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Urban Water Management in São Paulo Macro-metropolitan Area: Prospects of Integration in a Context of Urban Environmental Change.

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Presentation summary

- Floods and droughts, a permanent concern.
- Foundations of integrated water management in Metropolitan São Paulo.
- Urban environmental change: entangled effects of changing urban structures and hydrology.
- Metropolitan flood control: a case of critical infrastructure management.
- New prospects of cross-sector integration: de-pollution, flood control and energy safety in multi-objective projects.

Floods and droughts, a permanent concern

- Main changes: severe draughts and floods, heavy rains in dry season, continuity of rainy days
- The Eastern São Paulo State Metropolitan Network: economic development and water stress. [1.1](#) [1.2](#)
- Limitations of intra-metropolitan controls: urban degradation in a densely urbanized basin [1.3](#) [1.4](#)
- Conflicts on water use: urban supply, flood control, energetic security, strategic irrigation [1.5](#) [1.6](#)
- New complexities: expensive and distant supplies (and structural controls) [1.8](#)

Adaptation of urban structures to specific needs on flood control and water conservation

- Two analogous concepts: target pollution loads and controlled stormwater discharges [2.1](#) [2.2](#) [2.3](#)
 - “Mananciais” (Water Catchment Areas) and “Várzeas Tietê” (Floodplain Protection)
- Integrated planning in the prospect of environmental change:
 - Structural capacities must be reinforced to accommodate seasonal and out-of-season extremes of drought and flood and unprecedented continuity of precipitations
 - Urban management at municipal level shall be accountable for the land use control to preserve surface water sources and flooding areas.

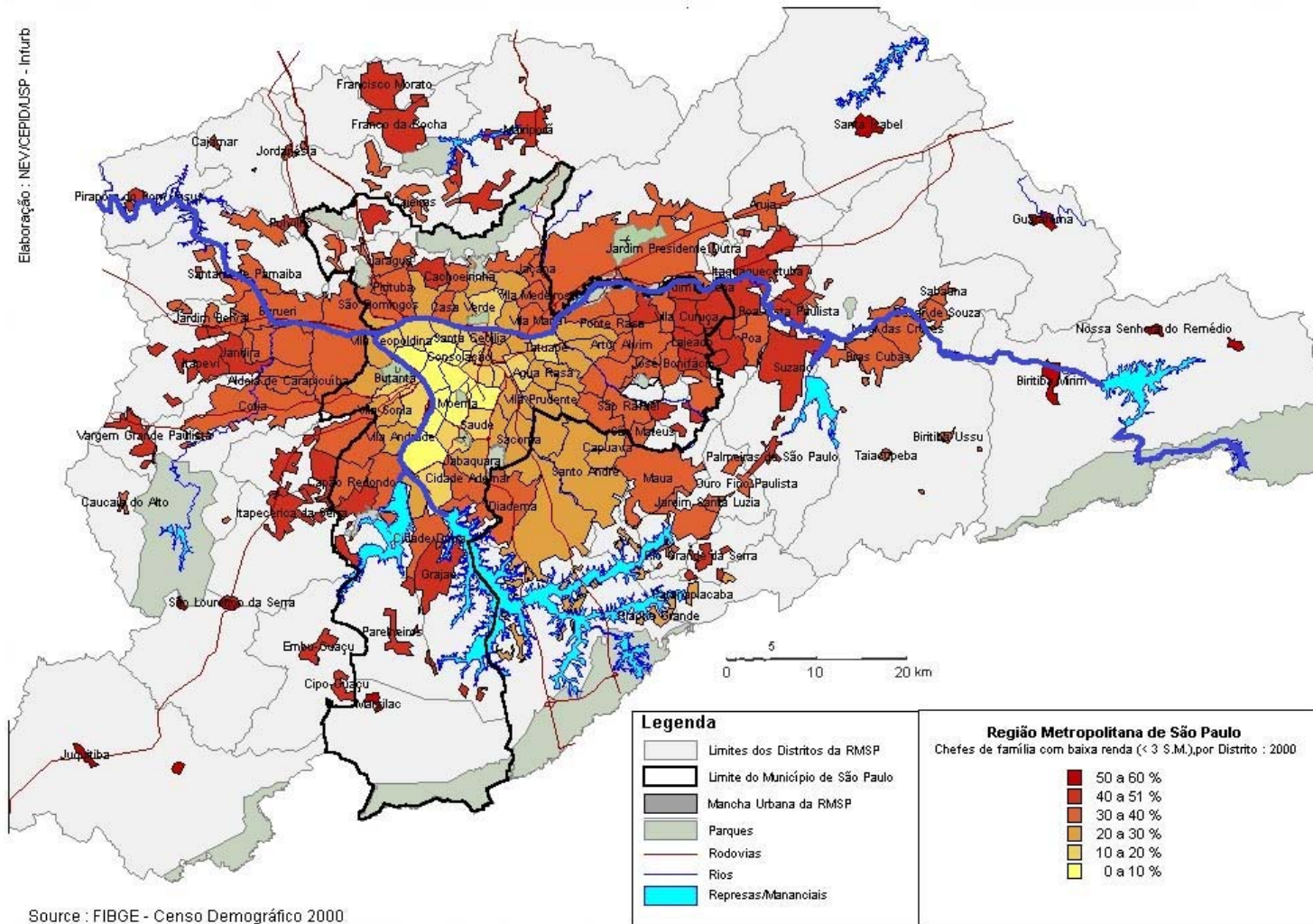
Urban environmental change: entangled effects of changing urban structures and climate

- Flood probabilities, hydrologic regime and rainfall variations
 - rapid urbanization → intensified flood routing
 - large recurrence intervals – 500 to 100 year flood – become more frequent
 - changing flood probabilities interfere on the design and operation standards for urban infrastructure works
 - systematic studies about possible influences of rainfall variations → very recent and non conclusive
 - Lessons learnt from 2009/10 floods
 - Peak daily rain depths (97 mm) did not exceed seasonal maxima
 - 45 days of continuous rain saturated all the detention buffers
 - Out of season floods disrupted protocols of routine maintenance

Urban environmental change: entangled effects of changing urban structures and climate

- Changes in the urban / metropolitan structure
 - Initial urban centers developed in the best sites regarding flood and landslide safety
 - The wealthier occupy the safer and better connected central areas → the poorer settle either on the outskirts or on the environmentally fragile remains of central areas
 - New neighborhoods develop next to the older central areas, enlarging the boundaries of the expanded center → poorer households relocated to a more distant and vulnerable location
 - Perpetuation of an urban logic of socio-environmental vulnerability → growing external outcomes of degradation

Distribution of low-income households. 2000



Source : FIBGE - Censo Demográfico 2000

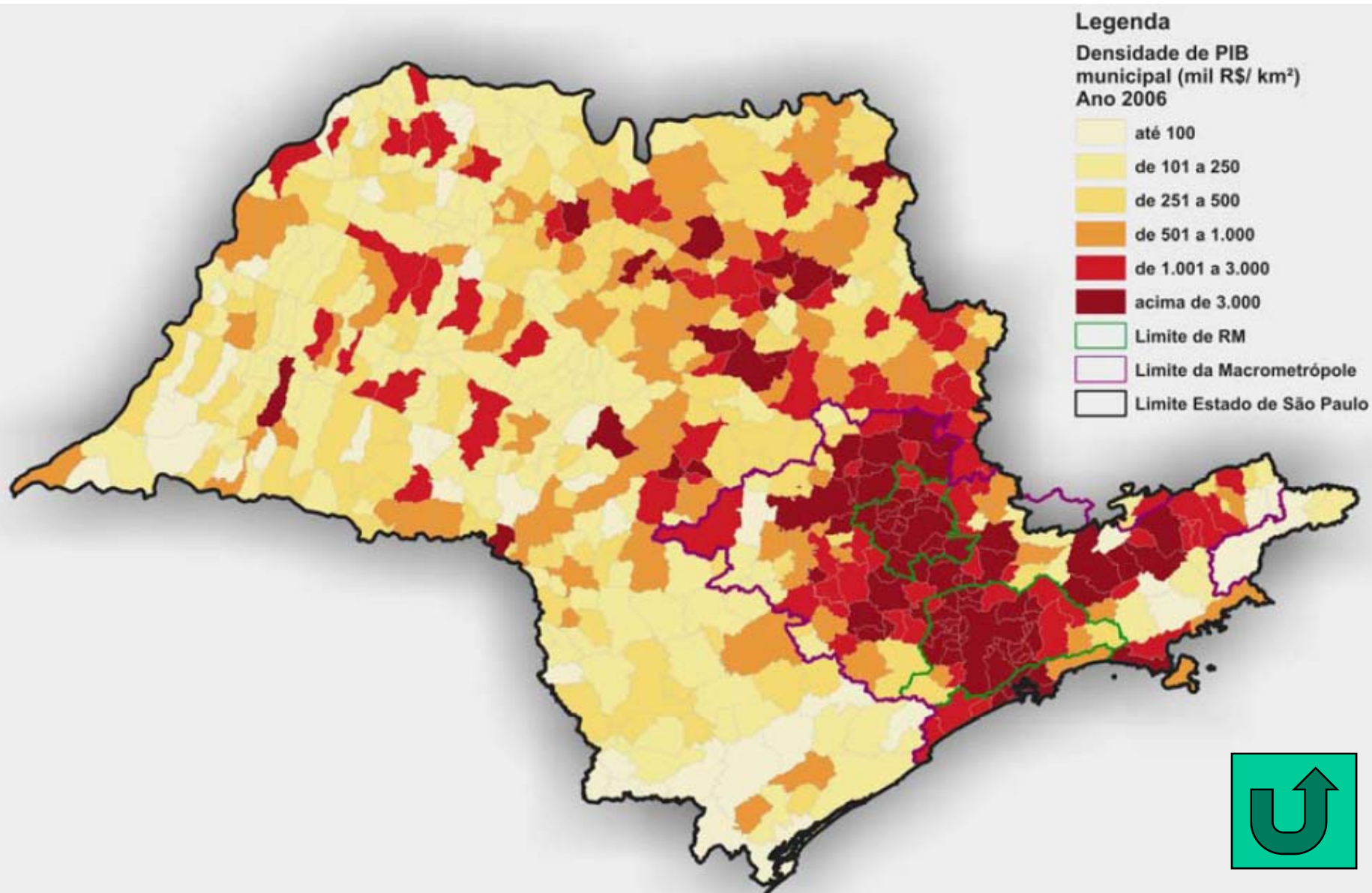
Metropolitan flood control: a case of critical infrastructure management

- Real time support for the maneuver of hydraulic structures and alert protocols. [3.1](#)
- Emergency circuits (backup) and new priorities for electricity re-connection in case of energy blackout, for macro-drainage control structures [3.2](#)
- Detention basins (dry ponds), sediments control and linear parks
- Urban drainage compliance with maximum discharge limits on larger streams [3.3](#)
- New prospects of integration: de-pollution, flood control and energy safety in multi-objective projects (the case of Pinheiros-Billings complex). [3.4](#)

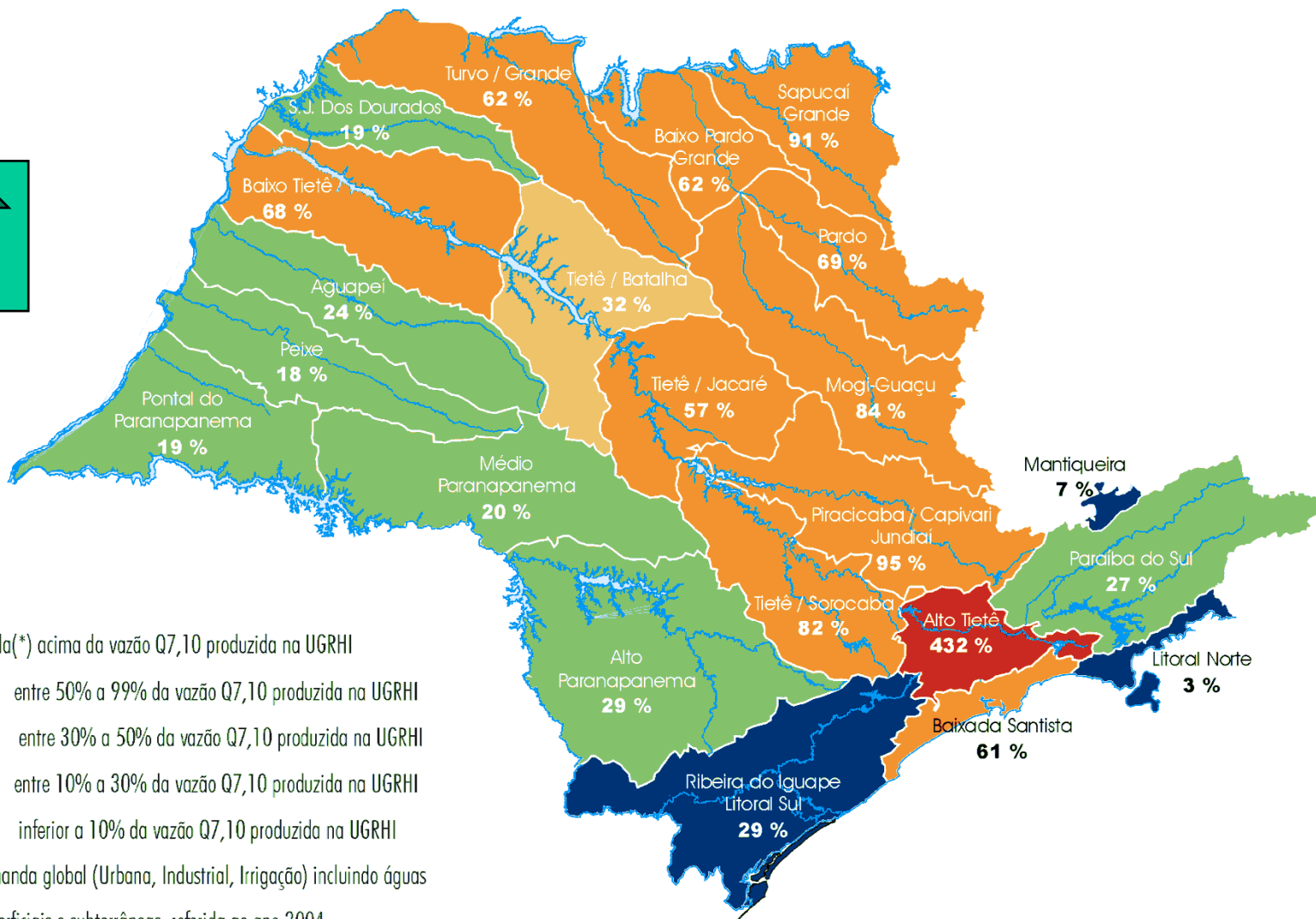
A possible conclusion

The escalating socio-environmental challenges of the metropolitan area are not responsive, anymore, to sector based initiatives. Apart the cross-scale integration, beyond the global-local duality, it is crucial to promote effective forms of cross-sector integration between different networks sharing common water resources and the metropolitan hydraulic infrastructure.

São Paulo State. GNP distribution and the Macro-metropolis.



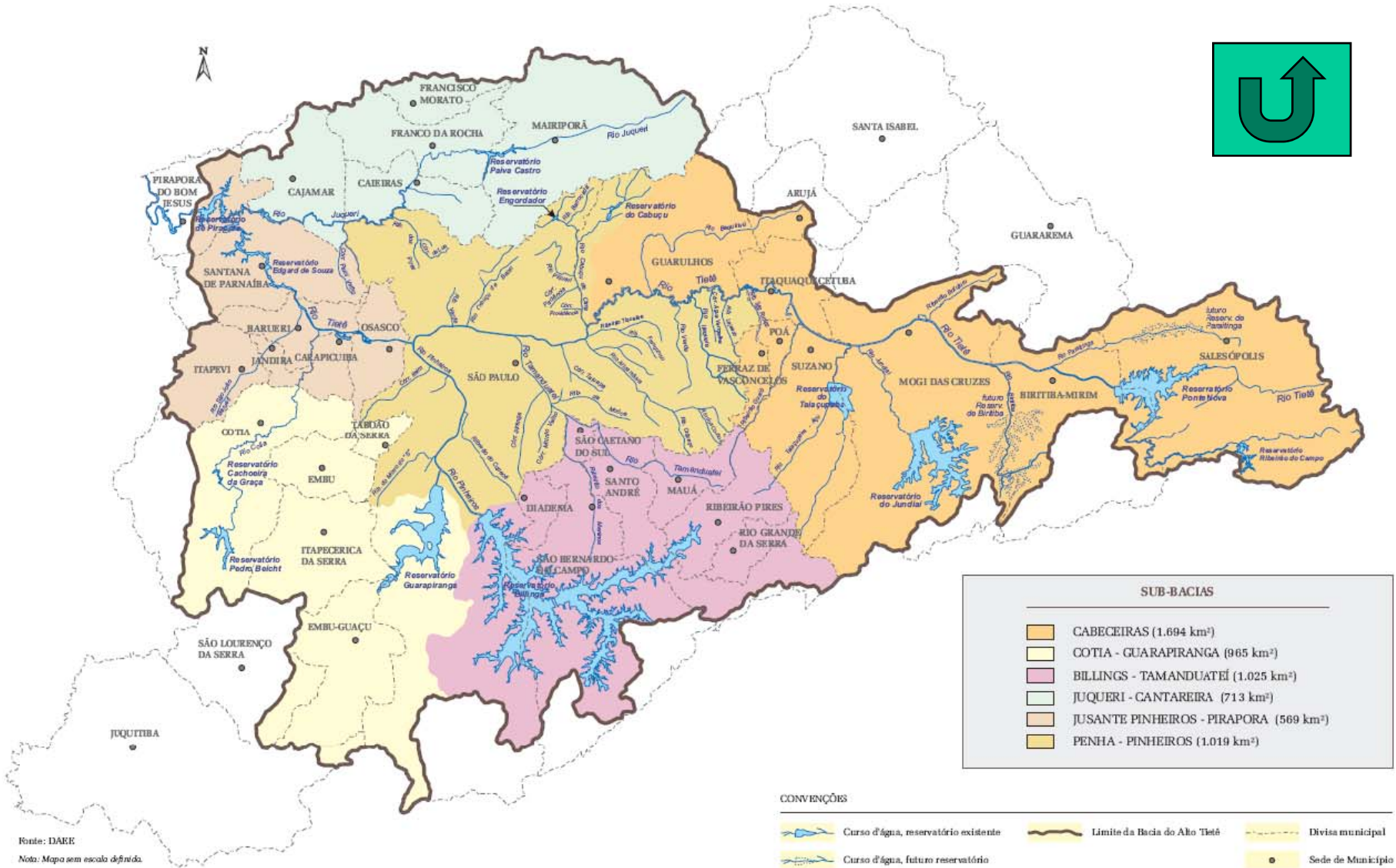
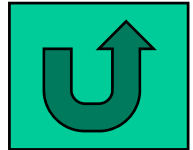
Water demand as a percentage of availability (Q7,10)



- Demanda(*) acima da vazão Q7,10 produzida na UGRHI
- " entre 50% a 99% da vazão Q7,10 produzida na UGRHI
- " entre 30% a 50% da vazão Q7,10 produzida na UGRHI
- " entre 10% a 30% da vazão Q7,10 produzida na UGRHI
- " inferior a 10% da vazão Q7,10 produzida na UGRHI

(*) Demanda global (Urbana, Industrial, Irrigação) incluindo águas superficiais e subterrâneas, referida ao ano 2004

Alto Tietê River Basin

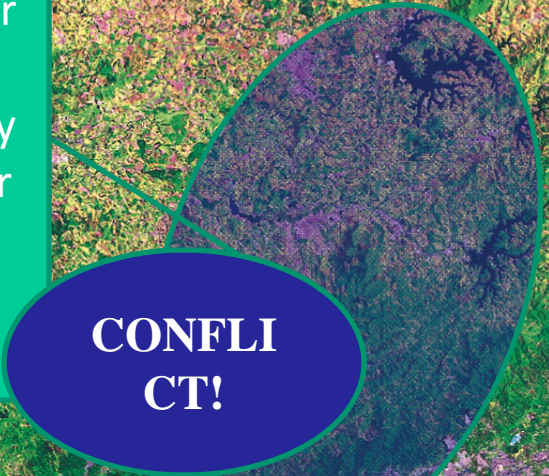


Main Use: Drinking Water Supply

95 % of time guarantee

• System: **Cantareira** 2002 – 32 m³/s 2004 – 30,4 m³/s 2007 – 29.9 m³/s

- transboundary transfer 33 m³/s
- 49% of the total supply
- conflicts with neighbor basin
- authorized until 2014
- no further expansion



CONFLICT!

• System: **Alto Tietê**
• 10 m³/s
• 15% of the total supply



CONFLICT!

with expansion up to 15 m³/s

2002 – 15.3 m³/s 2004 – 14.7 m³/s 2007 – 14.1 m³/s

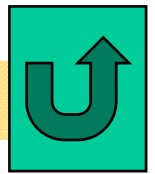
• System: **Guarapiranga – Billings**

- 14 m³/s
- 21% of the total supply
- conflicts with hydropower production
- serious water quality issues
- no further expansion



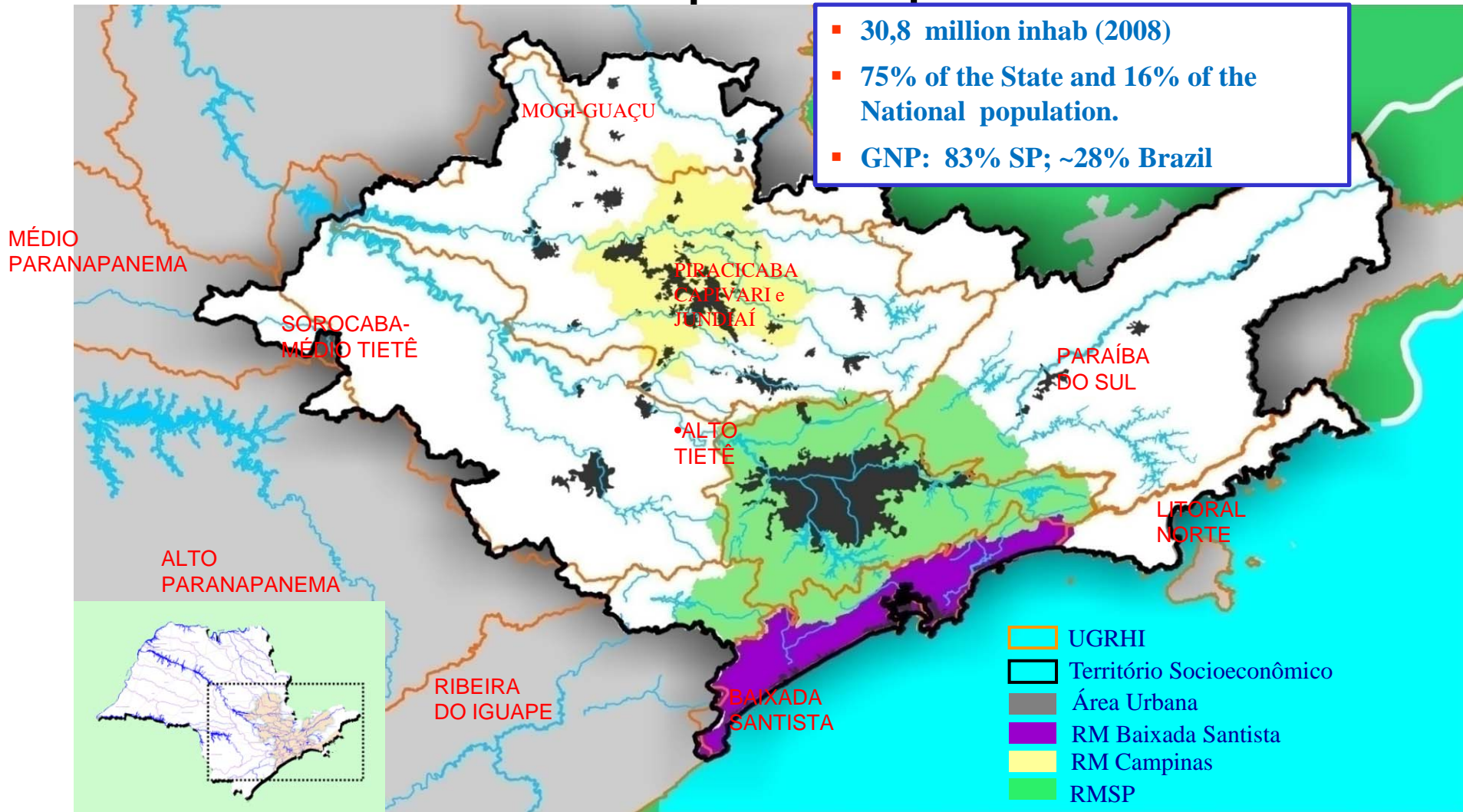
CONFLICT!

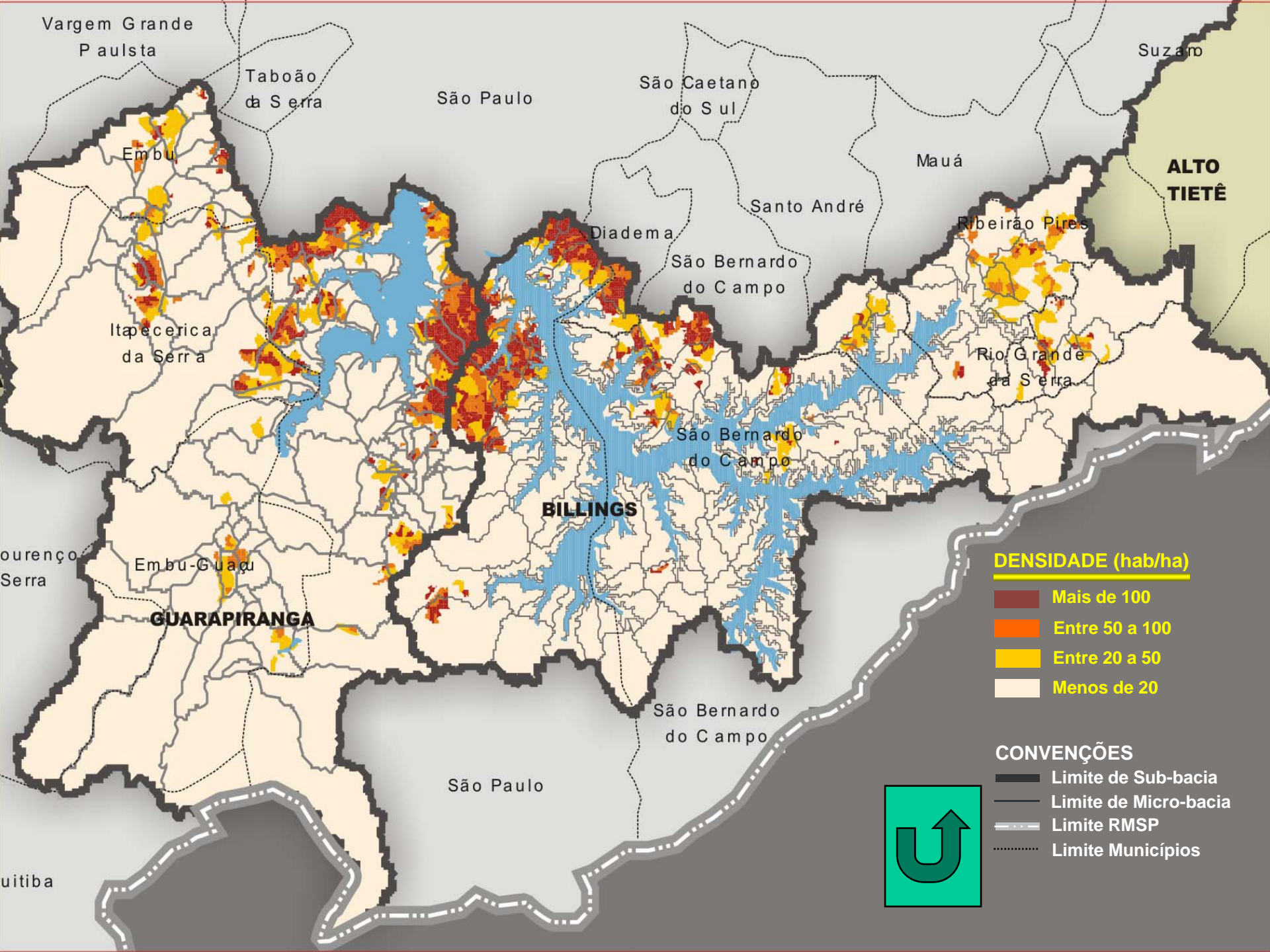
2002 – 14.5 m³/s 2004 – 14.2 m³/s 2007 – 13 m³/s



São Paulo Macrometropolis: Population and GNP

- 30,8 million inhab (2008)
- 75% of the State and 16% of the National population.
- GNP: 83% SP; ~28% Brazil





Vargem Grande
Paulista

Taboão
da Serra

São Paulo

São Caetano
do Sul

Suzano

**ALTO
TIETÊ**

Mauá

Embu

Santo André

Ribeirão Pires

Itapevica
da Serra

Diadema

São Bernardo
do Campo

Rio Grande
da Serra

BILLINGS

São Bernardo
do Campo

Lourenço
Serra

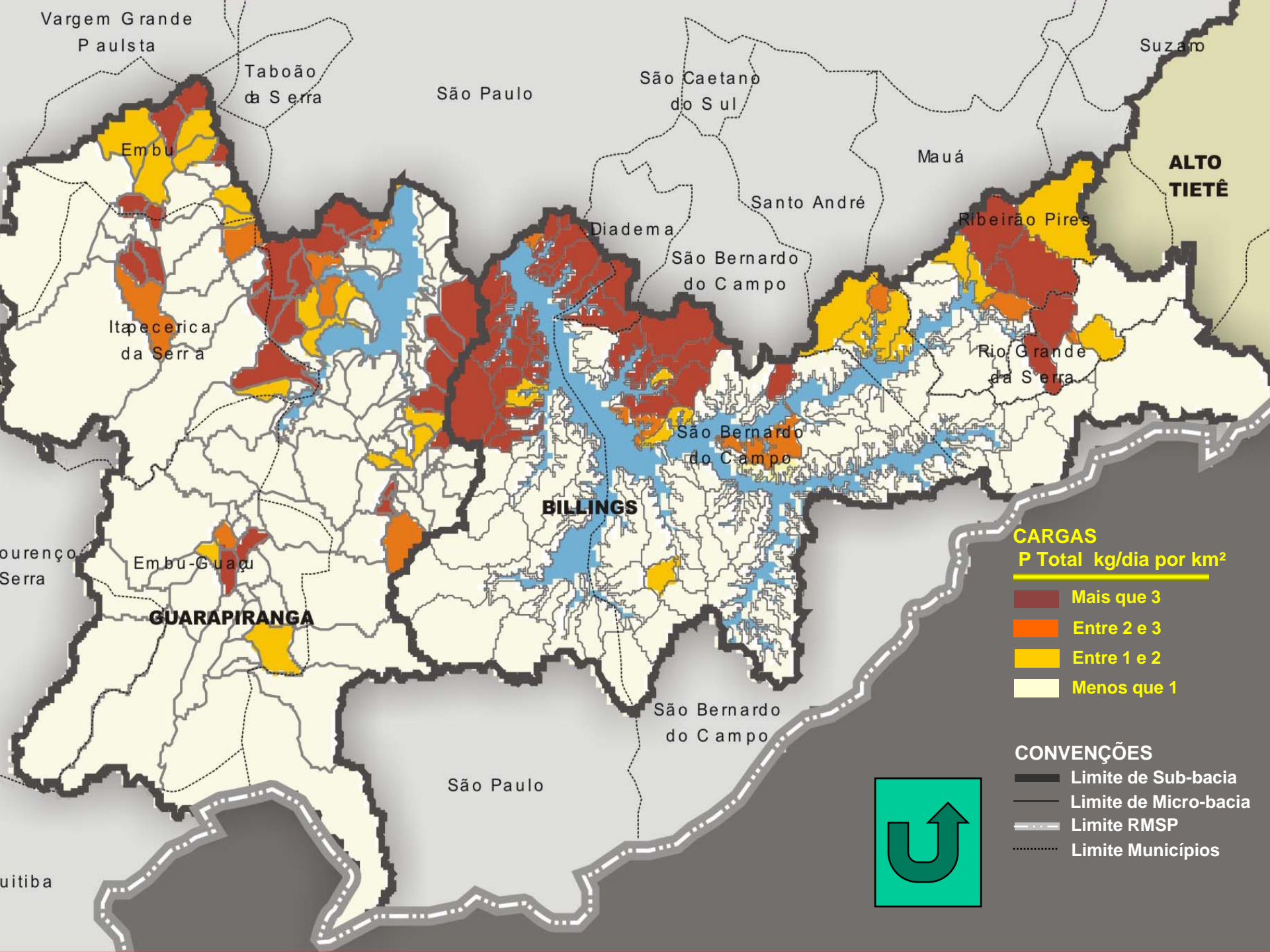
Embu-Guaçu

GUARAPIRANGA

São Bernardo
do Campo

São Paulo

Guaituba



Vargem Grande Paulista

Taboão da Serra

São Paulo

São Caetano do Sul

Suzano

ALTO TIETÊ

Mauá

Santo André

Ribeirão Pires

Diadema

São Bernardo do Campo

Itapevicera da Serra

Rio Grande da Serra

São Bernardo do Campo

BILLINGS

Lourenço Serra

Embu-Guaçu

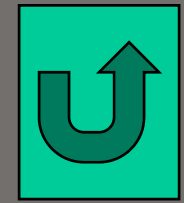
GUARAPIRANGA

CARGAS P Total kg/dia por km²

- Mais que 3
- Entre 2 e 3
- Entre 1 e 2
- Menos que 1

CONVENÇÕES

- Limite de Sub-bacia
- Limite de Micro-bacia
- Limite RMSP
- Limite Municípios

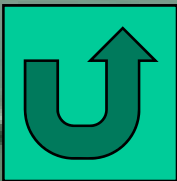


São Paulo

São Bernardo do Campo

Guaitiba

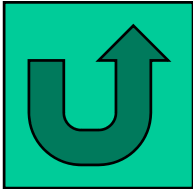
Guarapiranga Ecological Park



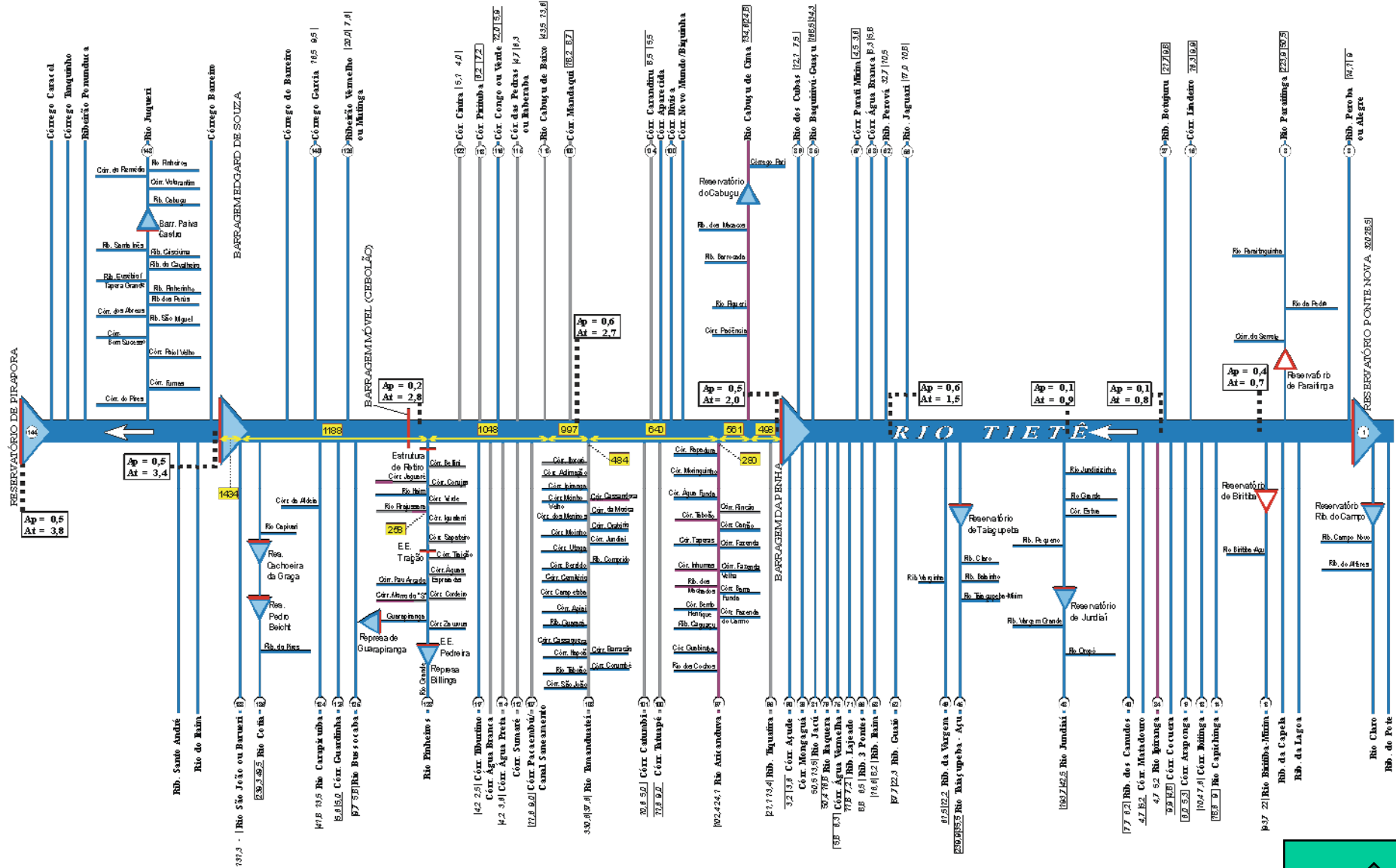
Guarapiranga Project: slum upgrading



Guarapiranga Project: slum upgrading



Metropolitan flood control: regulated discharges



LEGENDA

- Reservatório Existente
- Futuro Reservatório
- Rio, córrego, ribeirão
- Canais
- Barragem
- Galeria

Extensão (Km) da Sub-Bacia
 Área (km²) da Sub-Bacia

Identificação das Sub-Bacias (conforme Hidroplan)

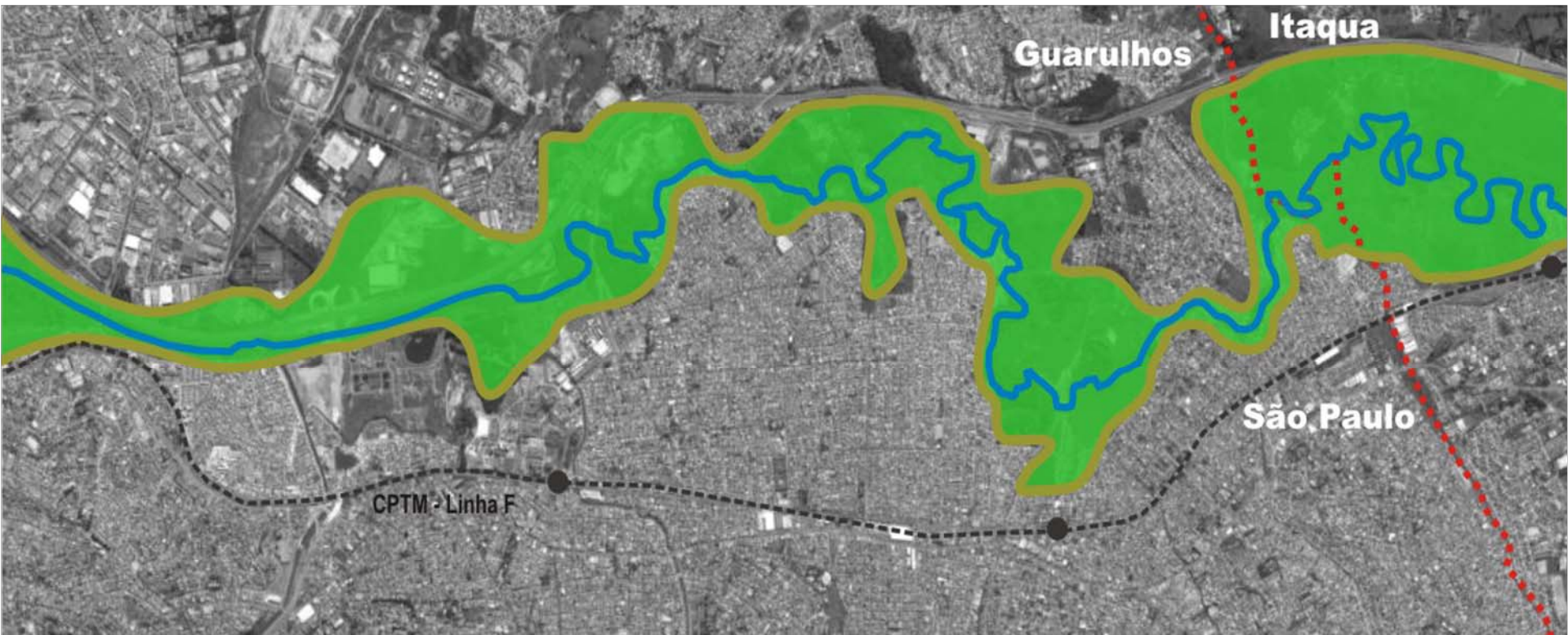
Ap : Área da Sub-Bacia (km² X 10³)
At : Área Acumulada (km² X 10³)

Vazões de restrição

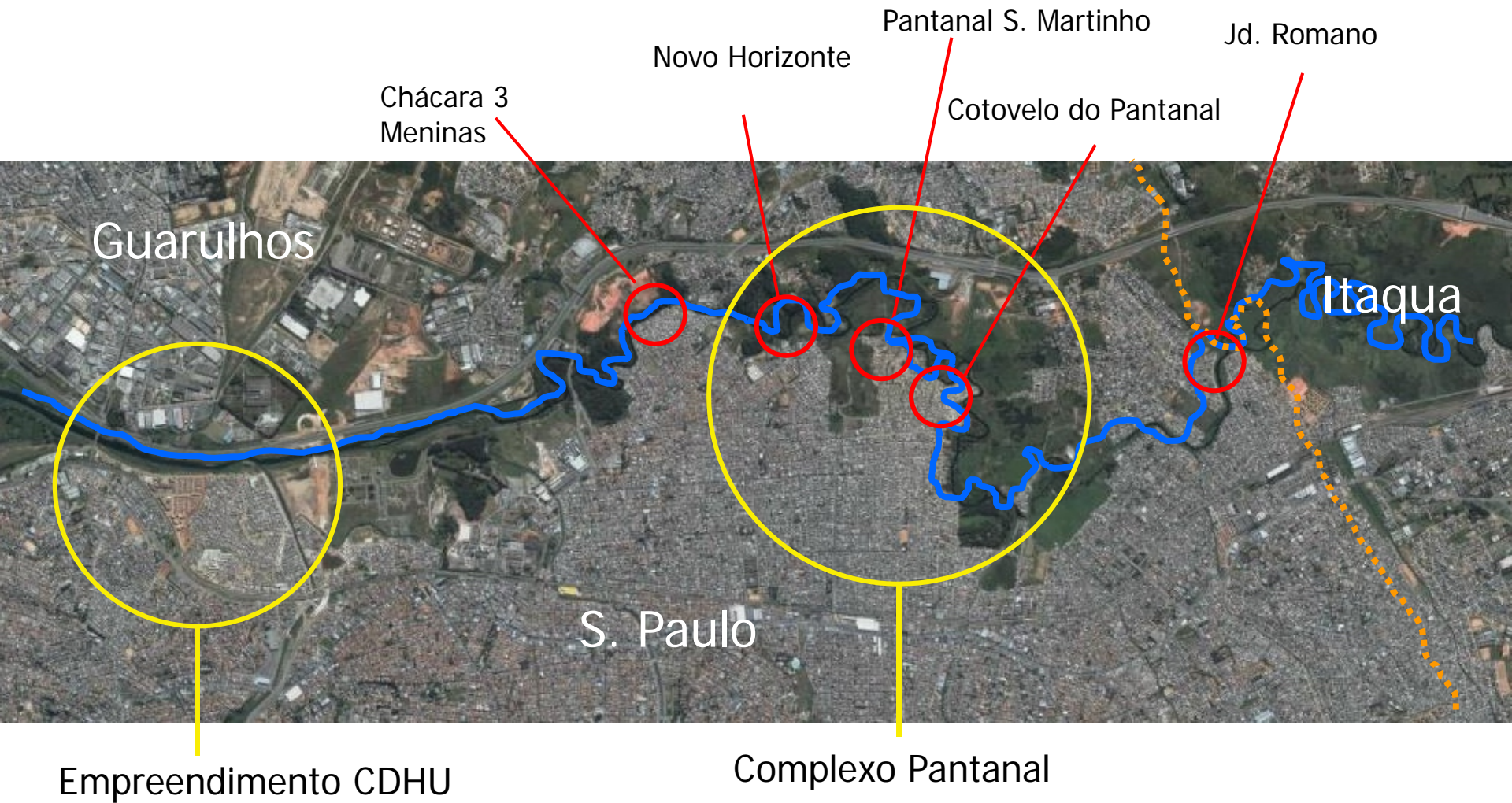
Nota: Não computada a área de Base do Rio Pinheiros no cálculo das áreas de drenagem



UPPER TIETÊ RIVERBANKS PARK



Controle de inundações e desenvolvimento urbano sustentável



Areas to be re-settled

Upper Tietê basin. Critical urban occupations on flooding areas.



Novo Horizonte



Cotovelo e Pantanal S. Marinho

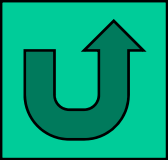


3 Meninas



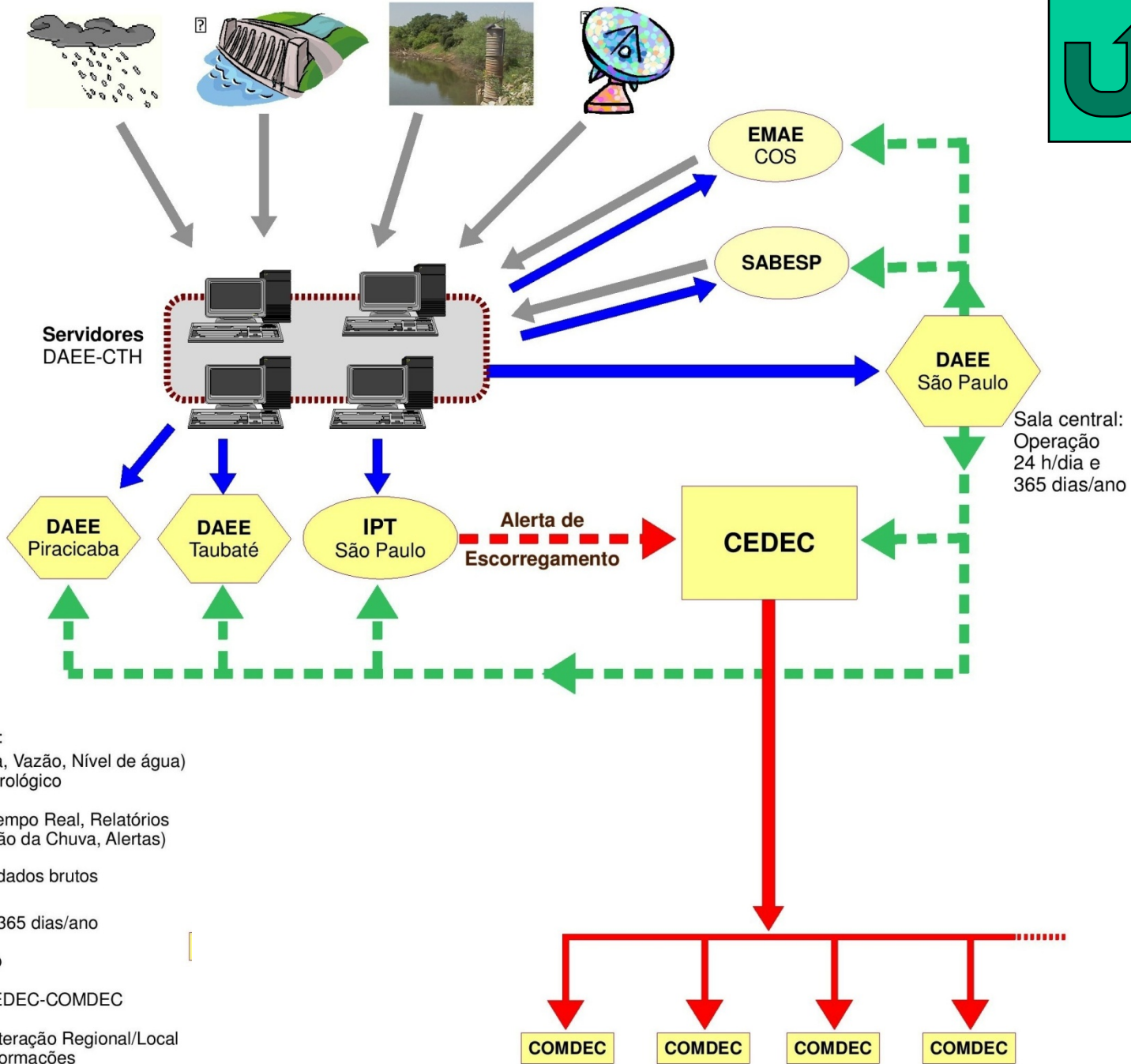
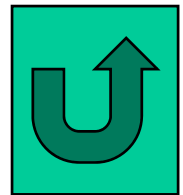
Jd. Romano

Upper Tietê Park Floods on 08/12/2009 – 11:30 AM.



Picture: Mario T L Barros

Postos Telemétricos do DAEE-CTH (EMAE, SABESP e outros, em breve)

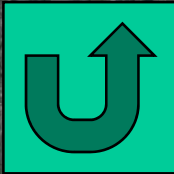
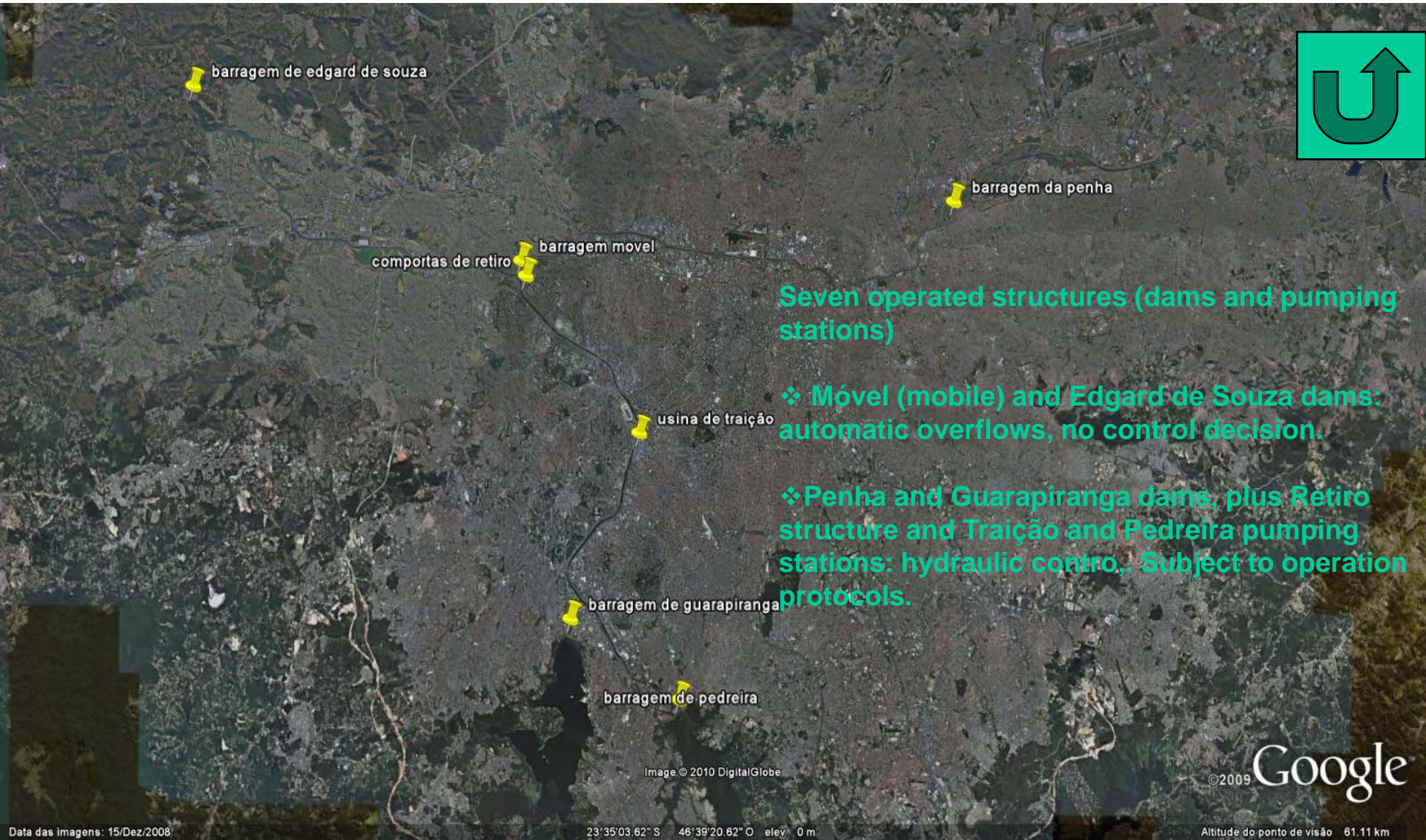


Legenda

- Fluxo de Dados tais como:
 - Rede Telemétrica (Chuva, Vazão, Nível de água)
 - Imagem do Radar Meteorológico
 - Software Google Earth
 - Produtos (Gráficos em Tempo Real, Relatórios de Eventos, Movimentação da Chuva, Alertas)
- Coleta e Transmissão de dados brutos
- Fluxo de Alerta, 24 h/dia, 365 dias/ano
- Alerta de Escorregamento
- Fluxo Próprio da Rede CEDEC-COMDEC
- Salas de Situação com Interação Regional/Local para Disseminação de Informações

São Paulo Metropolitan Region

Major flow controls. Dams and pumping stations



barragem de edgard de souza

barragem da penha

comportas de retiro

barragem movel

usina de traição

barragem de guarapiranga

barragem de pedreira

Seven operated structures (dams and pumping stations)

❖ Móvel (mobile) and Edgard de Souza dams: automatic overflows, no control decision.

❖ Penha and Guarapiranga dams, plus Retiro structure and Traição and Pedreira pumping stations: hydraulic contro., Subject to operation protocols.

Image © 2010 DigitalGlobe

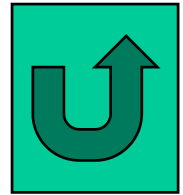
©2009 Google

Altitude do ponto de visão 61.11 km

23°35'03.62" S 46°39'20.62" O elev 0 m

Data das imagens: 15/Dez/2008

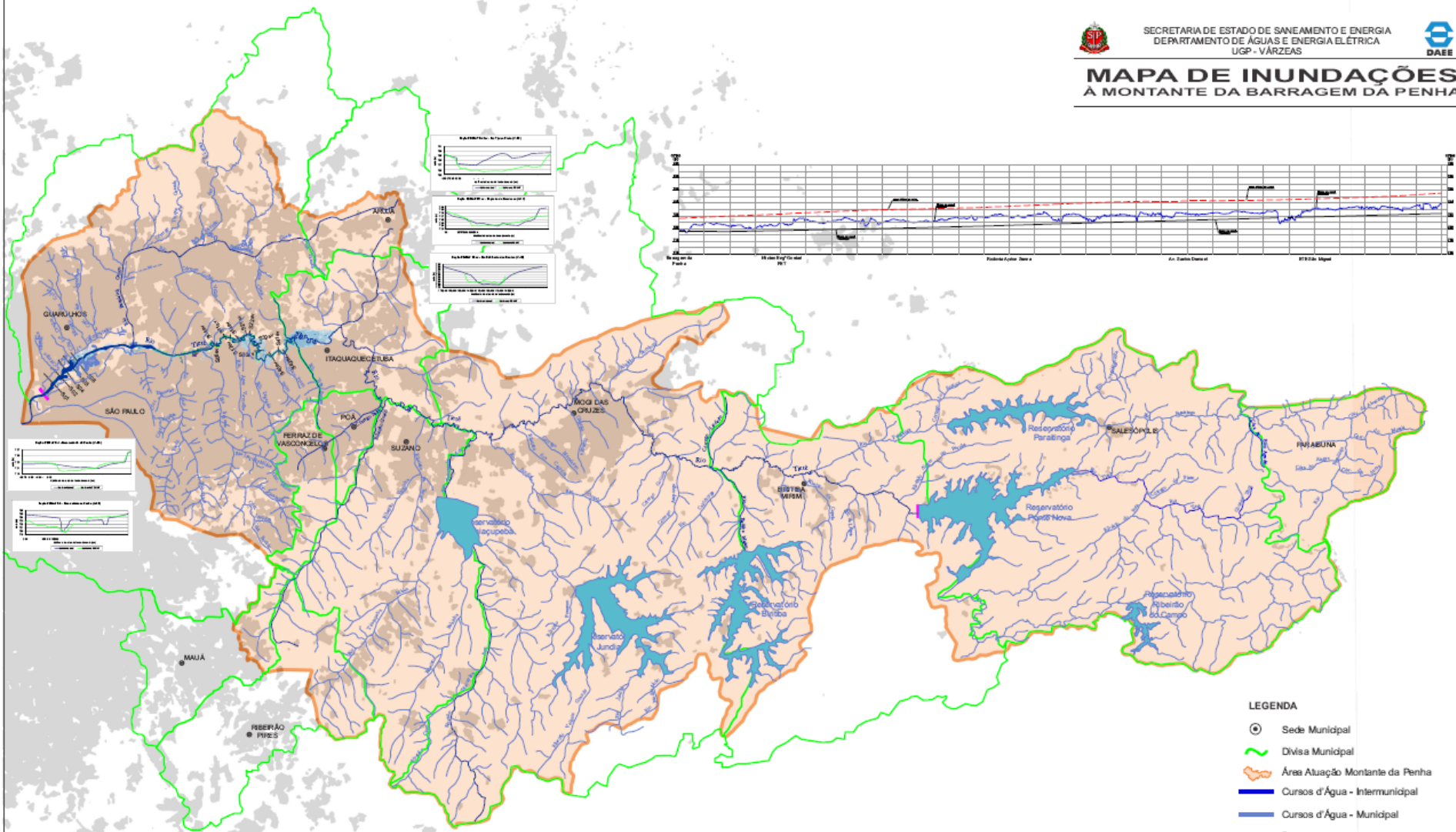
Upper Tietê eastern basin. Flood map.

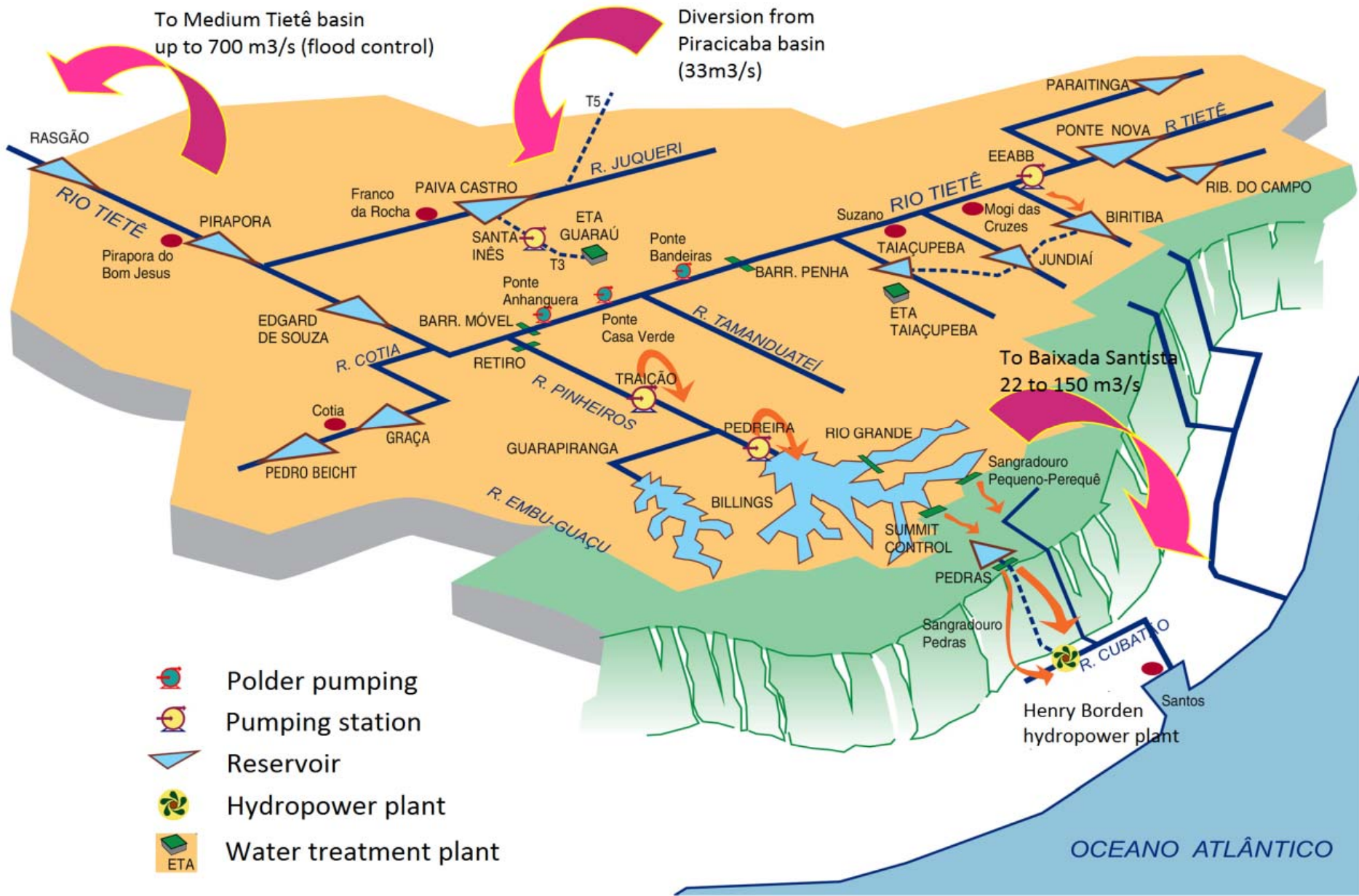


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UGP - VÁRZEAS



MAPA DE INUNDAÇÕES A MONTANTE DA BARRAGEM DA PENHA





Traição Pumping Station. Upstream view.



Rio das Pedras outflow (to Henry Borden plant)



Henry Borden hydropower plant

