. According to the document titled "*Normas de Tráfego nas Eclusas da Hidrovia do Tocantins*", the traffic is only allowed during the day, from 6 am until 6 pm.

The estimated time to fill and empty the upstream lock is 13 minutes and 14 minutes, respectively. For the downstream lock it is 14 minutes and 16 minutes, respectively.

The Lajeado and Estreito locks are planned to be built and were designed to have a length of 210 m, width of 25 m and maximum draft of 3,5 m. The typical convoy has 6 barges with a capacity of 10.500 tons.

Ports and Terminals

General

For the Tocantins-Araguaia Waterway System terminal analysis, the PNIH database was considered. Information gathered during the stakeholder consultation and from recent reports was included. In this database, 46 terminals are listed, of which 32 do not present information regarding the situation and only 5 are in operation. The Table below shows the number of terminals per situation.

Table 3.10.6: Situation of the Ports/Terminals located on the Tocantins-Araguaia Waterway System (Source: Developed from the PNIH database, 2013).

Situation	Quantity	Percentage
Demolished	1	2%
Operation	5	11%
Planned	8	17%
Without Information	32	70%
Total	**46**	**100%**

Several ports in the database do not have any information regarding their current status (see Table below). These were not considered in our analysis, neither were the ones classified as "demolished".

The Tocantins-Araguaia waterway system has two organized ports and three private terminals. The table below shows the ports and terminals located in this area.

Table 3.10.7: Ports and Terminals – Tocantins-Araguaia Waterway System (Source: Developed from the PNIH database, 2013).

Port/Terminal	Type	Location	Hinterland Connections
Belém	Porto Organizado	Margem direita da Baía de Guajará	BR-010 and BR-316
TUP Agropalma	Terminal de Uso Privativo Exclusivo	Rio Pará	BR-316 (and local roadways)
TUP J. F. de Oliveira Belém	Terminal de Uso Privativo Misto	Rio Maguari	BR-316 (and local roadways)
TUP Terfron	Terminal de Uso Privativo Misto	Margem direita da Baía de Guajará	PA-403
TUP Bertolini Belém	Terminal de Uso Privativo Misto	Margem direita da Baía de Guajará	BR-010 and BR-316
Vila do Conde	Porto Organizado	Rio Pará	PA-151

Considering the IWT, the above terminals/ports only handle cargo with the Amazon region as their origin and destination. None of them are situated along the Tocantins or Araguaia rivers. This may be explained by the fact that there isn't any commercial navigation on these rivers, only the transport of local cargo. This information was confirmed during the consultations.

In the past, there used to be transport of pig iron along the Tocantins River, from Marabá up to Barcarena, but since the crisis of 2008, the production of the Cosipar plant at the city of Marabá has decreased until its collapse.

Currently, a terminal called Ecoporto Praia Norte is planned to be built. It will be located at the Praia Norte city. The main cargo to be transported is coming from the Zona Franca de Manaus. It is expected that an increase of the industrial activities, such as beef industries. Thus, reefer cargo is being considered as potential return freight to Manaus.

Currently, the section of the Tocantins River where the terminal is planned to be implemented is not navigable. The company expects that government investments occur due to the project.

Further information about the current operational terminals/ports located at this system is provided below. The division is made according to the region where they are located.

Belém

The port of Belém is one of the two potential ports when it comes to handling the cargo originating from the Rio Tocantins. A porto organizado and a number of private terminals are presently operational.

Table 3.10.8: Terminals in Belém (Source: Developed from the PNIH database, 2013).

Name	Company
Belém	Companhia Docas do Pará – CDP
TUP J. F. de Oliveira Belém	J.F. de Oliveira Navegação Ltda
TUP Agropalma	Companhia Refinadora da Amazônia
TUP Bertolini Belém	Transportes Bertolini Ltda

At present the port and terminals handle nearly 1,3 million tons of cargo originating from the other ports in the Amazon basin, as can be seen in the following tables. RO-RO cargo constitutes the majority of the present flows.

Table 3.10.9: IWT transport with destination Belem by origin (Source: Relatório ANTAQ – Transporte de cargas nas Hidrovias Brasileiras 2011).

Area	2011
Manaus	1.093
Santana	112
Macapá	41
Santarém	23
Porto Velho	0
Total	**1.268**

Table 3.10.10: IWT with destination Belem by commodity,in 1.000 tons (Source: Relatório ANTAQ – Transporte de cargas nas Hidrovias Brasileiras 2011).

Cargo	2011
Ro-Ro	913
Oil products	331
Trucks	11
Other commodities	13
Total	**1.268**

Barcarena Area

The Port of Vila do Conde is located at the Barcarena area which is closer to the mouth of the Tocantins River. In this location there are an organized port and a private terminal. The table below shows them.

Table 3.10.11: Terminals - Barcarena area (Source: Developed from the PNIH database, 2013).

Name	Company
Vila do Conde	Companhia Docas do Pará - CDP
TUP Terfron	Rio Turia Serviços Logísticos Ltda

The tables below present the cargo that was handled in the port per origin and destination, respectively.

Table 3.10.12: Cargo and destinations IWT Barcarena area, in 1.000 tons (Source: Relatório ANTAQ – Transporte de cargas nas Hidrovias Brasileiras 2011).

Cargo	Destination	2011
Oil products	Almeirin	34
Petroleum Cokes	Itaituba	9
Containers	Manaus	0
Total		**43**

Table 3.10.13: Cargo and origins IWT Barcarena area, in 1.000 tons (Source: Relatório ANTAQ – Transporte de cargas nas Hidrovias Brasileiras 2011).

Cargo	Origin	2011
Caulim	Almerin	1
Machines	Manaus	0
Trucks	Manaus	0
Total		**1**

Marabá

In the past, there used to be transport of pig iron along the Tocantins river, from Marabá up to Barcarena, but since the crisis of 2008, the production of the Cosipar plant at the city of Marabá has decreased until its collapse.

Because of this the terminal in Maraba is no longer operational and no transport took place along the Tocantins in 2011.

Rail

Currently, there is only one railway in operation, a section of the North-South railway (EF-151), which is under Vale concession. This section connects the city of Açailândia and Palmas, with a total length of 719 km. In 2011, the main cargo transported was soya, soya meal, iron ore and sand. The total amount was about 2,6 million tons.

The North-South railway is under construction up to Estrela d'Oeste (SP). It is planned to be extended up to Barcarena (PA) and up to Rio Grande (RS) - see figure below.

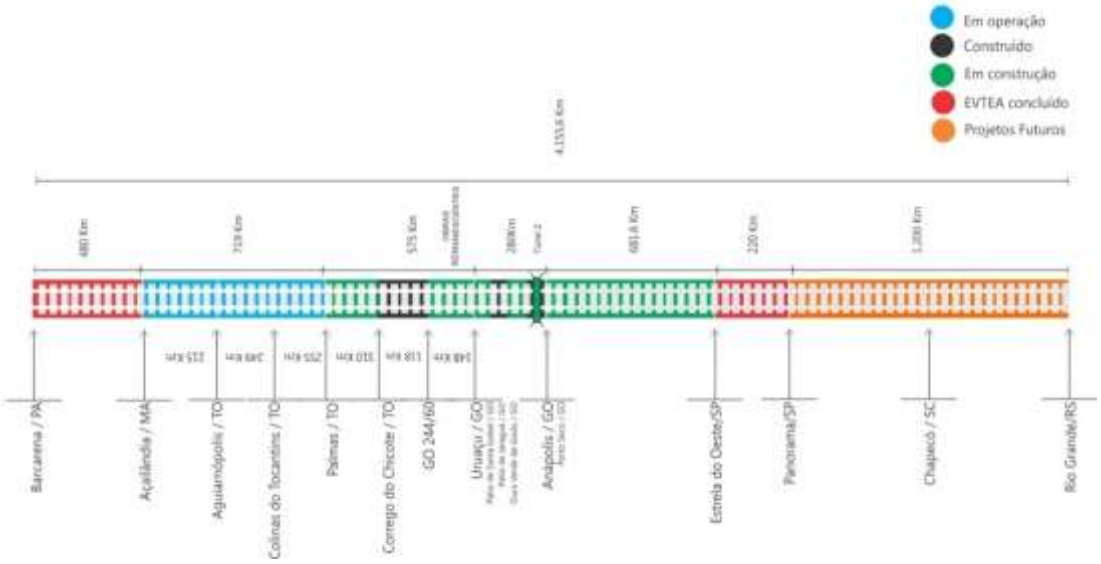


Figure 3.10.13: North-South railway unifilar diagram (Source: Valec, 2013).

The extension of the North-South railway from Açailândia up to Barcarena will directly compete with the Tocantins waterway system.

Roads

The choice of the roads that were analyzed was based on the routes of the cargo from the producer regions up to the export ports. The roads considered were mainly the Federal Highways, due to the state connections.

The condition of the roads was based on the characterization presented in the PNLT report ("Duplicada", "em obras de duplicação", "em obras de pavimentação", "Implantada", "Leito Natural", "Pavimentada", "Planejada", "Travessia").

Tocantins region road connections from Matopiba to Itaqui and Vila do Conde port areas:

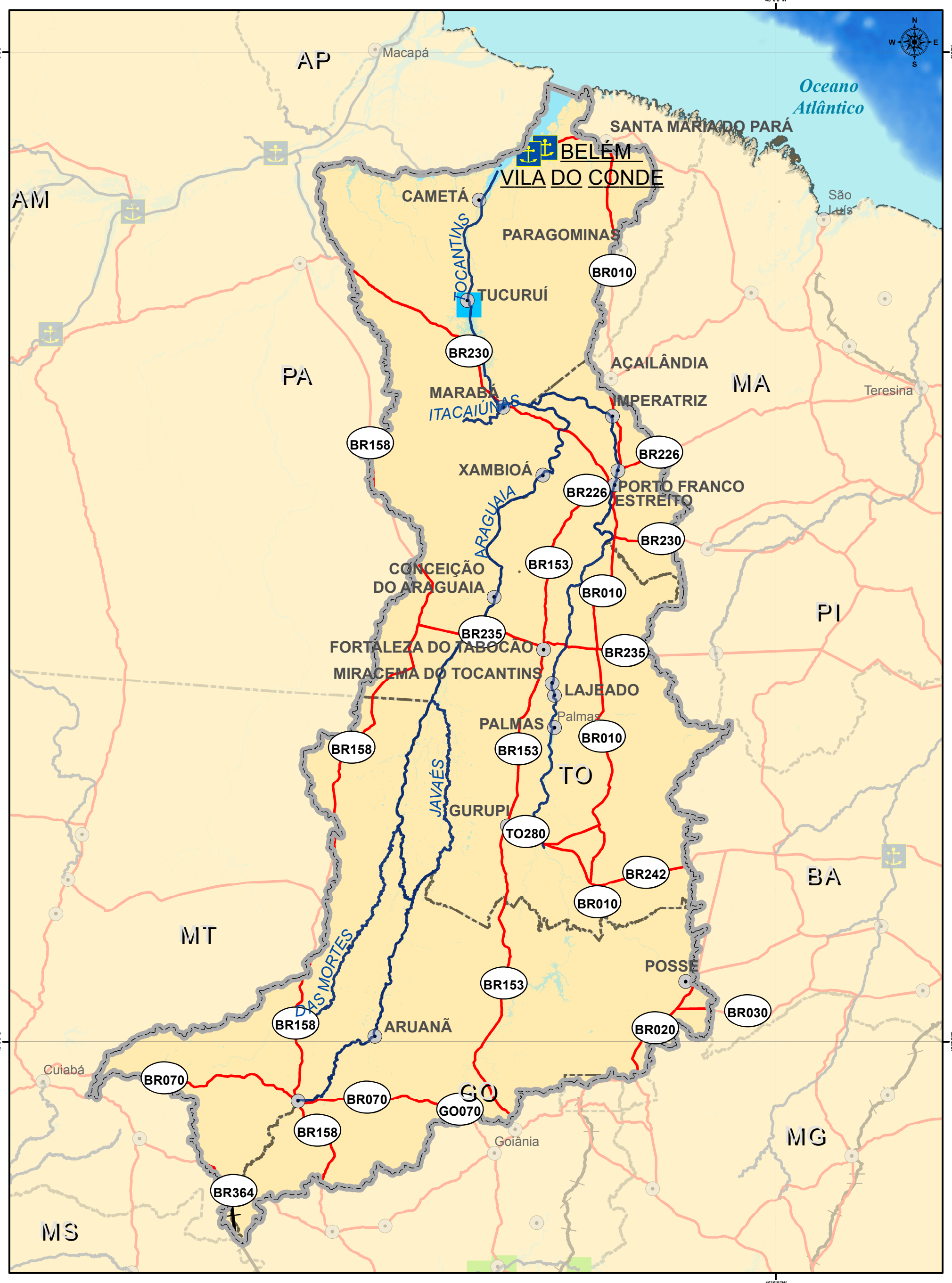
In general, road transportation in the Tocantins-Araguaia region from the ports of Vila do Conde and Itaqui to the agricultural production areas in the Matopiba area is difficult. The main roads for the longer distances are paved, which means that in general, conditions are relatively good. Close to the port and production areas, the roads are largely unpaved and therefore, weather affects road conditions. The distances to Vila da Conde exceed 1000 km and the and for the Itaqui port the distances average around 800 km.

Road access to the Itaqui port from Matopiba production areas:

The BR-135 is the main access road for the Itaqui Port. It is largely paved (although its conditions vary) except for some parts south of the Parnaíba River. Therefore, the BR-135 provides lower quality access for the Bom Jesus, Formosa do Rio Preto and Correntina regions. Here, the PI-140, which is paved and runs parallel to the BR-135, could be an alternative. For the Sambaíba, Balsas and Campos Lindas regions, the paved BR-230 provides access to the BR-135 and these regions therefore have relatively good accessibility.

Road access to the Vila do Conde port from Matopiba production areas:

Around the Vila do Conde port, the connections to the BR-010 are poor. The PA-252 is largely unpaved and has river crossings without bridges, making it unsuitable for cargo transportation. The PA-256 provides better access to the BR-010 because it has no river crossings without bridges. However, it is unpaved as well. The PA-150 provides better access to the south and connects with the BR-230 in the city of Marabá. From here the regions of Sambaíba, Balsas and Campos Lindas are relatively easily accessed. Currently, the regions south of the Parnaíba river (Bom Jesus, Formosa do Rio Preto and Correntina) have lower accessibility to the Vila do Conde port. However, some roads (such as the BR-235) connecting these regions to the BR-010 are planned.



CONVENÇÕES CARTOGRÁFICAS

- Capital Estadual
- Limite político adm.
- Hidrovia
- Massa d'água
- Portos e terminais
- Cidades principais

Barragem existentes
- Barragem sem eclusa
- Barragem com eclusa

Infraestrutura de transportes
- Rodovias
- Ferrovias

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA
0 40 80 160 km

SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

TRANSPORT CHARACTARISTICS HIDROVIA DO TOCANTINS - ARAGUAIA

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:6.000.000	- BRASIL -	JUL/2013

3.10.3.3 Characteristics of the existing fleet and Companies Operating

The Tocantins-Araguaia waterway system, but the section that comprises the Port of Belém and Vila do Conde, as it has been aforementioned, does not have commercial navigation, only crossings are being done by three companies, which are presented in the table below.

Table 3.10.14: Information about shipping companies (Source: ANTAQ Statistical Report, 2011).

Empresa de Navegação	Rio	Rota	Embarcação	Average Age (years)
Dario Rodrigues Salazar – ME	Araguaia	Araguaiana (MT) / Montes Claros de Goiás - Registro do Araguaia (GO)	Balsa + Empurrador	10
Renato de Almeida – ME	T	Caseara (TO) / Santana do Araguaia - Barreira do Campo (PA)	Balsa + Empurrador	21
Pipes Empreendimentos LTDA.	Tocantins/Araguaia	Diversas	Balsa + Empurrador	16,7

It has been pointed that, as several bridges are being constructed along the river, the crossing transport may lose its importance.

During the meetings was mentioned that once bottlenecks of the waterway are overcome (e.g. pedral do Lourenço demolition), private companies will start investing in this logistic corridor, by ordering barges and building terminals.

3.10.3.4 River Management System

As approached in the Chapter 3.10.4, The Tocantins-Araguaia waterway system is managed by two River Administrations; AHITAR, from the source up to the borders of the São João do Araguaia, Esperantina and Bom Jesus do Tocantins cities; and AHIMOR, from this point up to the mouth. Those river administrations are responsible for the maintenance of the waterway, such as signaling, monitoring and dredging.

The monitoring of the water level by AHITAR, as it has been stated in the Chapter 3.10.4, is not being performed anymore, the last measure was done in 2009. This was due to the lack of available budget.

According to the document “Normas e procedimentos da Capitania Fluvial do Araguaia-Tocantins”, there is only signaling along the section between Miracema do Tocantins (TO) and Estreito (MA).

3.10.3.5 Intermodal competition

Based on the findings presented in Chapter 3.10.2, we conclude that the potential cargo for Tocantins waterway system in 2031 consists on the one hand of the cargo flows generated by the future steel mill in Marabá (import of coal between Vila do Conde and Marabá and exports of steel from Marabá to Vila do Conde) and on the other hand on the export of agricultural cargoes from the Matopiba region. The volumes are presented in the following table.

Table 3.10.15: Volumes Tocantins waterway system (excluding Belem-Amazonas flows) (in 1000 tons).

Cargo	2031
Soy	6.426
Soy meal	1.341
Corn	1.318
Fertilizers	1.545
Other Agricultural	145
Coal	9.371
Iron ore	1.976
Manganese	3.643
Pig iron	936
Steel	16.119
Others	22
Total	**42.842**

The flows related to the steel production in Marabá are not subject to competition from other sea-ports or other modes of transport. For the agro flows from Matopiba however, the road connection to the port of São Luis offers an alternative. Direct trucking from the Matopiba region is an alternative for multi-modal transport to Vila do Conde.

For the multi-modal alternative we assume that this agro cargo will be transshipped to inland barges in the port of Miracema do Tocantins (this port does not exist, but it has been assumed that a port would be located at this municipality). During the next stage of the project this assumption will be tested and optimized. For each significant micro-region (producing more than 400.000 ton of soy per annum, or containing at least one municipality producing more than 100.000 ton per annum) the transport distances for the different alternatives haven been determined. On the basis of these transport distances the resulting transport cost have been calculated using the transport cost model (see Chapter 1.3.4). The results are presented in the following table.

Table 3.10.16: Transport cost between the Matopiba region and the Northern ports (R$/ton)

Region	Micro-region	Vila do Conde	Vila do Conde	São Luis
		multi-modal	road	road
BA+TO	Formosa do Rio Preto	181	270	232
	Correntina	224	322	284
	Campos Lindos	151	185	188
MA+PI	Sambaíba	187	194	145
	Balsas	170	192	155
	Bom Jesus	182	275	184
	Baixa Grande do Ribeiro	174	228	174

The following table presents the ratio between the cost of multi-modal transport along the Tocantins to Vila do Conde and the cheapest direct trucking alternative.

Table 3.10.17: Transport cost ratio between multi-modal transport and the cheapest direct trucking alternative

Region	Micro-region	Vila do Conde
		multi-modal/road
BA+TO	Formosa do Rio Preto	78%
	Correntina	79%
	Campos Lindos	81%
MA+PI	Sambaíba	129%
	Balsas	109%
	Bom Jesus	99%
	Baixa Grande do Ribeiro	100%

The multi-modal solution is certainly not the cheapest one in every situation. For the municipalities in the MA+PI sub-region, direct trucking to São Luis is preferable to multi-modal transport to Vila do Conde. For the remaining municipalities in the BA+TO sub-region the average weighted multi-modal transport costs are about 78% of the direct trucking cost.

It can be concluded that for these latter municipalities (with a total soy production of nearly 4 million tons per annum in 2011) the competitiveness of the multi-modal alternative can be characterized as “reasonable”.

3.10.4 Governance and institutions

For a long time the Midwest/[Center-West] region was virtually isolated from the Southeast and South regions of the country due to difficulty in transport, that depended almost exclusively on river navigation until around the 50s. This panorama changed when, during the Juscelino Kubitschek (1956-1960) administration/term, the goal was to interconnect the macro-regions in the country through the construction of highways. On that occasion, the BR-153, popularly known as Belém-Brasília Highway, was built and was opened in 1960. This work attracted an important migration pool to the region, beginning to develop urban centers – until then/[so far] mainly concentrated around rivers – in the vicinities of the highways.

If during the military government an incentive policy was promoted in the national sphere to occupy the area of the 'Amazônia Legal' [legal Amazon region] by granting credit lines through the SUDAM and the Banco da Amazônia for private companies to install. The state of Goiás, specifically, developed projects of irrigated agriculture for the production of soy, rice and watermelon, also contributing to the occupation of the region. Irrigated agriculture, besides installed in the vicinities of where traditional communities lived, required the construction of channels to drain the water of rivers like Formoso and Javaés, diminishing not only their flow but also the quantity and diversity of fish in the region.

In the 1980s, inspired by the American project of integrated regional development, named *Tennessee Valey Authority* – TVA, the federal government, supported by a Council of Ministers and groups of entrepreneurs in the North and Midwest/[Center-West] regions, developed the Projeto de Desenvolvimento Integrado da Bacia do Araguaia-Tocantins – PRODIAT [Araguaia-Tocantins basin integrated development project] whose purpose was to populate and develop the Cerrado region based on the agriculture-transport-energy trinomial and had the Araguaia-Tocantins waterway as its integration axis.. The Project, however, was discontinued during the José Sarney term, as he devided to prioritize the investments in railroads.

More recently, due to the increasing bottleneck in the logistics of the country, mainly concentrated around the growth of the highway network, initiatives were resumed to make the operation of logistics through waterways feasible. Nationwide programs, such as the "Avança Brasil" (Multi-year Plan for 2000-2003), brought the proposal to make the Araguaia Tocantins corridor feasible. The cited program intended to promote multimodal integration of the transports from this corridor to the states of Tocantins, Maranhão, Goiás, Pará, and Mato Grosso, reducing costs and facilitating the distribution of local products both to the internal and the external markets.

The intention of increasing the logistic capacity of the country often runs into lack of an integrated planning beyond the transport ambit. One of the crucial aspects to make the growth of the waterway feasible, for example, relates to the multiple uses of water resources. This is because the growing demand for energy sources gave an important emphasis to the rivers, which have been receiving frequent projects of hydroelectric facilities.. Even though the Bill 3,009/97 is pending, a bill that anticipates that it is mandatory to build a lock when dams are built for hydroelectrical facilities, while there is no alignment on the topic the Tocantins/Araguaia region, for instance, will keep stretches that make river navigation

unfeasible, as is the case of Estreito (TO) and Lajeado (TO), just to mention the most critical for the region.

To this end, the Confederação da Agricultura e Pecuária do Brasil (CNA) [the confederation of agriculture and cattle raising in Brazil] and the Federação da Agricultura e Pecuária do Estado do Tocantins (FAET), as representatives of private interestes, requested the Federal Justice in Palmas (TO) to open a public class action to prevent the construction of the Estreito hydroelectric power plant until the simultaneous construction of the lock is defined, otherwise navigation would be harmed. This issue is being/[has been] discussed within the Congress, involving representatives from the Ministries of Mines and Energy (Annex I), as well as the Ministry of Transports (Annex I), besides the Agência Nacional de Transportes Aquaviários (Annex I), [national agency of water transports] Agência Nacional de Águas (Annex I),[national water agency], Associação Brasileira das Empresas Geradoras de Energia, [Brazilian association of power generation companies], and Confederação Nacional da Agricultura e Pecuária, that are usually asked to participate in forums where this debate is inserted[54].

Besides the above cited, other national and regional agents are also connected to the waterway management of the Tocantins – Araguaia. Some of them have this intermediating character, and were consulted by the IBAMA during the licensing process (like those listed in "Other agents"). Others are agents who have in their formal assignment effective action on the waterway, as is the case of AHITAR and AHIMOR. In the table below it is possible to view the major agents relating to the waterway topic, as well as their area of operation, according to their formal assignment. It is worth highlighting that such assignments reflect the content anticipated by the legal text that defines them, not depicting, in some cases, their real work. These assignments are, in turn, listed in the Annex/Annex I, and the way they relate will be untangled along the text. We will see that the formal assignments have not been totally carried out, as detailed in the already described macroanalysis.

Table 3.10.18: Formal Assignment Matrix of the Tocantins – Araguaia Waterway Agents

[54] Por exemplo, em 2007, representantes da ANTAQ e ANA participaram da 5ª Reunião do Grupo de Trabalho Conjunto de Competitividade da Câmara dos Deputados, em Brasília na qual discutiu-se o gargalo imposto pela falta de construção de eclusas para o usufruto do transporte aquaviário. Outro exemplo foi a audiência pública promovida em abril de 2012 pela Comissão de Meio Ambiente e Desenvolvimento Sustentável da Câmara dos Deputados.

	Port Mgt	Inspection	Waterway maintenance	Licensing Process	Regulation
Waterway Administration (WA) - AHITAR			■		
Waterway Administration (WA) - AHIMOR	■		■		
CDP - Companhia Docas do Pará	■				
Capitaincy of Ports		■			
Directorate of Waterway Transports - Pará		■	■		
CPH - Companhia de Portos e Hidrovias Pará	■				
Environmental Secretariats				■	
DNIT/DAQ					■
ANTAQ		■			■
IBAMA				■	■
Other Agents**				■	

*Achievement of dredging, rock excavation, signaling.
** This block encompasses all the agents consulted by IBAMA within the licensing process (Fundação Palmares, FUNAI, INCRA, IMCbio, IPHAN, and the Public Ministry).
Source : Arcadis Logos Consortium, 2012/Consórcio Arcadis Logos, 2012

Besides the assignments listed in the columns, there is also the Gestão de Conflitos de Uso Múltiplo da Agua [water multiple use conflict management], that is nationally peformed by the ANA (Agencia Nacional de Aguas). ANA's mission is also implementing and coordinating shared and integrated management of water resources and regulating water access, promoting its sustainable use for the benefit of the current and future generations. In addition to this, the institution has other strategic core definitions. Multiple use is something that has been generating a hot debate, especially in the case of the hydroelectric power plant construction on navigable rivers; these debates happen due to lack of a definition of who is responsible for the construction and operation of the lock on these rivers with a navigation potential. In a more regional plan, there are the Committees of Hydrographic basins whose purpose, besides approving the Plano de Recursos Hídricos [water resources plan] of the basin, is to mediate conflicts on water use as first administrative instance, to establish mechanisms, and suggest values to be charged for water use

In the case, for example, of the construction of the Tucuruí lock, Eletronorte, in the late 70s, contracted the studies for the transposition of the difference in level. The former Portobrás was the developer of the basic design of the system, that would be composed of two locks and one channel. The works started in 1981, but were disrupted in 1989. In 1997, studies were conducted to update/[for the updating of] the basic design, making the resumption of the works feasible in 1998; the conclusion happened only in 2010. The operation and maintenance of the electric, electronic, and mechanic equipment and the civil structure of the transposition system of the Tocantins River are the responsibility of Eletronorte itself, which will receive over

the next two years, having April 2011 as the starting date, funding from the DNIT that amounts to R$ 7.2 millon. Since the very federal government bears the operation and maintenance costs of the lock, no duty is charged directly from the users, but the duty charged for the use of the waterway is embedded in the fuel price of the vessels. On the other hand, the study and basic design of the Lajeado lock, to transpose the Usina Hidrelétrica de Luis Eduardo Magalhães [hydroelectric power plant], were requested and contracted in the late 90's by the Administração Hidroviária do Tocantins Araguaia – AHITAR (Annex I) [waterway administration] which at the time was linked to the Companhia de Docas do Pará (Annex I), which was in turn linked to the Ministry of Transports. Nevertheless, so far the works of this lock have not been concluded.

If, on one hand, the most logical alternative is to prepare the dam, power plant and lock designs at the same time, starting their construction simultaneously, on the other hand, if the three constructions are executed by to the same contrator, the current concession model for the exploitation of the energy potential of the rivers would not allow the construction costs of the lock to be transfered through the tariff charged by the concessionnaires and it would be necessary to define who would bear such costs (Lino, Carrasco e Costa, 2008).

In order to contribute to the river navigation breakthrough, the Ministry of Transports showed that it is willing to bear the construction costs of the locks, so as not to burden the energy final consumer with potential increases in tariffs and resolve the deadlock between the energy and transport sectors with regard to lock construction. Thus, the Ministry of Transports, through DNIT (Annex I) Departamento Aquaviário (DAQ) [waterway department] proposed the Estudo de Viabilidade Técnica Econômica e Ambiental (EVTEA) for the region recently, in an atempt to map the bottlenecks that make river navigation difficult along the course of the rivers of the Araguaia and Tocantins Basin. The lack of locks in a great part of the potentially navigable stretch makes the waterway stretch under AHITAR responsibility intrinsically unfeasible for regular navigation.

[The] AHITAR, whose assignment would be to provide engineering works and services to support and make navigation feasible along the rivers, has been regularly undergoing the lack of access to financial resources to conduct studies and implement the necessary improvements (dredging, rock excavation, pruning, signaling, beaconage works, etc.). This lack of access to resources also made giving updated information on the river level to users impossible for AHITAR, something that it used to do and had been considered a good practice by the Tribunal de Contas da União (2006) [federal court of audits] At AHITAR's website the latest river diagram is dated July of 2009.

This is due to the difficulties imposed by the covenant model adopted between DNIT and CODOMAR (Annex I), linking all Administradoras Hidroviárias (Annex I).[waterway administrations] to the latter. Thus, the function of the Administradora has benn quite emptied. its participation in the management of this waterway is restricted to issuing opinions mainly with regard to maneuvering in ports and contributing to the licensing process.

The lack of resources intended to the waterway management is the reflex of a wider panorama, where government programs do not address this issue as prioritary. The Programa de Aceleração do Crescimento [growth accelleration program], announced in 2007, for

instance, destined R$ 735 million to ports and waterways; R$ 500 million were destined just to the conclusion of Tucuruí locks, with only a small part to deal with the other bottlenecks imposed to navigation.

Given the relative lack of AHITAR's operational effectivity, the Secretaria de Planejamento e Modernização da Gestão Pública (Annex I),[secretariat of public management planning and modernization] together with the Secretaria de Indústria e Comércio, Instituto Natureza do Tocantins – NATURATINS (Attachement I) and others that compose the Coordenação de Programas e Projetos Estratégicos (COPPE) [strategic programs and projects coordination] of the government of the state of Tocantins, have been working to intercede in favor of rendering navigation on the Tocantins River feasible, as it has great part of its length within this state. The Araguaia River is not being considered within these initiatives a priori for commercial navigation purposes because there are important social and environmental aspects restricting this feasibility. COPPE has been consulted by the DNIT on the preparation of the EVTEA in the region and is working in the development of the Plano Estadual de Logística de Transportes [transport logistics state plan], that will translate into the state ambit the guidelines of the national plan (PNLT).

The river stretch that does not present great restraints to navigation is under Administração Hidroviária da Amazônia Oriental – AHIMOR (Annex I).[Eastern Amazon waterway administration] management This entity, as well the remaining Administrações Hidroviárias, has been having great difficulty to obtain resources to implement the maintenance works needed for perennial navigation. However, as its area of operation interests the flow of goods between the Amazon Basin and the Midwest/[Center-West] region and even makes the access to sea navigation feasible, its participation can be better observed with regard to bank and floating signaling and other small size maintenance works supported by private companies interested in commercial navigation in the region.

Thus, works that would, by definition, be the responsibility of Administradoras Hidroviárias have been driven either by state/municipal policies or by companies directly interested in using the waterway usually for cargo transport. The latter usually submit proposals to work jointly with the AHs, [waterway admininstration, WA] using their technical body and equipment (often under unfit maintenance conditions).

The waterway management in the Tocantins Araguaia region also integrates the management of ports that are being administered partly by the Companhia de Docas do Pará – CDP (Annex I), and partly by municipalities and private companies. The Companhia de Docas do Pará manages the areas of the Organized Port, collecting the tariffs related to the storage and use of land and water infrastructure and keeps records of loading and unloading in the ports. When a company wishes to construct a private port, it should get un touch first with the Navy (Annex I) and then with ANTAQ. The latter checks whether the port does not overlap the area of the organized port, but the construction of the port must be authorized by the Brazilian Navy, that must receive the design to asess whether it endangers waterway space and navigation safety. Through its Port Captaincies (Annex I), the Navy checks along the rivers and at the the same time directs/[at the same time that it directs] signaling in maintenance or construction works. To this end, there is an interaction between the Port Captaincies and the

WAs, which are responsible for implementing signaling in the course of the waterway based on directions from the Navy.

Beyond port construction, ANTAQ is responsible for regulating, inspecting and supervising concession contracts, as well as for the authorization and permission of waterway transport services and waterway and port infrastructure exploitation.

In the state of Pará, where the Tocantins River is navigable until its mouth, there are other institutions that are related to waterway management. The Secretaria Estadual de Transportes (Annex I) [state transport secretariat] has a Diretoria de Transportes Hidroviários [waterway transport directorate] with competences that mix with those of the WA concerning the engineering works to make river and lake ways navigable and their beaconage and signaling. With relation to ports, it is up to the directorate to make the project feasible, to implement and inspect the project, but this must be done in line with ANTAQ, the Captaincy of Ports, and the Companhia Docas to prevent failures when preparing the designs or doubled/double/duplicated inspections.

Also within the area of operation of the government of the state of Pará, it is worth highlighting the work of the Agência de Regulação e Controle de Serviços Públicos do Estado do Pará – ARCON (Annex I) [public service regulation and control agency], that adopts regulation and inspection actions on the waterway transport public service, that is mainly connected with passenger transport. The Companhia de Portos e Hidrovias – CPH (Annex I) [port and waterway company] was established for the purpose of managing small size public port infrastructure and stimulating the use of waterways in the state, acting as an interlocutor with other agencies (DNIT/DAQ, AHIMOR, ANTAQ, IBAMA, etc.) on behalf of the government of the state. The CPH remained emptied a long time and its assignments are being once more resumed and reassessed over the last two state administrations. There is interaction also with Secretaria Estadual do Meio Ambiente [state secretariat for the environment], supporting the environmental licensing process.

Still with regard to the environmental licensing on the Tocantins-Araguaia waterway, the Procuradoria Geral [general attorney's office] of the IBAMA, through the process Nº 02001.002048/1995-49, issued its judgement saying that, to their understanding, an Estudo de Impacto Ambiental e Relatório de Impacto Ambiental (EIA-RIMA) [environmental impact study and report] should be prepared for the entire waterway project, even though the licenses are specific for work and stretch.

In 1996, the Fundação de Apoio e Desenvolvimento da Pesquisa da Universidade Federal do Pará (FADESP) [research support and development foundation] handed IBAMA the waterway EIA/RIMA, which, after due evaluation, considered it insufficient for issuing the licenses. Then FADESP and AHITAR had the cooperation of technicians from other institutions to conduct a new study, which was submitted to IBAMA in 1999. From this study the IBAMA scheduled five public hearings that were to take place in the same year, in the municipalities of Estreito (MA), Pedro Afonso (MA), Conceição do Araguaia (PA), Água Boa (MT) and Luiz Alves (GO). The Ministério Público Federal - MPF (Annex I), [federal public ministry] supported by organizations such as the Instituto Socioambiental (ISA) and the Conselho Indigenista Missionário (CIMI) [missionary [indigenist]council], presented a court order to prevent the conduction of the

public hearing in Estreito (MA). This preliminary order was annullled, the hearings were rescheduled, but the MPF obtained a new preliminary order to prevent the hearings to take place, a fact that led to the suspension of the waterway licensing process indefinitely. Only in 2001 were all the preliminary orders that blocked the progeress of the licensing process annulled, but only in 2003, after negociations among the representatives of the MPF, IBAMA, Ministério do Planejamento (Annex I), and the Ministério dos Transportes, it was decided to dismember the licensing in Tocantins Waterway and Araguaia Waterway and it was then necessary to file away the EIA/RIMA that had been protocoled in 1999.

In 2005, it was defined that there would be only one interlocutor to speak to the licensers in order to identify and diffuse successful actions. Among the conquests of this new behavior is the change of approach, that used to take into account the waterway licensing as a whole and now deals only with civil and hydraulic works.

3.10.5 SWOT Tocantins-Araguaia waterway system

Strengths	Weaknesses
• The geographic location of the Tocantins and Araguaia rivers is good for cargo transport (especially commodities coming from the Mato Grosso region). • Tocantins River – The capacity of the Tucuruí lock is ample – There are locks planned for the Estreito and Lajeado dams – The current bridges are wide and high do not represent obstacles to navigation – The river width, sinuosity, and bed (intrinsically sandy) are adequate for navigation.	• The location of the das Mortes River is not strategic as to cargo transport in the region. • AHITAR and AHIMORface difficulties to work, imposed by the lack of access to financial and human resources (due to the covenant signed between DNIT/DAQ and CODOMAR). • Tocantins River – The road network is unreliable and not dense, but still much used for the transport of agricultural production. – There is no adequate port infrastructure for agricultural production outflow. – Between the Tucuruí reservoir and Marabá, the major problem is the Pedral de São Lourenço (a stone outcropping) that is about 43 km long and causes problems to navigation during the dry season.. – Low depth (< 1.5 m), sandbanks and bed sedimentation upstrem of Marabá cause problems to navigation during the harvest time. • Araguaia River – The road network is even more unreliable and less dense (than in the vicinities of the Tocantins River), but is still used for transport of the agricultural production. – There is no adequate port infrastructure for agricultural production outflow. – The region where the Bananal Island is located, and its surroundings, besides being an important environmnental preservation area (UCPIs), concentrates a significant presence of indigenous ethnicities making the surroundings of the Araguaia River more sensitive to the investment in infrastructures supporting thr waterway transport. – Low depths, high sedimentation levels, and the presence of rocks impair navigation along the river. – Competition between the highway and railway modes for the transport of agricultural products is high.

Opportunities	Threats
• Steel – The expectation for 2031 (considering the ALPA) is the transport through inland navigation of more than 20 million tons of steel, iron ore, manganese (Marabá - Vila do Conde) and coal (Vila do Conde - Marabá). • Agricultural products – Soybean and corn exports (from the MATOPIBA region to Vila do Conde) – Fertilizers imports (from Vila do Conde to the MATOPIBA region) • The cargo, from Mato Grosso and Goiás, could be transported through the Araguaia River. • On the Tocantins River the constucion of 3 dams is foreseen (Marabá, Serra Quebrada and Tupirantins), to allow navigation from the mouth to Porto Nacional if they have locks. • On the Araguaia River the construction of the Santa Isabel dam is foreseen to allow , navigation on the Araguaia River from Marabá to Xambioá, together with the Marabá dam, if the locks are built • For agricultural cargo from Bahia and Tocantins the intermodal transport through the Tocantins River is competitive compared with the road transport (in case the necessary infrastructure for such are built). • The ALPA Project demands full operation of the WS for transo=porting steek and coal between Marabá and Vila do Conde.	• Steel and coal – There is, however, no certainty with regard to the structuring investments associated to the ALPA steel plant in Marabá. • Agricultural products – Competition with other transport modes (railway/road) that access ports not connected with a waterway system. – The planned dams (Marabá, Serra Quebrada, Tupiratins) do not include locks. – The operation of the power plants (hydroelectric) may cause problems to navigation (altering the hydraulic regime of the river). – For agricultural cargoes from Maranhão and Piauí, the road transport to São Luis is cheaper than the intermodal transport through the Tocantins River.

3.11 URUGUAY WATERWAY SYSTEM

3.11.1 Physical system of the river and environmental and social aspects

The Uruguay Waterway System comprises three waterways considered by this plan: the Chapecó, the Ibicuí and the Uruguay waterways, inserted in the Uruguay River Basin. Together, these waterways total 1,219km, intercepting the territory of 87 municipalities, in the states of Rio Grande do Sul and Santa Catarina which, together, total 1,159,833 inhabitants (IBGE, 2010).

Nowadays the Uruguay Waterway System does not have adequate navigability conditions for the passage of commercial convoys. The Uruguay River, in the Brazilian stretch, presents large extensions of rock outcroppings, rapids and some low falls, resulting in many stretches with minimum depths under 1m. The Chapecó River has the same behavior as the Uruguay River, presenting a number of insuperable rapids and low falls, and the SPPs built and planned do not include lock systems. The Ibicuí River has smaller slopes, however, it has intense silting processes and shallow depth problems. The construction of the planned UHEs in the Uruguay River will allow commercial navigation only in isolated stretches of this river.

The analyses and studies conducted for the characterization of the physical, social and environmental conditions of the potential waterways of the Uruguay Waterway System followed the methodologies presented in Chapter 1 – item 1.3 Methodology, of this report.

Due to the great volume of information collected and analyzed, this chapter presents the summary of the main results and conclusions for each river under study.

The CD annexed to this report (Step C: Assessment and diagnosis) contains a table in the .xls format, that shows in a more detailed way all the variables and information analyzed for each river and for each section studied.

The Linear Diagrams in this chapter summarize the mentioned table, following the methodology exposed in chapter 1, item 1.3 of this report.

As the result of the final step of the Strategic Waterway Plan (Step F: Preparation of the final strategic plan) a Georeferenced Database is presented, which contains all the existing information in the table of the CD annexed to this report.

The main characteristics regarding the navigability conditions of the waterways of the Uruguay WS can be verified jointly in the linear diagram presented in sequence.

58°30'0"O
57°0'0"O
55°30'0"O
54°0'0"O
52°30'0"O
27°0'0"S
28°30'0"S
30°0'0"S

PARAGUAI
ARGENTINA
URUGUAI
PR
SC
RS

CHAPECÓ
NOVA ERECHIM
SÃO CARLOS
CHAPECÓ
IRAÍ
PORTO MAUÁ
PORTO LUCENA
SÃO BORJA
ITAQUI
IBICUÍ
URUGUAIANA
URUGUAI
ALEGRETE
CACEQUI
SOBRADINHO
DONA FRANCISCA
CACHOEIRA DO SUL
JACUÍ
MUÇUM
LAJEADO
ESTRELA
BOM RETIRO DO SUL
MONTENEGRO
CAÍ
TAQUARI
TAQUARI - RS
RIO PARDO
CHARQUEADAS
TRIUNFO

01-010
01-020
01-030
01-040
01-050
01-060
01-070
01-080
02-010
02-020
03-010

01
02
03

CONVENÇÕES CARTOGRÁFICAS

Referências Locacionais
- Capital Federal
- Capital Estadual
- Sede Municipal
- Limite político adm.
- Limite municipal
- Massa d'água

- X Jusante
- X Montante

- 01 Rio Uruguai
- 02 Rio Ibicuí
- 03 Rio Chapecó

Bacias do SH Uruguai

Trechos de 10 km (xx-yyy)
xx: n° do rio
yyy: n° do trecho
*km = yyy * 10*

Escala de ponderação dos temas
1 - 5 (baixa - alta)
- IN - Insignificante
- BA - Baixa
- ME - Média
- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

N W E S

ESCALA GRÁFICA
0 15 30 60 km

SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA

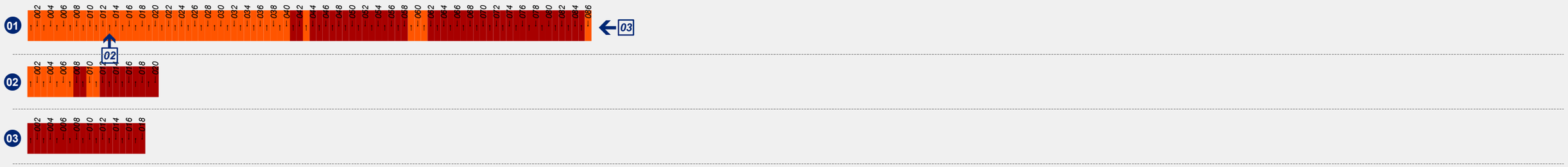
MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGNÓSTICO DE NAVEGABILIDADE

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:2.000.000	SH URUGUAI	MAI/2013



DIAGNÓSTICO DE NAVEGABILIDADE

CATEGORIAS - 5	CATEGORIAS - 4	CATEGORIAS - 3	CATEGORIAS - 2	CATEGORIA - 1
MUITO ALTO DE:	ALTO DE:	MÉDIA DE:	BAIXA DE:	
Sinuosidade; ou	Sinuosidade; ou	Sinuosidade; ou	Sinuosidade; ou	Ausência das ocorrências
Profundidade mínima; ou	Profundidade mínima; ou	Profundidade mínima; ou	Profundidade mínima; ou	
Empecilhos à navegação (construções); ou	Empecilhos à navegação (construções); ou	Empecilhos à navegação (construções); ou	Empecilhos à navegação (construções); ou	
Energia do rio; ou	Energia do rio; ou	Energia do rio; ou	Energia do rio; ou	
Leito do rio; ou	Leito do rio; ou	Leito do rio; ou	Leito do rio; ou	
Assoreamento; ou	Assoreamento; ou	Assoreamento; ou	Assoreamento; ou	
Anteparos naturais; ou	Anteparos naturais; ou	Anteparos naturais; ou	Anteparos naturais; ou	
Largura mínima do rio.	Largura mínima do rio.	Largura mínima do rio.	Largura mínima do rio.	

CONVENÇÕES CARTOGRÁFICAS

01 Rio Uruguai
02 Rio Ibicuí
03 Rio Chapecó

Confluências

Numeração dos trechos
n° < Jusante
n° > Montante

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

N W E S

ESCALA GRÁFICA
0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

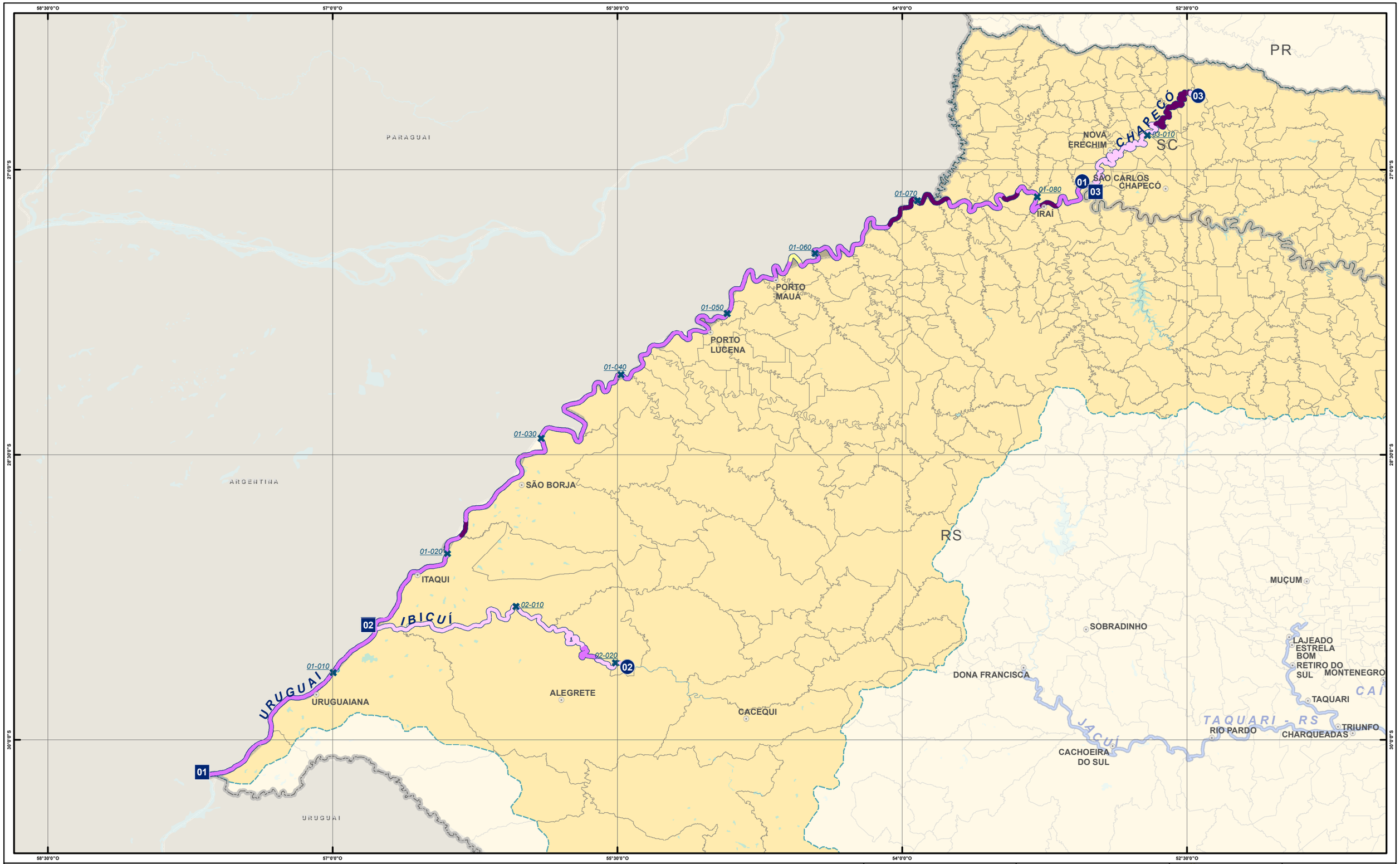
DIAGRAMA UNIFILAR DO DIAGNÓSTICO DE NAVEGABILIDADE AGRUPADO PELO SISTEMA HIDROVIÁRIO (SH)

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	SH URUGUAI	MAI/2013

The Uruguay River Basin has an area of 174,612km^2, encompassing 385 municipalities in the states of Rio Grande do Sul (RS) and Santa Catarina (SC), something that represents a contingent of 4,789,345 inhabitants (IBGE, 2010). Among the most populous are Santa Maria and Passo Fundo, in Rio Grande do Sul and Chapecó, in Santa Catarina.

In conservationist terms, the basin has 59% of its area (inserted) in the Atlantic Forest biome and 41% in the Pampa biome. In its extension, there are 297 mining works, 56 natural caves, 15 Integral Protection Conservation Units (IPCU's), 4 Sustainable Use Conservation Units (UCUS), 64 Biodiversity Conservation Priority Areas (APCB's) of extreme or very high priority, 2 Maroon Lands 146 INCRA settlements and 26 Indigenous Lands.

The main social and environmental characteristic which is worth to highlight to foster the integrated planning of occasional necessary interventions in the region where the Uruguay WS is inserted, can be verified jointly in the linear diagram presented in sequence.



CONVENÇÕES CARTOGRÁFICAS

Referências Locacionais
- Capital Federal
- Capital Estadual
- Sede Municipal
- Limite político adm.
- Limite municipal
- Massa d'água

- X Jusante
- X Montante

- 01 Rio Uruguai
- 02 Rio Ibicuí
- 03 Rio Chapecó

Bacias do SH Uruguai

Trechos de 10 km (xx-yyy)

xx: n° do rio
yyy: n° do trecho

*km = yyy * 10*

Escala de ponderação dos temas

1 - 5 (baixa - alta)

- IN - Insignificante
- BA - Baixa
- ME - Média
- AL - Alta
- MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

N W E S

ESCALA GRÁFICA

0 15 30 60 km

SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

VULNERABILIDADE SOCIOAMBIENTAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:2.000.000	SH URUGUAI	MAI/2013

VULNERABILIDADE SOCIOAMBIENTAL	CATEGORIAS - 5	CATEGORIAS - 4	CATEGORIAS - 3	CATEGORIAS - 2	CATEGORIA - 1
	UC - proteção integral; ou Terra indígena	UC - uso sustentável; ou Comunidade quilombola	Assentamento INCRA; ou Vulnerabilidade ao desmatamento; ou Cavidades naturais	APCB; ou Mineração - Lavra e garimpo	Ausência das ocorrências

CONVENÇÕES CARTOGRÁFICAS

01 Rio Uruguai
02 Rio Ibicuí
03 Rio Chapecó

Confluências

Numeração dos trechos
n° < Jusante
n° > Montante

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA
0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA VULNERABILIDADE SOCIOAMBIENTAL PARA POSSÍVEIS INTERVENÇÕES AGRUPADO PELO SISTEMA HIDROVIÁRIO (SH)

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	SH URUGUAI	MAI/2013

The linear diagram shows that the Chapecó and Uruguay rivers have the most vulnerable areas from the social-environmental point of view, mainly in their final portions. In the Chapecó River, between the municipalities of Quilombo and Três Rios (SC), there are Integral Protection Conservation Units (stretches 12 to 17). The Uruguay River has UCPIs in the stretches 22 (municipality of São Borja/RS) and from 68 to 72 (Derrubadas/RS), besides Indigenous Lands in the stretches 78 (Vicente Dutra/RS) and 82 (Iraí/RS).

The main characteristics of the Uruguay WS waterways are described below.

3.11.1.1 Uruguay Waterway

a) Navigability Diagnosis

The Brazilian stretch of the Uruguay River has about 760km in length and 174,612km^2 of draining area. It begins in the Serra Geral (SC) mouths in elevations of approx. 1,800m with the name of Pelotas River. Only after receiving the waters of the Canoas River its name changes to Uruguay River, running in the East-West general direction until receiving, on its right bank the waters of the Peperi-Guaçu River. From this point on it begins to turn Southeast, serving as the border initially between Brazil and Argentina (stretches 1 to 71), until receiving the Quaraí River, tributary of the left bank that serves as border between Brazil and Uruguay; and from there it runs South, dividing Argentina and Uruguay. Its mouth is in the Prata River, where the river meets the Paraná River.

The main tributaries are, on the right bank: Peixe, Chapecó, Peperi-Guaçu Rivers; and on the left bank: Icamaquã, Inhandava, Apuaê, Passo Fundo, Várzea, Ijuí, Ibicuí, Quaraí and Negro Rivers.

According to INMET data, the average annual rainfall in the Uruguay hydrographic region is 1,623mm, distributed in a not well defined way throughout the year. However, there are tendence to bigger flows during the period between May and October and water deficiency between November and March. The average flow in Uruguaiana (stretch 8) is about 4,250m^3/s (see Appendix VII, item 4.9.1). The basin had, until the end of December/2007, a total granted flow of 110.1m^3/, destined mainly for irrigation (91,5% of the total).

The Uruguay Waterway correspond to the stretch from the confluence of the Quaraí River, in the triple border Brazil – Argentina – Uruguay, to the mouth of the Chapecó River (stretch 86), immediately upstream of the Chapecó Mouth dam, resulting in about 860km of extension.

The stretch studied of Uruguay River is in a plateau region (Campanha Gaucha and das Araucárias plateaus). In the first 280km (stretches 1 to 28) the river bed has sedimentary characteristics, typical of alluvial deposits. From this point upstream, the river has a rocky bed and higher slopes.

The main Brazilian cities located along the waterway are Uruguaiana (RS), Itaqui (RS) São Borja (RS), Porto Xavier (RS), Porto Lucena (RS), Itapiranga (SC), Barra do Guarita (RS), Iraí (RS) and São Carlos (SC), being Uruguaiana (RS) the main one.

The navigation along Uruguay River is broadly used in mainly in its lower stretches, in the Prata basin, from the mouth to Concepción del Uruguay, in Argentina. Several cabotage vessels can

be seen on this stretch. From this city to Salto, in Uruguay, navigation becomes more and more difficult due to the several and extensive islands and sandbanks. The Salto Grande UHE (1890 MW) is in this city, which was concluded in 1979 and has not a concluded locks system, making the transposition of vessels unfeasible. The reservoir of this UHE is 140km long and reaches the proximity of the triple border, near to the Quaraí River mouth.

Upstream of the Quaraí mouth, corresponding to the effectively brazilian stretch of the Uruguay waterway, navigation is only on the stretch of 219km between Uruguaiana (RS) and São Borja (RS) (stretches 8 to 26), only by small scale vessels and in the flood period, when depths are higher. There are no adequate conditions for commercial navigation on the remaining stretches.

The Uruguay River has elevated minimal widths and presents stretches with high rates of sinuosity, concentrated mainly in the stretch more upstream of the waterway (stretches 27 to 86). The several existing rock outcropping and river islands can, however, cause narrowings and increase the expected sinuosity.

According to the Brazilian Navy, when in middle and low waters, the many rapids, low falls, and rock outcropping existing in its course, the river do not have sufficient depth to allow the passage of vessels of reasonable size. There are sandbanks in the flattest stretches. There is only intermittent navigation in isolated stretches and crossing services between Argentinean and Brazilian localities, with vessels of small draft. The existing border crossings by barge are located in the cities of Itaqui (RS) (stretch 18), Porto Xavier (RS) (stretch 45), Porto Vera Cruz (RS) (stretch 50), Porto Mauá (RS) (stretch 55) and Porto Soberbo (RS) (stretch 65/66).

There are three bridges crossing the Uruguay River (stretches 9, 27 and 82) in the river segment under study. The dimensions of those bridge spans can compel the split up of the convoys.

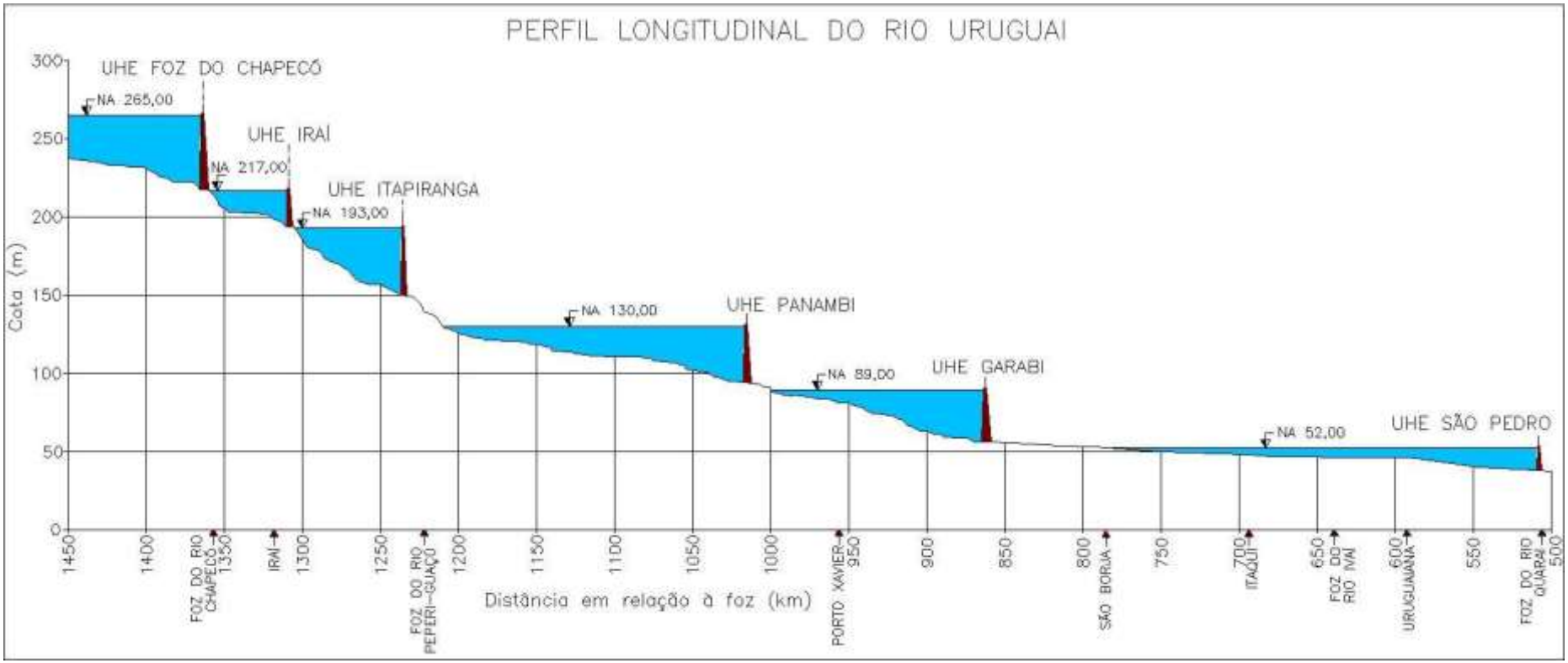
Three hydroelectric power plants were implemented in the Uruguay River (Foz do Chapecó, Machadinho and Itá), with the total installed power about 3,500MW, all of them located upstream of the waterway stretch considered. However, the regularization of the flows provided by these dammings can influence navigability conditions in the Uruguay Waterway throughout the year.

Figure 3.11.1: Uruguay River, near Mauá Port (RS) (stretch 54) (Grupo RBS, 2013)

Figure 3.11.2: Natural obstacles in the Uruguay River (stretch 74) (Prefeitura Municipal de Pinheirinho do Vale, 2011).

Figure 3.11.3: Salto Moconá in the Uruguay River (stretch 71) (Tapira Turismo, 2012)

Moreover, five new hydroelectric power plants are predicted to be constructed along the Uruguay Waterway: São Pedro, Garabi, Panambi, Itapiranga and Iraí. If provided with locks, they can allow navigation along discontinued stretches of the Uruguay River. Yet, even with the conclusion of these HPPs there will be stretches that can not be navigated, once they are under fluvial regime, and that shall be improved with dredging and rock demolition. The figure below shows the division of falls defined in the Inventário Hidrelétrico of the Uruguay River (hydroelectric inventory).



LENGTHWISE PROFILE OF THE URUGUAY RIVER
Elevation (m)
Distance from the mouth (km)

Figure 3.11.4: Longitudinal Profile of the Uruguay River

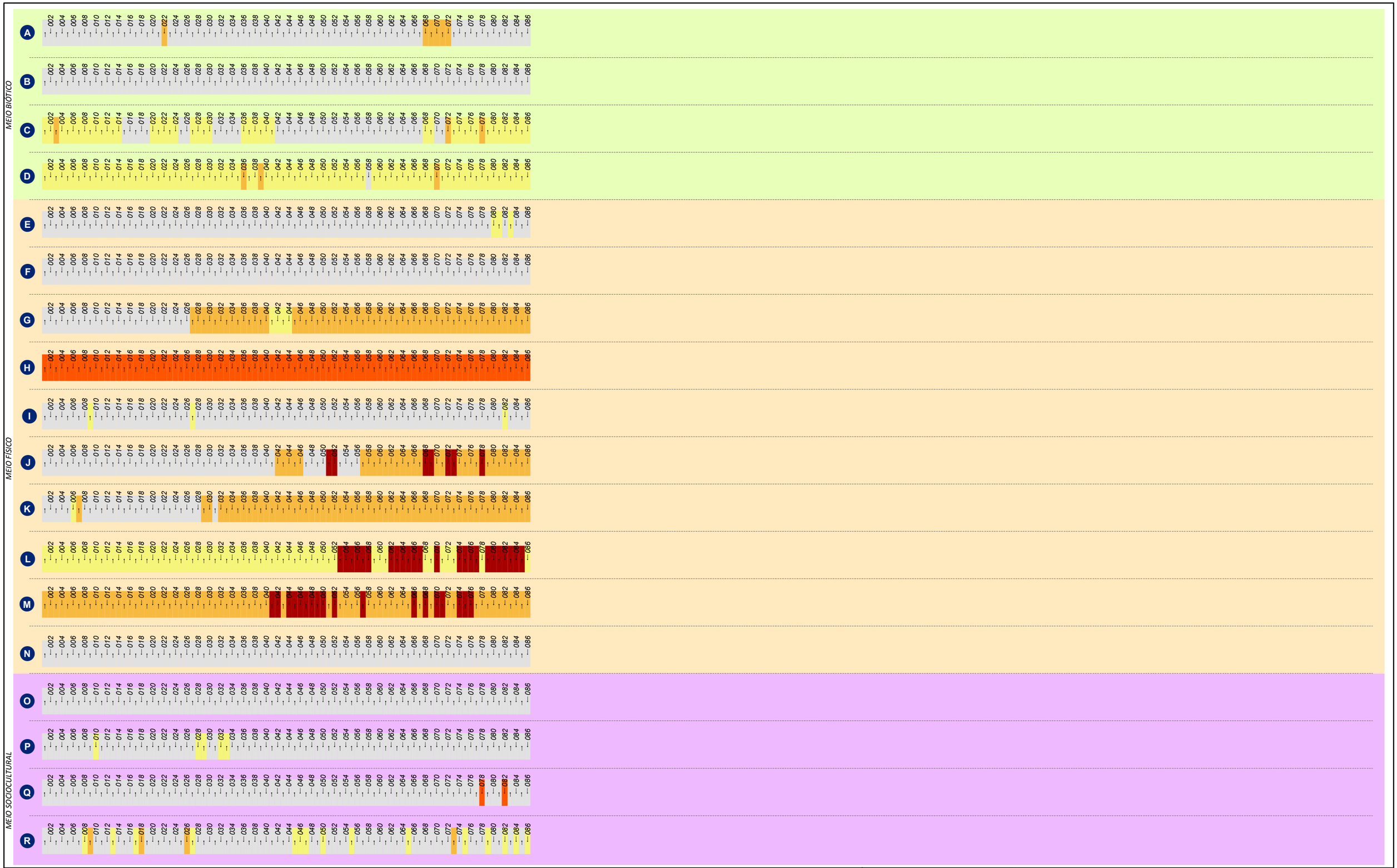
b) Social and environmental vulnerabilities

The Uruguay Waterway is 852 kilometers long[55] and is inserted in the Uruguay River basin (previously described). The waterway surrounding area intercepts the territory of 47 municipalities that, jointly, have a population of 555,584 inhabitants (IBGE, 2010), in the states of Santa Catarina and Rio Grande do Sul. The FIRJAN index (2010) varies between 0.83 in the municipalities of Águas de Chapecó (SC) and 0.54 in Barra do Quaraí (RS).

[55] The Uruguay River is an international river, serving as Brazilian border with Argentina and Uruguay. It is worth to say that in this study only the existing social and environmental variables were considered in the surroundings of the waterway in national territory.

Map 62: Uruguay Waterway Location

With regard to the social and environmental vulnerability, 9% of the 78 stretches, into which the waterway was divided for the purpose of this analysis, present Integral Protection CU – in the stretches 22, the São Donato Biological Reserve, between the municipalities of São Borja (RS) and Itaqui(RS), and from 68 to 72, the Parque Estadual do Turvo (Turvo state park), in the municipality of Derrubadas (RS) – and Indigenous Lands – in stretch 78, called dos Índios River, in the municipality of Vicente Dutra (RS) and in stretch 82, an area called Kaingan de Iraí, in the municipality of Iraí (RS).



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO URUGUAI	MAI/2013

3.11.1.2 Ibicuí Waterway

a) Navigability Diagnosis

The Ibicuí River is one of the main tributaries of the Uruguay River, located in the Western region of Rio Grande do Sul. Encompassing 30 municipalities, the river has an extension of about 385km and a drainage area of 35,439km². Its is formed by the junction of the Ibicuí-Mirim River, whose mouth is in Cacequi (RS) and by the Santa Maria River but, along its course, receives the contribution of the Toropi, Jaguai and Ibirapuitã Rivers. Its mouth is in the Uruguay River, between the municipalities of Uruguaiana (RS) and Itaqui (RS).

The Ibicuí River has the characteristics of low lands, with a mainly sedimentary bed. Its banks are low and the bed is sandy, what generates flood problems in its course in the rainfall period. Its waters are much used in rice field irrigation, mainly at the low water period, considerably reducing flows and returning turbid water to the river, sometimes laden with pesticides. The recreational use of the waters is intense in this basin, with several public resorts throughout the basin, monitored by FEPAM.

The extensive water intake for agriculture and livestock farming, together with sand extraction, change continuously the river bed, and, combined with the pesticides spread along the river, make it extremely fragile within a very frail ecosystem.

The average flow of the Ibicuí River is 950m3/s, in the Passo Mariano Pinto Fluviometric Station (see Appendix VII, item 4.9.3).

The Ibicuí Waterway correspond to the stretch between its mouth, in the Uruguay River, and the city of Manoel Viana (RS) (stretch 20), the main city reached by the waterway, resulting in about 200km of extension.

The Ibicuí Waterway has adequate navigation conditions along its alignment only in the rainfall period, between May and October. However, the river does not have adequate conditions for commercial navigation in the rest of the year mainly due to the shallow depths in the dry season, which, combined with the intakes for the agriculture and to the extensive sandbanks, result in minimal depths that range between 0.70m and 1.35m.

This Waterway has an average slope of about 10cm/km, being higher in the first 20km downstream and decreasing when moving upstream. The sinuosity rates, on the other hand, increase upstream, reaching a rate of 2 from the stretches 14 to 20. The critical minimum widths are located in stretches 16 to 20, when the values are less than 100m.

The high development of sandbanks in the river bed during the drought period causes the occurrences of more educed radius of curvature than expected and narrowings of the navigable channel in several stretches. The high mobility of the sediments in the river bed contributes negatively to navigation.

Figure 3.11.5: Morphological Behavior of the Ibicuí River (Brasil das Águas, 2007)

Only two bridges cross the Ibicuí waterway: in Manoel Viana (RS) (stretch 20) and in the mouth (stretch 1). Both allow the passage of commercial vessels. Moreover, there are barge services in two locations of the Low Ibicuí: Mariano Pinto (RS) and Passo do Silvestre (RS).

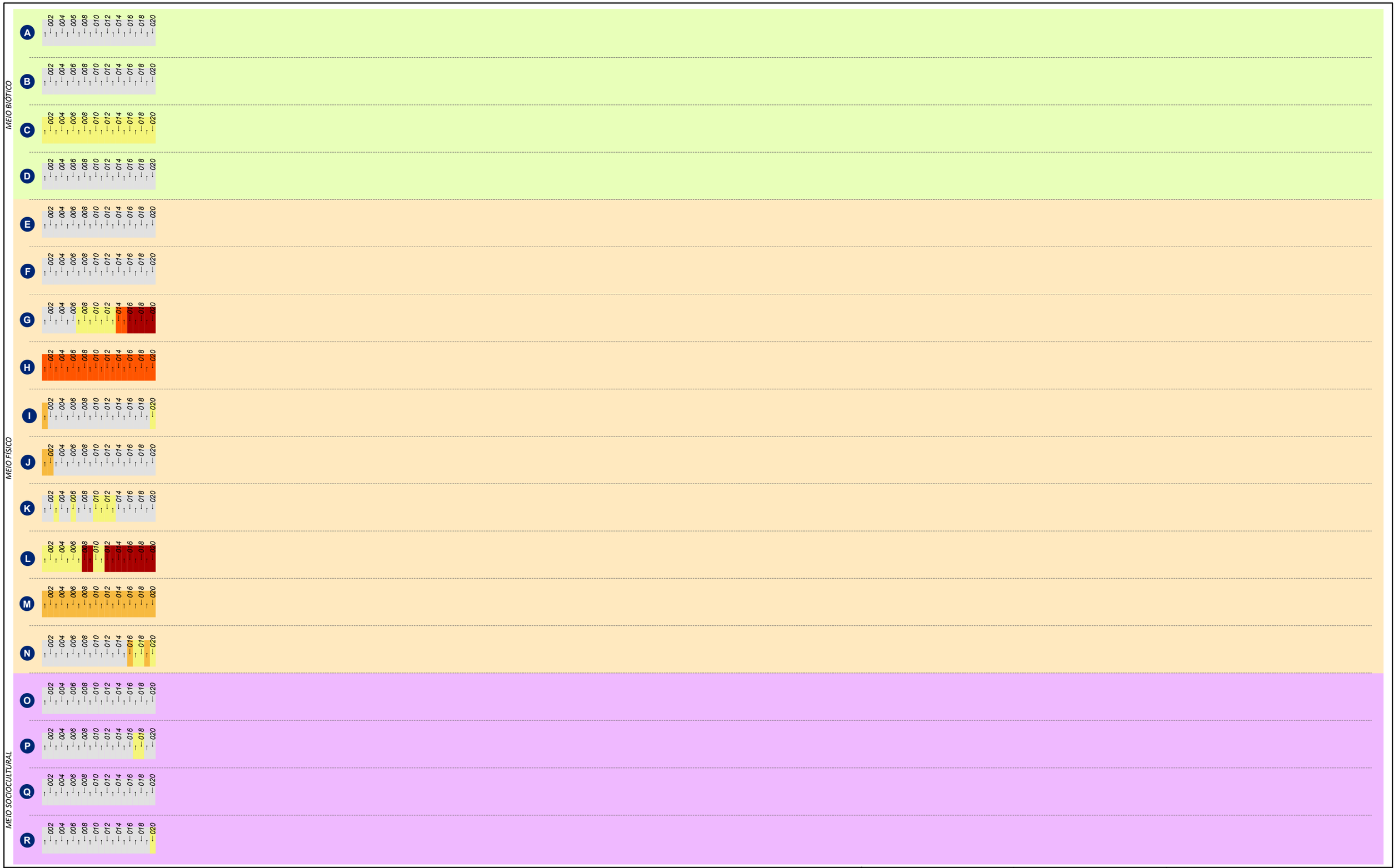
The Uruguay River is subject for the implementation of new hydroelectric power plants. Among them is the São Pedro UHE which, if implemented, will flood the stretch of the Ibicuí Waterway, allowing navigation in stretches currently unnavigable, during the drought period.

b) Social and environmental vulnerabilities

The Ibicuí Waterway, which is a tributary of the Uruguay River, is 196km long, and is located in the Uruguay River basin (previously described). The waterway surrounding area goes through the territory of four municipalities in Rio Grande do Sul: Alegrete, Itaqui, Manoel Viana and Uruguaiana, with a population of 248,319 inhabitants (IBGE, 2010). The FIRJAN index (2010) varies: from 0.72 in the municipality of Alegrete to 0.63 in the municipality of Manoel Viana.

Map 63: Ibicuí Waterway Location

The analysis of this waterway shows that there are not, among the 20 stretches analyzed, big areas to be highlighted from the social and environmental point of view, except the occurrence of APCBs of very high action priority in the vicinities of the entire waterway.



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO
- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO
- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL
- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO IBICUÍ	MAI/2013

3.11.1.3 Chapecó Waterway

a) Navigability Diagnosis

The Chapecó River is the major SC tributary of the Uruguay River, located west of the state of Santa Catarina. It is approximately 248 km long and its drainage area is about 8,180km². Its spring is allocated in the vicinities of the Southern limit of the state of Paraná, within the SC municipality of Água Doce. The Chapecó River receives in its high course dozens of smaller rivers, being the Roseira River the most important one. Its mouth is in the Uruguay River in the municipality of São Carlos (SC) downstream of the Foz do Chapecó Dam.

There is not a defined flood regime in the Chapecó River, with flood events in different periods of the year. The average flow is of 250m³/sec (see Appendix VII, Item 4.9.2).

The river is in the Planalto das Araucárias (SC) and its bed is mainly rocky. The susceptibility to aggradation is considered low.

The Chapecó Waterway correspond to the stretch from its mouth, in the Uruguay River, to the SPP São Domingos (stretch 18), near the cities of São Domingos (SC) and Ipuaçu (SC), resulting in an extension of about 180km.

Nowadays the river does not have navigability conditions due to: high rates of sinuosities (values higher than 3), abrupt curves, narrowing of the river (stretches with widths under 10m) and mainly the presence of many rapids, falls, and rocky outcrops along the alignment of the waterway. The minimum depths are less than 1m in many stretches, with high runoff speeds.

Figure 3.11.6: Rapids in Chapecó River (stretch 7) (Panoramio, 2013)

In the final upstream stretch of the waterway there is the SPP Quebra Queixo (stretch 15), whose dam is located about 150km from the Chapecó River mouth. This PCH has no lock system and is insurmountable by vessels.

In the stretch under study there are five rural bridges, many of them with free height and span widths that prevent the passage of commercial convoys, and should be reformed.

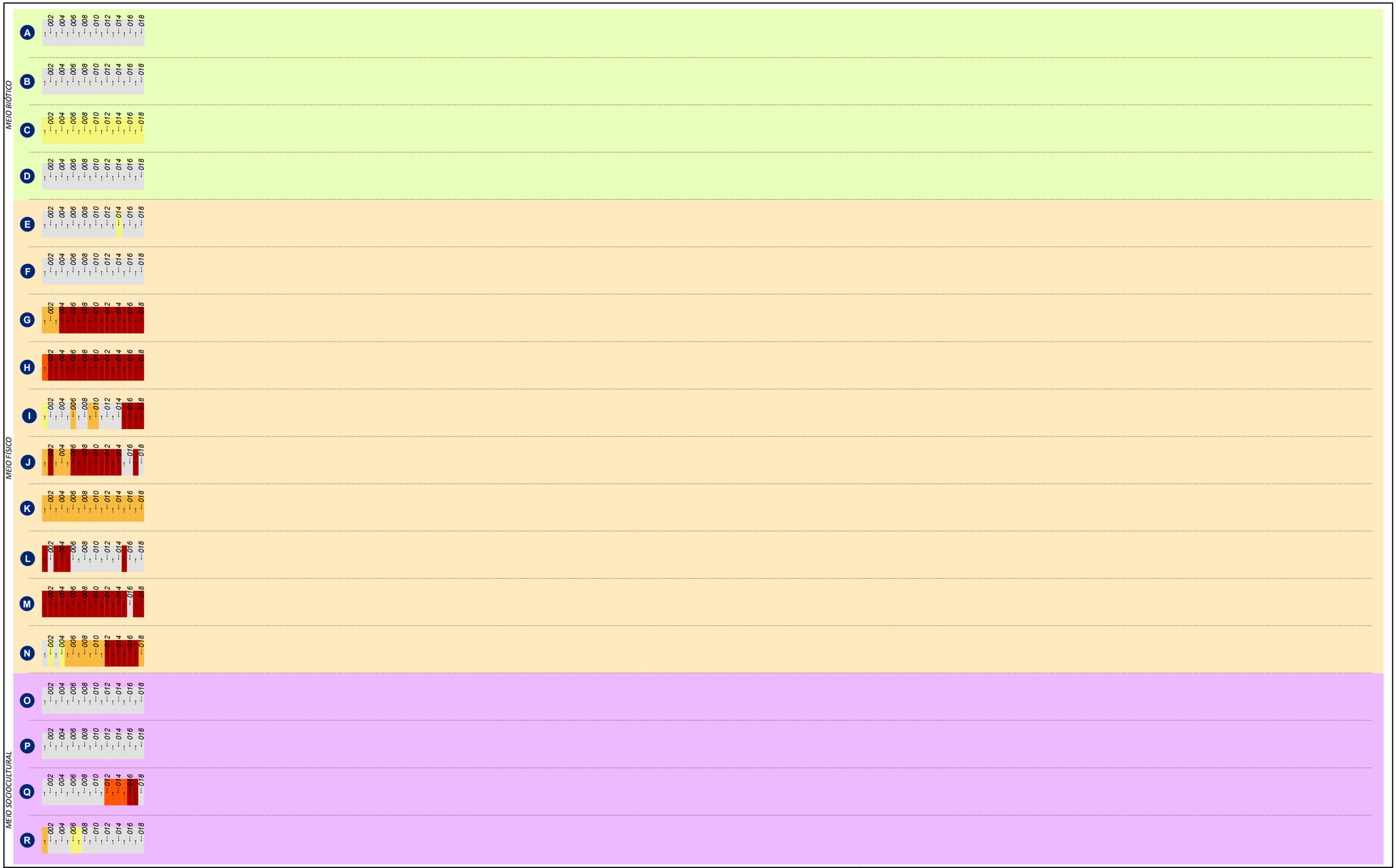
Besides the hydroelectric power plants already implemented along the river, this river is the object of studies for the implementation of new hydroelectric power plants, which will use the series of existing rapids along the Chapecó River. According to the Inventário Hidrelétrico do Rio Chapecó (Chapecó River hydroelectric inventory), approved by ANEEL, in the stretch under study are expected six hydroelectric power plants: Águas de Chapecó, Porto Ferreira, Santo Antônio, Foz do Xamim, Foz do Chapecozinho and Saudade UHEs. Navigation feasibility on the Chapecó River will depend on the construction of locks in these dams.

b) Social and Environmental Vulnerabilities

The Chapecó Waterway, which is a tributary of the Uruguay River, is 172 kilometers long, located in the Uruguay River basin (previously described). The area surrounding the waterway goes through the territory of 26 municipalities between the states of Santa Catarina and Rio Grande do Sul, totaling a population of 335,930 inhabitants (IBGE, 2010). The FIRJAN index (2010) varies: from 0.84 in Chapecó (SC) to 0.57 in the municipality of Rio dos Ínidos (RS).

Map 64: Chapecó Waterway Location

The vicinities of the waterway was divided into 18 stretches, 33% of which have Indigenous Lands, being worth to highlighting the stretches 12 to 17, where there is an area called Chapecó between the municipalities of Ipuaçu and Entre Rios (SC).



CONVENÇÕES CARTOGRÁFICAS

BIÓTICO

- A Unidade de Conservação - Proteção Integral
- B Unidade de Conservação - Uso Sustentável
- C Áreas Prioritárias para Conservação da Biodiversidade
- D Desmatamento do trecho

FÍSICO

- E Mineração - Lavra e garimpo
- F Espeleologia
- G Sinuosidade
- H Profundidade
- I Empecilhos à navegação (construções)
- J Energia do rio
- K Leito do rio
- L Assoreamento
- M Anteparos naturais
- N Largura do rio

SOCIOCULTURAL

- O Comunidades quilombolas
- P Assentamentos INCRA
- Q Terra indígena
- R Ocupação lindeira

N° dos trechos

n° < Jusante

n° > Montante

Escala de ponderação dos temas

1 - 5 (baixa - alta)

IN BA ME AL MA

IN - Insignificante

BA - Baixa

ME - Média

AL - Alta

MA - Muito alta

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA

0 50 100 200 km

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

DIAGRAMA UNIFILAR DA CRITICIDADE DOS MEIOS: FÍSICO, BIÓTICO E SOCIOCULTURAL

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1: 5.850.000	RIO CHAPECÓ	MAI/2013

3.11.2 Economic Aspects

3.11.2.1 Current inland waterways transport

The influence zone of the Uruguay River is formed by the states of Rio Grande do Sul, Santa Catarina, Parana and São Paulo. The main economic use of the river is for generation of hydroelectricity and it is dammed in its lower portion by the Salto Grande Dam and by the Itá Dam upstream in Brazil. Neither dams have locks to enable shipping. There is no current inland waterway transport on the Uruguay River. Commodities are handled by rail or highway. The terminals near the Uruguay river handle mostly commodities with Argentina as main destination or origin.

The export of commodities from states in the influence zone of the Uruguay river is concentrated on the Southern Waterway System and the Parana–Tiete Waterway. The export of commodities in this influence zone is mainly concentrated on the ports of Rio Grande and Santos as well as Itajaí, São Francisco do Sul and Paranaguá. The main products exported on these rivers are sugar (bulk), soy beans, soy meal and corn. It's overseas destinations are China, the Netherlands and the United States. In these transport flows the Uruguay river plays no role.

In Rio Grande do Sul the road infrastructure is well developed and passenger transport over water only exists in special cases. Larger cities next to the Uruguay river are Sao Borja with approximately 66.000 inhabitants and Uruguaiana with 136.000 inhabitants. Currently there is no passenger transport, due to the presence of a relatively good highway network. We expect no further shift, since there are no dense residential areas. Hence passenger transport on the Uruguay river will not be further discussed.

3.11.2.2 Planned developments

Mercosur is an economic and political agreement among Argentina, Brazil, Paraguay, Uruguay, and Venezuela. Bolivia, Chile, Colombia, Ecuador, and Peru currently have associate member status.

Commercially, Mercosur brought rapid changes to the bordering states, especially Rio Grande Do Sul, due to being the only state of Brazil that borders two of its partner countries (Uruguay and Argentina) as well as being very close to the Paraguayan border. The growth of the strategic partnership has continued to be developed in recent years. Brazilian investments in Argentina have reached US$ 5 billion in 2010. Other important steps for Mercosur include increased discussion with the EU with regards to bilateral trade agreements, participation in the World Trade Organization (WTO) and large scale involvement in the Free Trade Area of the Americas (FTAA).

Concerning other relevant economic developments in the hinterland region of Uruguay River, especially regarding the production and export of agricultural commodities via sea ports, please refer to the sections concerning Paranà-Tietê Waterway, Paraguay Waterway and Southern Waterway.

3.11.2.3 Future inland waterways transport

The Uruguay River forms the Plata river Basin, together with the Paraguay River and the Parana – Tiete River Basin. Current and future inland water transport on the Paraguay river has mainly Mato Grosso and Mato Grosso do Sul as its origin. An important transport flow (by Vale) is the transports of iron ore and manganese on the stretch between Corumbá and Nueva Palmira (Uruguay). The total transport is about 4.5 million tons of iron ore and 500,000 ton of manganese per year. Part of the ore is used in the region of Buenos Aires and the rest is exported. The Uruguay River is not likely to play a role in transport flows from Mato Grosso (do Sul) to Argentina and Uruguay.

In inland shipping on Tietê and Parana – Tietê River, three main segments can be distinguished. The first segment is agricultural products (soy, soy meal, corn, and sugar) from São Simão over a long distance (650 to 750 kilometers) to terminals in Pederneiras, Anhembi and S.M Serra. These products are further transported by train (Pederneiras) or truck (Anhembi and S.M. Serra) to the port of Santos for export over sea. The second segment Is sugar cane from a number of terminals to the sugar factory of Diamante (Cosun) in Jaú (near Pederneiras, at the Tietê river). The distances vary from 50 to 100 kilometers. The third and last segment is large amounts of sand over short distances (20 to 40 km) on Paraná and Tietê rivers. The destinations of these transport flows are mainly overseas countries, with Santos as the main port. So we can conclude that in these three segments the Uruguay river is not likely to play a role in the future.

Since there will be no inland water transport on the Uruguay river is likely to occur, no transport forecasts have been can be made for this river.

3.11.3 Transport System

3.11.3.1 Transported Cargo

Currently, there is not a substantial volume of cargo being shipped in the Uruguay waterway system and, as can be seen in Chapter 3.11.2, no significant increase of cargo was identified.

Infrastructure

Existing in the Uruguay waterway system which, as mentioned in Chapter 3.11.1, comprises the Chapecó, Ibicuí and Uruguay Rivers.

a) Waterway/River infrastructure

The physical characteristics of the Uruguay waterway system, as well as the planned dams, were already mentioned in Chapter 3.11.1.

After the analysis of several official documents and the interviews, it is evident that there is no commercial navigation in this system, only river crossing. Besides, there are no operative waterway terminals in this system, according to PNIH 2013 database.

Highways

This item discusses the highways which are part of the Uruguay waterway system. It is worth mentioning that the ones described below are the potential concurrent or connections.

BR-158

The BR-158 is a federal longitudinal highway that crosses the country from North to South. Its initial point is between the highways BR-230 and PA-415 in the municipality of Altamira, in the state of Pará. Then, it crosses the states of Mato Grosso, Goiás, Mato Grosso do Sul, São Paulo, Paraná, Santa Catarina and Rio Grande do Sul (where it crosses the Paleorrota geopark), and ends in the border with Uruguay, in the municipality of Santana do Livramento.

The highway crosses the BR-285 near the city of Panambí (RS), forming in complement to it a way concurrent to the Uruguay River, connecting the Northwest of the Rio Grande do Sul and the West of Santa Catarina with the westernmost of Brazil, in the border with Uruguay and Argentina, through the BR-285. It has good pavement conditions and in some stretches there is a shoulder in asphalt. It has a single roadway and there are some police control stations.

BR-285

The BR-285 is a Brazilian transverse roadway beginning in Araranguá, Santa Catarina, crossing the mountain range and the plateau of Rio Grande do Sul, with an extension of approx. 674.5km, passing by cities like Vacaria, Lagoa Vermelha, Passo Fundo, Carazinho, Ijuí and São Luiz Gonzaga and ending in São Borja, Rio Grande do Sul, on the border with Argentina.

The route between Vacaria and Araranguá, although taking place in a stretch of mountain range and with defective infrastructure, also has an unpaved stretch between the cities of São José dos Ausentes and Timbé do Sul, making this stretch not much used. In 2012, the works for the paving of the stretch from São José dos Ausentes to the state limit were initiated.

The BR-285 creates a connection of the BR-158 with the BR-472, forming an important network competing with the Uruguay Waterway. It has a single roadway, with the paving in acceptable conditions, shoulder only in some points and a good network of assistance and surveillance, such as police and load balances.

BR-472

The BR-472 is a Brazilian federal highway which cuts the westernmost Rio Grande do Sul. It begins in Frederico Westphalen, but is important only from São Borja on. From there, it runs through the Uruguay River region and passes by Uruguaiana, which is essential because many cars and trucks travel between Brazil and Argentina through this municipality. The BR-472 ends at Barra do Quaraí, where the triple border between Brazil, Argentina and Uruguay is.

In the city of São Borja, it connects with the BR-285, forming a competing way to the Uruguay Waterway. Its pavement is in good conditions, with a single roadway and not much infrastructure in its surroundings. In the crossing of the Ibicuí River, the BR-472 ends in a one way metallic bridge, stopping the vehicles in the highway to wait their turn to cross it.

MS
SP
PR
SC
RS
PARAGUAY
ARGENTINA
URUGUAY
Asuncion
Curitiba
JOINVILLE
BLUMENAU
Florianópolis
FLORIANÓPOLIS
SANTA ROSA
SÃO BORJA
CRUZ ALTA
SANTIAGO
SOBRADINHO
SANTA MARIA
CAXIAS DO SUL
NOVO HAMBURGO
ESTRELA
TAQUARI
CANOAS
CHARQUEADAS
GUAIBA
PORTO ALEGRE
URUGUAIANA
ALEGRETE
CAMAQUÃ
SANT'ANA DO LIVRAMENTO
BAGÉ
PELOTAS
RIO GRANDE
PASSO FUNDO
Oceano Atlântico
BR163
BR158
BR282
RS163
BR472
BR153
BR470
BR116
RS158
RS569
BR377
BR285
BR386
BR101
BR287
RS241
RS640
BR290
RS377
BR293
BR392
BR471
RS453
30°00'S

CONVENÇÕES CARTOGRÁFICAS

- Capital Estadual
- Limite político adm.
- Hidrovia
- Massa d'água
- Portos e terminais
- Cidades principais

Barragem existentes
- Barragem sem eclusa
- Barragem com eclusa

Infraestrutura de transportes
- Rodovias
- Ferrovias

REFERÊNCIAS

Fontes:
- Base Cartografica Integrada do Brasil ao Milionéssimo - IBGE, 2010
- ANA, 2010
- PNTL, 2010

ESCALA GRÁFICA
0 25 50 100 km
SISTEMA DE COORDENADAS GEOGRÁFICAS, DATUM HORIZONTAL: SAD69

LOCALIZAÇÃO DA FOLHA

MINISTÉRIO DOS TRANSPORTES

ARCADIS logos

PLANO HIDROVIÁRIO ESTRATÉGICO - PHE

TRANSPORT CHARACTARISTICS HIDROVIA DO URUGUAI

EXECUTADO POR:	ESCALA:	FOLHA:	DATA:
ARCADIS logos	1:4.000.000	- BRASIL -	JUL/2013

3.11.3.2 Characteristics of the existing fleet and the operative companies

The fleet operating in the Uruguay waterway system is dedicated to the crossing transport. Due to the fact that it does not contribute to the cargo transport along the system, no analysis of the fleet was made.

3.11.3.3 River Information Management System

As described in Chapter 3.11.4, the Uruguay Waterway system has a management structure similar to that of the South system, with the same waterway administrator, the AHSUL, and having the SPH as responsible for the maintenance of the system (dredging, signaling works and other activities).

The document of the Capitania dos Portos do Rio Grande do Sul (Rio Grande do Sul port captaincy) named "Norma para a Capitania dos Portos da NPCP-RS" (standards for the NPCP-RS port captaincy) does not report the existence of signaling or beaconage for this system.

There was no information related to water level monitoring of the rivers under this analysis. There are no nautical charts either.

3.11.3.4 Intermodal competition

As there is no substantial cargo volume being transported and its increase was not identified, no analysis of the intermodal competition was made for this waterway system.

3.11.4 Governance and institutions

The Uruguay Waterway system has a structure very similar to the South waterway system, having, to a large extent, the same intervening agents. Below is a summary table of those agents. It is worth stressing that such assignments reflect the content anticipated by the legal text that defines them, not portraying, in some cases, their real work.

Table 3.11.1: Matrix of the Formal Attribution of the Uruguay Waterway Agents

	Port administration	Inspection	Waterway maintenance	Licensing Process	Regulation
Waterway Administration (WA)	■		■		
Captaincy of the Rio Grande do Sul ports		■			
State superintendence – SPH	■		■		
State Environmental Secretariat				■	
DNIT/DAQ			■		■
ANTAQ		■			■
IBAMA				■	■
Other Agents**				■	

*Achievement of dredging, rock excavation, signaling.
** This block encompasses all the agents consulted by IBAMA within the licensing process (Fundação Palmares, FUNAI, INCRA, IMCbio, IPHAN, Public Ministry)

Source Consórcio Arcadis Logos, 2012

The AHSUL, as already mentioned, represents the Union and is responsible for the maintenance of the inland navigation in the waterways of the states of Rio Grande do Sul and Santa Catarina, operating also in the Uruguay Waterway, but with less expressivity, since the currently navigable stretch of this waterway represents a route of less expressivity (Source: Consórcio Arcadis).

At the state level, the SPH also operates in the waterway, with the attribution of planning, coordinating, executing and inspecting the dredging services and works related to the deepening, improvement, expansion and conservation of the access channels of the ports and of the navigable waterways and lakes in the state of Rio Grande do Sul, as well as nautical signaling services and works.

The Rio Grande do Sul Port Captaincy (Annex I), as well as the Southern Waterway, directs about the necessary signaling for the operation of the waterway, as well as inspects whether its standards are being followed. If not, it informs the SPH or the AHSUL, depending on the area of the problem. Its objective is also to guarantee navigation safety, to prevent water pollution and national defense.

The committee presented in the Southern Waterway, called Convênio de Cooperação Técnica e Financeira (technical and financial cooperation covenant), signed by SEINFRA/RS - Secretaria de Infraestrutura do Rio Grande do Sul (Rio Grande do Sul infrastructure secretariat) and SPH/RS – Superintendência de Portos e Hidrovias (port and waterway superintendence) in February, 2012, is also present in the Uruguay Waterway with the same objectives:

modernization of the South and Uruguay waterways, in their technical aspects of dredging, signaling, beaconage and instrumentation.

This committee is only the first step to putting the "Comitê Gestor da Hidrovia" (waterway management committee) into effect, with the participation of federal and state entities responsible for the infrastructure of this waterway, like DNIT, Antaq, DHN – Diretoria de Hidrografia e Navegação (navigation and hydrographic directorate) and DPC – Diretoria de Portos e Costas (coasts and ports directorate) at the federal level and of SUPRG – Superintendência do Porto de Rio Grande and of SPH – Superintendência de Portos e Hidrovias, at the state level.

Besides these national committees presented in the waterway, it is valid to remember that the Uruguay Waterway is an international waterway, and there has to be interaction between the Brazilian government and the government of other countries (Argentina and Uruguay).

Being an international waterway that delimits the border between Brazil and Argentina and between Brazil and Uruguay, it has to be licensed by IBAMA jointly with the authorities of those other countries. IBAMA shall ask the state secretariats to manifest technically in relation to the compliance of the project with its respective plans and standards, as well as the environmental agencies of Argentina and Uruguay.

Within these state secretariats, more specifically SEMA/RS – Secretaria do Meio Ambiente do Rio Grande do Sul (Rio Grande do Sul environmental secretariat) and the Secretaria de Estado do Desenvolvimento Sustentável de Santa Catarina (Santa Catarina sustainable development state secretariat), there are the Comitês de Bacias Hidrográficas, collegiate organisms which are part of the Sistema Nacional de Gerenciamento de Recursos Hídricos (national system of water resources management). The committees are composed by representatives of public agencies and entities with interest in the management, supply, protection and use of water resources, as well as representatives of the municipalities of the corresponding Hydrographic Basin, of water users and representatives of the Civil Society acting in the water resources area by means of their associative entities. Besides approving the Plano de Recursos Hídricos [water resources plan] of the basin, the purpose of such committees is to mediate conflicts on water use at the first administrative instance, to establish mechanisms and suggest values to be charged for the use of water

The interactions among the governments of the different countries generally take place through binational agreements prepared and discussed by their chancelleries with the assistance of the involved Ministries - Ministérios das Relações Exteriores, da Defesa, da Fazenda, da Integração Nacional, do Meio Ambiente e dos Transportes (foreign affairs, defense, finance, national integration, environment and transports ministries).

In the case of Brazil, some bilateral agreements have been already signed. However, the agreements have a long period of procedures before they are signed by the authorities of each country and, for its enforcement, need the approval of both National Congresses to be transformed into law, which many times makes the process ineffective.

The IIRSA (Annex I) also operates in the Uruguay Waterway region, since it is located in the region called "Eje MERCOSUL" – Chile" (Mercosul – Chile axis), comprising Chile, Argentina, Paraguay, Uruguay and Brazil.

For this axis, the study was divided into 6 (six) groups, each one of them responsible for different stretches and objectives:

- Group 1 – Belo Horizonte – Argentina/Brazil border – Buenos Ayres – this group has as strategical function to reach, consolidate and improve the infrastructure and logistics standards necessary for a good performance of the region in the global markets; use the region's scale and demand conditions to attract the public-private participation and disseminate the experience in the other Axes; optimize commercial and service flows in the economical centers of Argentina and Brazil; and optimize the logistics basis to strengthen the industry located in this space in the global competitivity.

- Group 2 – Porto Alegre – Argentina/Uruguay Limit – Buenos Ayres – has the same objectives as Group 1, but in different operation places.

- Group 3 – Valparaíso – Buenos Ayres – besides the objectives of the other groups (1 and 2), it also aims at facilitating that Chile serves as a logistical platform for the other countries of this axis to develop markets for their products and services in Asia.

- Group 4 – Coquimbo – Argentina central region – Paysandu – this group has as strategical function to optimize commercial and service flows between economic centers of Argentina, Brazil, Chile, Paraguay and Uruguay; articulate commercial and service flows with the Paraguay-Paraná Waterway axis; promote the eco-tourism development in the region; and develop and improve the regional productive chains.

- Group 5 – Energetic Group – its objective is to promote the increase of confidence in the electric and gas systems of the region; consolidate and increase the capacity of generation, transmission and distribution of energy in areas demographically dense and of high production; and diversify the energetic matrix of the MERCOSUL countries.

- Group 6 – Pehuenche – its strategical function is to create connectivity and service alternatives to the commercial flows of the MERCSUL countries and Chile; stimulate the intra-regional development; and promote the development of integrated tourism in the region.

Altogether, these groups generated 107 projects for the improvement of the MERCOSUL – Chile Axis, each one within its area of operation, with an estimated investment of 35,836.2 million dollars; among them, seven anchor projects totaling an amount of 6,277.00 million dollars were elected. Only one of these projects involves Brazil, and is related to the energetic and not to the waterway issue. The main improvement suggested for river transport is: construction of new ports and adequacy of the existing ones, but not as a priority.

As it was said in the Tietê-Paraná Waterway, the transposition of the Itaipu UHE would link the Paraná River to the Prata River, in Argentina, which is originated from the union of the Paraguay River with the Uruguay River, thus generating the MERCOSUL Waterway, which will

have 7000 navigable km, bringing together four MERCOSUL countries (Brazil, Argentina, Paraguay and Uruguay), with the capacity to move 80% of the economy of the region, generating a huge savings in the costs of transports and hence a higher product competitiveness.

3.11.5 Uruguay Waterway System SWOT

Strengths	Weaknesses
• The Uruguay River is navigable only in some specific stretches and during the rainy season. • There is an active Technical Committee, composed of state and federal authorities, to overcome challenges that influence river navigability.	• The Uruguay River is wide, presenting rock outcrops, rapids, falls and shallow depth in many segments. • The Salto Grande Dam has no locks downtream of the Brazilian border, thus preventing navigation up to the Atlantic Ocean. • The Chapecó River is currently not commercially navigable, once it has rapids, falls and rocks along the entire waterway. • The Ibicuí River has many sandbanks, has very sinuous stretches and shallow depths. • AHSUL faces difficulties to operate, imposed by the lack of access to financial and human resources (due to the agreement signed by DNIT/DAQ and CODOMAR). • The waterways of the rivers Uruguay and Chapecó have conservationist areas, as indigenous communities and Integral Conservation Protection Units, the last one being only for the Uruguay River. • Currently, there is no significant cargo in this WS.

Opportunities	Threats
• There are three dams planned to be constructed in the Uruguay River. They will allow the navigation in segmented stretches of the river, do not eliminating, however, all the stretches with obstacles to the navigation (rock outcrops and shallow depths.	• There are dams planned to be constructed in the Chapecó River, but, so, it is necessary lock systems and it is important that the locks are constructed simultaneously with the dams. • As the Uruguay River is a waterway of international use, international agreements (Brazil-Uruguay-Argentina) have to be negotiated to avoid, among others things, the illegal transport of cargo by the waterway. • No significant cargo volumes were identified in the influence area of the Uruguay WS until 2031.

4 LONG LIST OF MEASURES

In this chapter, bottlenecks and possible measures for IWT development are presented. The bottlenecks and measures were gathered from the recommendations given during the stakeholder interviews (see product 2: Stakeholder Consultations Report), from the International Benchmark Analysis and from meetings with the specialists mainly based on the information from the SWOT analysis - the macro SWOT and those of the waterway systems (both are part of product 3: Assessment and Diagnosis Report). This chapter approaches the main results of the Analysis and Diagnosis phase and introduces starting points to the next step (the Elaboration and Evaluation of Strategies) of the plan.

The measures and bottlenecks are at a very general level in this Report, as they are the result of grouping possible measures to overcome the bottlenecks. The measures can apply to one or more waterway systems. In some cases the suggested measures are mutually incompatible. The prioritizion of the bottlenecks and the necessity and efficiency of many measures will only be confirmed during the development of strategies for the waterway systems in step D (Elaboration and Evaluation of Strategies).

The measures have been categorized to distinguish different types of tools on a macro level. The following five types emerged:

- Effective waterway management
- Integrated government planning
- Adequate public-private partnerships
- Suitable financial incentives
- Supportive framework

4.1 EFFECTIVE WATERWAY MANAGEMENT

Effective waterway management aims at improving the navigability by providing the following services:

- Investments in the waterway infrastructure to improve the navigability
- Maintenance of the waterway to guarantee the improved navigability
- River information to enable the shipping lines to optimally use the improved navigability

Bottlenecks:

- In case of accidents, specially when they occur in locks, there are no alternative systems to assure navigation during this downtime.
- Little river information: insufficient information for adequate planning and consequently for reliable services; no guaranteed waterdepth.

- Little reliability on the waterways as there is no guarantee that the river will be kept navigable throughout the year due to lack of maintainence and planned hydroelectric dams that normally block navigability while built, and after that if locks are not constructed.
- Delays (waiting time at locks) at hydroelectric dams.
- Low prioritization of investments in waterways, in comparison to other transport modes (roads and rails).

Possible measures:

- Provide nautical charts
  - Organize the administration of the official cartography and nautical charts.
  - Update nautical charts
- Categorize rivers: determine navigability classes for sections of each waterway system based on the vessel classification. Which parts of the river should be able to accommodate which vessel class?
- Determine current navigability conditions on a detailled level: authorities responsible for ensuring navigation should have updated and detailled information about the conditions of the waterway. Therefore they should (regularly) carry out studies on waterways in their jurisdiction. These studies should contain:
  - **Bathymetry:** a study of underwater depth of rivers;
  - Water regime studies: **installing (and maintaining) gauging stations at strategic locations** (places prone to sedimentation, bridges) to measure variation in water level;
  - **Infrastructure dimensions**: develop a database of infrastructure dimensions linked to current water depths. Besides that, bridges, locks, terminals, etc. should have dimensions that enable navigation. When the minimal required dimensions are determined (based on vessel classes and river category), infrastructure that does not meet these requirements has to be adjusted.
- Guarantee river maintenance: once a waterway is operational for commercial navigation, it needs to be maintained to ensure reliability of the transport system. The responsible river maintenance authorities should draw up a plan in which maintenance activities are integrated and if necessary, prioritized. Maintenance activities include:
  - Dredging: The water regime (natural or unnatural) can cause erosion and sedimentation. The deposit of sedimentation decreases the draft of the river and can impair navigation. Waterways should be dredged in locations where the minimum navigable draft is not met.
  - Clearing excessive vegetation: Waterways should be cleared of vegetation that obstructs navigation.

  - Maintaining signalling: Signalling on the river should be clearly visible and when waterways are navigated at night, buoys should be equipped with lights.

- Invest in more dams in the rivers:
  - Build dams, including locks, to improve navigability (water depth).
  - Obly the construction of a lock when a dam for power generation will be implemented.
  - Improve the management of multiple uses of water (power generation and irrigation) by, for example, requiring the hydroelectric power plants to guarantee a minimum level for navigability.
- Improve/create River Information Services (RIS)
- Invest in new technologies:
  - Develop ships and barges that are adapted to the local conditions, for instance for low water.
  - Cooperate with universities for technological developments and economic forecasting.

4.2 INTEGRATED GOVERNMENT PLANNING

An integrated government planning system carefully coordinates the requirements of different stakeholders. In the case of IWT the following, sometimes conflicting, planning aspects are important:

- Intermodal development
- Rail and road development
- Hydroelectricty
- Irrigation
- Spatial planning
- Environment

Bottlenecks:

- Environmental Licensing Process
  - Unclear environmental licensing process for waterways.
  - Delay in obtaining the environmental permits causes delays in the starts of the operations.
- CONIT could help to integrate/coordinate actions regarding transport not only within the Ministry's limits, but also with other institutions that can impact on navigation (energy sector, water management authorities, etc.).

- Low institutional articulation: demands of IWT have not been addressed and/or articulated in the implementation of projects from other sectors.
  - Poor integration between WAs and PAs, as waterways doesn't exist without port and vice-versa, and as they are managed by diferent institutions (one from MT and the other from SEP), they need to have coordinated actions.
  - Water management hasn't been able to give enough support to navigation, and, for instance, dams, built by the energy sector, are not being constructed with locks.
  - Poor integration between the planning of waterways, highways and railways in an infrastructure investment plan.
  - Federal Government needs to prioritize investments in waterways.

Possible measures:

- Determine clear roles and responsibilities for governmental institutions involved in the IWT:
  - Improve the organization of attributions and responsibilities among the intervenient institutions involved in the waterway management. Revising the responsibilities of these institutions will contribute to a more efficient waterway management and enable cooperation between institutions.
  - Better arrange responsibilities regarding the management of the waterways between the WA´s, DNIT, CODOMAR and MT.
  - Set up a clear responsibility system for a) investments in and maintenance of waterways, and b) navigating on rivers
- Improve cooperation with environmental departments:
  - Develop a protocol on which aspects should be given priority when analyzing environmental permits for waterways. Ports and waterway licensing processes should be clearly differentiated.
  - Involve relevant stakeholders in policy making process as early as possible: the expertise of interested groups (environmental groups, private companies, etc.) should be considered in the policy making process to gain support, optimize strategies and reduce resistance.
- Improve relative position of IWT in transport policies, in comparison to rail and road modes: create an institutional environment in which the waterway transport mode receives proportional attention to that of the road and rail modes.
  - Under DNIT there should be balance between road, rail and waterway transport modes. Another option could be creating, under the MT structure, three departments at the very same level: one for roads, one for railways and the other for waterways. In Europe, Waterway Transport even gets advantages above road and railway transport. The reason for this is sustainability, cost reduction of transport and to reduce congestions on the road.

  - CONIT should articulate more the transport interests to the energy sector and Port Secretariat interests.

- Improve the connection with other transport modes and, consequently, the intermodality to stimulate the IWT sector, which relies on other transport modes.
  - Adopt logistic concepts in the form of intermodal chains, with the use of inland waterways as part of the whole chain.
  - Make transhipment fast, easy and cheap. IWT needs other transport modes for the vast distances to be travelled from producing areas to the ports (for exports), therefore transhipment is often necessary.

- Integrate development of waterways with other sectors in a clear spatial planning:
  - Focus first on the economic feasible cases for IWT and put other interests like electricity, water management next to it. A completely holistic approach might be too complex, taking time to reach certain goals.
  - Guarantee waterway access for new industrial plants: If extra transhipment can be avoided, the competitive position of IWT would increase sharply. With direct access to waterways and transport to seaports, the costs of IWT would decrease and congestion on the roads could be avoided.
  - Integrate the development of IWT with the development of new producing areas. Production in Brazil is shifting north. Investments to facilitate this shift with adequate infrastructure should be a priority.
  - Participation of WAs in the river basin committees in order to add to the demands of state departments / municipal transport the importance of taking into account the maintenance of navigation conditions and, consequently, to promote more integrated Master Plans.

4.3 ADEQUATE PUBLIC-PRIVATE PARTNERSHIPS

The rapid further development of IWT requires a clear division of the tasks and responsibilities of the public and private partners in this development. Once the division has been defined, each of the partners can concentrate on his role in the process, being assured that the remaining parts of the puzzle are taken care of by the other partner. A division that is generally applied is that the public partner is responsible for the infrastructure and the private partner for superstructure and equipment.

Bottleneck:

- The division between public and private parties is not always clear, and differs sometimes per state.
- Private parties ares sometimes more efficient to execute certain tasks, but not always get their role pointed out in a clear way.
- Limited resources (human and financial) of the AHs to invest in the waterways.

Possible measures:

- Promote Public-Private Partnerships (PPP) in the maintenance of the waterways. Although investments in infrastructure are primary a public task, cooperation between private companies and public authorities can be very helpful. Especially if one or a small number of companies gain advantages from investing in infrastructural bottlenecks.
  - PPP for the maintenance and operation of waterways and locks. The government should determine general priorities, keep budget oversight and keep environmental control.
  - To achieve an efficient PPP, funds should be released that promote the inclusion of qualified companies.
- Promote partnerships in the policy making process.
  - Involve shipping companies - their input and demands - in the policy making process.
  - Improve and strenghten partnership between agriculture and industry sectors.
- Leave investments in terminals and vessels to the private sector.
- Focus on implementing plans (instead of making more plans) and involve private companies in the implementation.
- Create an inland waterway culture/environment, including crewing regulations, ship regulations, safety regulations, a supply chain for the fleet, etc. (good examples of such an environment can be found in Western Europe, where the private sector has created this).

4.4 SUITABLE FINANCIAL INCENTIVES

Adequate financial incentives will stimulate the development of IWT as a link in the intermodal transport chain. They not only consist of grants and subsidies, but also should consider the abandonment of counter-productive taxes.

Bottlenecks:

- Multimodal transport may lead to recurrence of taxes on goods.
- Restrictions to expant quickly the Brazilian shipbuilding market.

Possible measures:

- Abandon taxes for transhipment: taxes on transhipment are not helping IWT, on the contrary.
- Integrate taxes for different modalities: Waterway transportation is, unlike road transportation, mostly depending on different modalities. The current tax system for

these different modalities is not clear in some states. Therefore, a uniform tax system should be developed where the transhipment between different modalities should be taxed in a fair way. Perhaps subsidies should be provided to realize multimodal integration or modal shift.

- Give carbon credits for companies/industries using the waterways.
- Lower or even zero import taxes on ships (temporarily). In other parts of the world overcapacity exists which can be used economically in Brazil's growing economy.

4.5 SUPPORTIVE FRAMEWORK/GOVERNANCE

Providing a supportive framework for IWT development is essential to enable growth to the IWT sector. To achieve that, some areas would possibly need to be reorganized, for instance crewing regulations, ship's regulations, safety regulations and the internal structure of the Ministry of Transport itself as far as the IWT is concerned.

Based on the interviews and the benchmark a list of bottlenecks has been drawn-up that can be the basis for a set of IWT stimulating laws and policies.

Bottlenecks:

- Increase in the number of relevant laws results in a complex set of regulations and jurisdictions that hinders investments and private enterprise.
- The agreement between DNIT/DAQ and CODOMAR does not result in a solid/secure framework for the institutions involved.
- Constant changes in the sector´s regulations and in the institutional structure
  - The insertion of EPL in the sector's structure should help to bring more cohesion and integration into transport planning.
  - Legislation is changing ANTAQ's attribution, which is a bit unclear during this transition.
  - New MP (595/2012) paralyzed some investments due to uncertainties (not yet approved; lack regulation).
  - Delays in the analysis of applications for implementing Terminals of Private Use by ANTAQ.
- Lack of qualified crew
  - Only two schools of the Navy (CIAGA and CIABA) that are focused on the maritime industry.
  - Difficulties in setting up partnerships with the Navy for training courses in independent units.
- Lack of knowledge about the benefits and possibilities of IWT, which can influence the decisions of logistics companies. Road transport is easier to be organized.

Possible measures:

- Increase the number of training centers dedicated to inland navigation, by means of facilitating the establishment of new courses for an expanding market.
- Make employment laws less rigid and more predictable, lower the rule for minimum crew on a ship and invest in training of manpower for navigating.
- Provide incentives for IWT starters
  - Speed up and simplify the process for attaining tax exemption and licenses
- Give more media attention to the waterway theme.
  - Marketing of social, economic and environmental benefits of IWT
- Prioritize investments in passenger transport, via social viability.

GLOSSARY

Area of "organized" port

An area determined by an act of the Executive Power, which includes port facilities and the protection and access infrastructure of the organized port.

(Source: MP 595/2012)

Bareboat or demise charter parties

Complete leasing of a ship, unequipped, for use in transport of merchandise, for which it will be necessary to outfit, equip, provision and crew it.

(Source: GEIPOT – Glossary of transportation technical terms, 1997)

Barge, Lighter

The same as scow, dory and flatboat.

(Source: Brazilian Naval Engineering Society – SOBENA)

Barge

A vessel with or without its own propulsion, with a flat bottom, designed for transporting liquid or dry bulk products. When it does not have its own propulsion, it is moved by a tugboat or pusher tug.

(Source: Brazilian Naval Engineering Society – SOBENA)

Bathymetry

This is the measurement of ocean, lake and river depths and is expressed cartographically by bathymetric curves that connect points of the same depth with vertical equidistances, similar to topographic contour lines.

(Source: DNIT)

Breadth

Vessel width at the cross section to which it refers. Example, Rib Beam 2, etc. When the section is not indicated, it refers to the master section beam.

(Source: Brazilian Naval Engineering Society – SOBENA)

Cabotage

That which takes place between ports or points on Brazilian territory, using a sea route or a combination of this and inland waterways.

(Source: Resolution 843/2007 – Grant to operate in Ocean Transportation/Cabotage/Port support)

Charter

A contract through which the owner of a ship or any vessel (shipowner) grants or rents to another (charterer), total or partial use of the ship or vessel, for transport of merchandise, people or objects. The same as charter party.

(Source: GEIPOT – Glossary of transportation technical terms, 1997)

Convoy

An assembly of vessels without propulsion, grouped side by side and/or in a line, that navigate tugged or pushed by other vessel(s) with propulsion.

(Source: NORMAM--0088/DPC)

Dam

A **dam**, **weir** or **reservoir,** is an artificial barrier, made in water courses for retention of large amounts of water. It is used primarily for residential water supply, agriculture, industries, electrical energy production or regularization of flow to allow navigation.

Deep-sea navigation

That which takes place between Brazilian and foreign ports.

(Source: Resolution 843/2007 – Grant to operate in Ocean Transportation/Cabotage/Port support)

Downstream

That part of the water course going away from its source, in the direction of its mouth.

(Source: MMA-Glossary of terms relating to the management of border and transborder water resources, 2006)

Draught, Draft

The vertical distance, taken from a cross section plan, between the lowest part of the vessel in this plan and the waterline. The same as water draft.

(Source: Brazilian Naval Engineering Society – SOBENA)

Dredger

A vessel for removing material from the bottom of shallow waters. It is normally used within or near ports to increase the depth of access channels or turning basins.

(Source: Brazilian Naval Engineering Society – SOBENA)

Ferry boat

A flat-bottomed vessel, with a shallow draft that allows it to operate close to river banks and in shallow water, with a broad beam, often used to transport vehicles.

Ferry ship

A smaller-scale ship used to transport passengers, generally on leisure travel, also transporting their automobiles.

Hydrographic region

Brazilian territorial space consisting of a basin, group of basins or contiguous hydrographic sub-basins with homogeneous natural, social and economic characteristics or similar is considered a hydrographic region, in order to guide the planning and management of water resources.

(Source: CNRH Resolution No. 32, of October 15, 2003)

Inland navigation

That which occurs on inland waterways over national or international routes, on rivers, lakes, canals, lagoons, harbors, coves, inlets and sea areas considered sheltered, by vessels classified or certified exclusively for this modality of navigation.

(Source: Resolution 1555/2009 – Cargo Transshipment Station)

Inland waterway

A navigable route located within terrestrial boundaries, such as rivers, lakes, lagoons and canals, etc.

(Source: NORMAM 28/DHN)

Inland waterway transport

That taking place through river and lake navigation, in inlets, rivers, harbors and coves, or for crossing.

(Source: GEIPOT – Glossary of transportation technical terms, 1997)

Lock

A lock is a hydraulic engineering work that allows ships to climb or descend rivers or inland seas in locations where there are varying levels (dams, waterfalls or rapids). Locks function as stairs or elevators for ships.

Nautical Chart

An analog or digital cartographic document specifically prepared for waterway navigation, published officially by a government or, under its authority, by an authorized waterway service.

(Source: NORMAM-25/DHN)

Navigation Channel

A free sea passage between navigation obstacles or restrictions. If the passage leads to a port or terminal, it is called an access channel.

(Source: NORMAM-17/DHN)

Navigable Rivers

Rivers with rudimentary navigation, open navigation and waterways.

Notice to Skippers

This is a bi-monthly publication (known as "the booklet") prepared by the Navy Hydrography Center (CHM), delegated by the Hydrography and Navigation Directorate (DHN), for the purpose of providing navigators and general users with information designed for updating Brazilian nautical charts and publications. In addition, "Avisos aos Navegantes" contains some of the Nautical Radio Warnings in effect and other general information important for navigational safety.

Organized port

A public asset built and equipped to meet the needs of navigation, passenger movement or movement and storage of merchandise, and whose traffic and port operations are under the jurisdiction of a port authority.

(Source: MP 595/2012)

Pilot

This is a non-crew waterway Professional who provides paid pilotage services.

(Source: NORMAM--1122//DPPC)

Pilotage services

This is the set of professional advisory activities provided to a captain, required by local particularities that make free and safe movement of a vessel difficult. It consists of pilot, pilotage launch and watchman.

(Source: NORMAM--1122//DPPC)

Port Authority

The administration of the organized port.

(Source: Resolution 55/2002 – Port Leasing)

Port facility

An installation located within or outside the area of an organized port, used for moving passengers, for moving or storing goods, destined for or coming from waterway transportation.

(Source: MP 595/2012)

Port operator

A legal entity pre-approved to perform activities involving passenger movement or merchandise movement and storage, going to or coming from waterway transport, within the area of an organized port.

(Source: MP 595/2012)

Public administration

The direct and indirect administration of the federal government, states, Federal District and municipalities, including private entities under private law under government control and foundations established or maintained by the government.

Pusher tug

A small robust and high power ship, with a bow of special shape and construction, designed to push a barge or assembly of barges that form a convoy. See Tugboat.

River basin

The drainage area of a water course or lake. The Waters Law (Law 9.433/97) chose the river basin as the territorial unity for implementation of the National Water Resources Policy and operation of the National Water Resources Management System (SINGREH) as one of its bases, as provided for in its Art. 1, V.

(Source: MMA—Glossary of terms relating to the management of border and transborder water resources, 2006)

Roll-on/Roll-off

A system for loading highway vehicles and trucks, on ships or planes, by direct movement of the vehicles themselves. (Including a complete train or loose railway car in ocean transport).

(Source: GEIPOT – Glossary of transportation technical terms, 1997)

Roll-on/Roll-off ship

Ships with openings in the stern and/or broadside, allowing vehicles to embark directly into the holds by means of planks (ro-ro).

(Source: GEIPOT – Glossary of transportation technical terms, 1997)

Standard vessel

A hypothetic vessel that has the characteristics for which the waterway is designed. In other words, for a length of “x”, with a beam of “y” and for a maximum draft of “z”, this being for cases of minimum water depths.

Small-scale port facility

One designed for port operations of moving passengers, goods or both, through inland navigation.

(Source: Resolution 1.284/2009 – Construction, Exploration and Expansion of IP4)

Tanker

A ship designed for waterway transport of bulk liquids, such as oil and its derivatives, chemical products, LOG, etc.

(Source: Brazilian Naval Engineering Society – SOBENA)

Terminals for exclusive use

A port facility used under authorization, located outside the area of an organized port.

(Source: MP 595/2012)

Transshipment port

A port facility located near an organized port and used exclusively for operations of transshipment of goods on inland navigation or cabotage vessels.

(Source: MP 595/2012)

Tug, Tugboat

A small, but very strong ship, with a high-power engine and good mobility, designed to tow other vessels.

(Source: Brazilian Naval Engineering Society – SOBENA)

Upstream

In the direction of the headwaters of a river.

(Source: MMA-Glossary of terms relating to the management of border and transborder water resources, 2006)

Vessel, Craft

Any construction, including floating platforms, and, when tugged, fixed platforms, that is subject to registration with the maritime authority, and is able to move through the water by its own means or not, transporting people or cargo.

(Source: NORMAM-02/DPC)

Waterway

A physical space, natural or not, in ocean, sea, river, lake and lagoon waters used for navigation.

(Source: NORMAM 28/DHN)

Waterway

An inland navigation route with standardized characteristics for certain types of vessels, constructed through engineering and regulation works and with signaling and navigation support equipment.

(Source: NORMAM 28/DHN)

Waterway infrastructure

This is the set of areas and resources designed to allow safe operation of vessels. It includes an access channel, a turning basin and respective nautical beaconage and signaling.

(Source: Resolution 1555/2009 – Cargo Transshipment Station)

Waterway system

The set of river stretches with potential for commercial navigation that functions in an integrated manner within a hydrographic region.

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