

RIO MADEIRA RUN-OF-RIVER HYDRO PROJECTS

SEDIMENT TRANSPORT MANAGEMENT

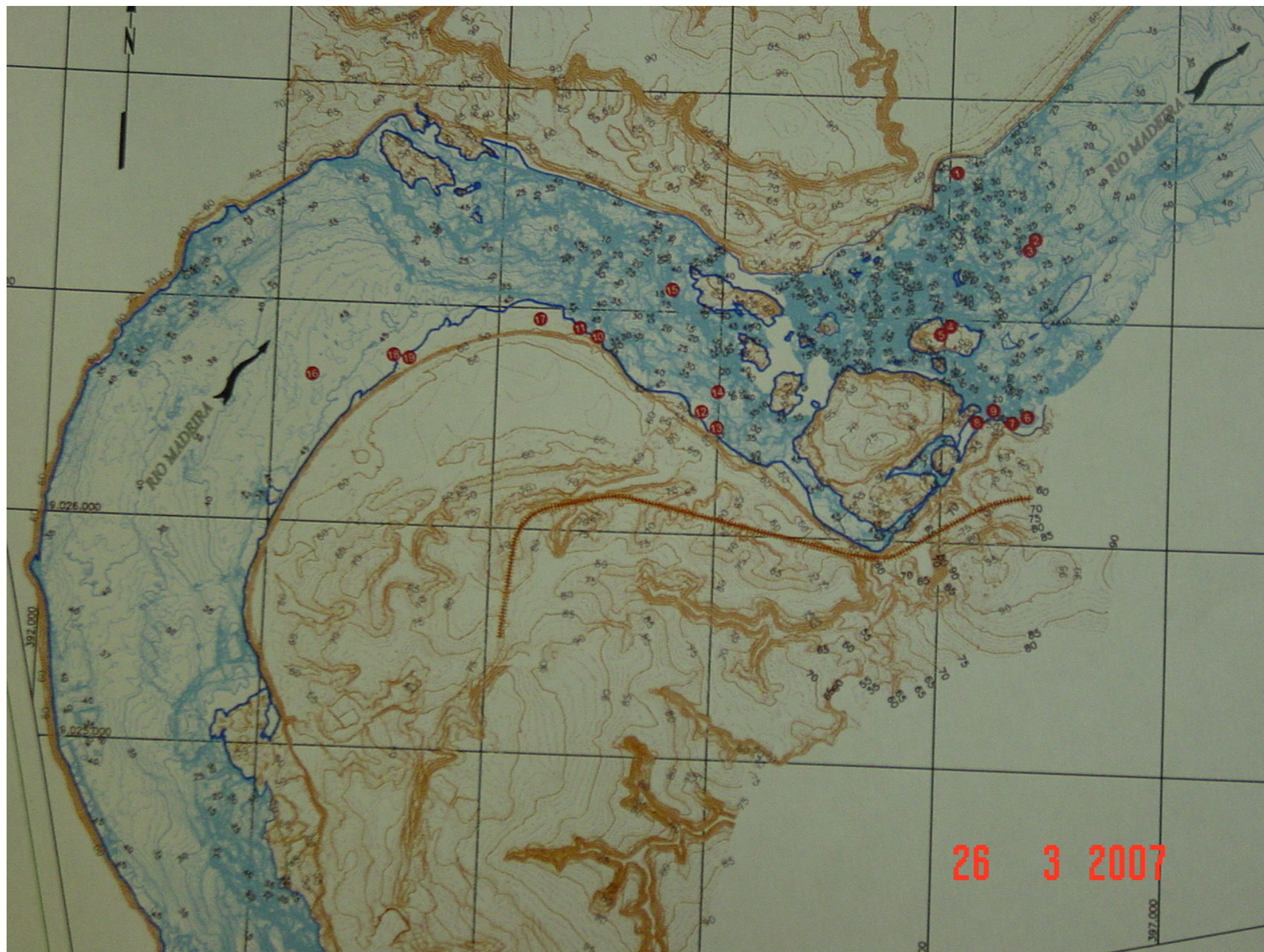
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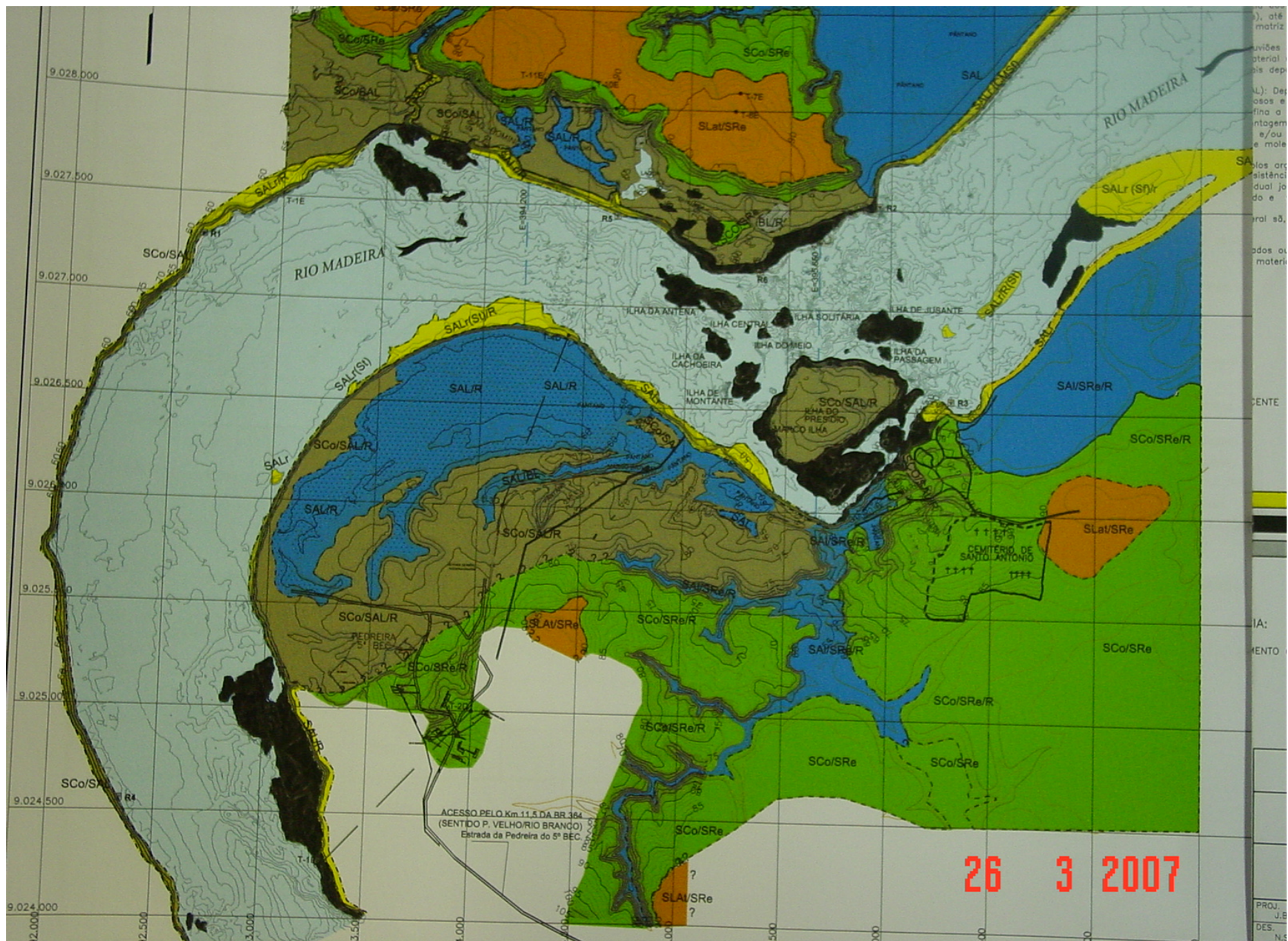
MAIN CHARACTERISTICS OF RUN-OF-RIVER HYDRO PROJECTS

- **Water and sediment transport through the upper pool is very similar to the initial river flow conditions**
- **Practically no stagnation zone in the main channel**
- **Ensure long project life without any significant sedimentation in the upper pool unlike large dams and reservoirs**

SOME EXAMPLES OF RUN-OF-RIVER HYDRO PROJECTS

- **In France on the Rhône River and its tributaries there are 22 run-of-river projects built 20 to 50 years ago with 10 to 50 m head**
- **Pak Mun in Thailand was built 25 years ago**
- **Sidney A. Murray off the Mississippi River in Louisiana was built 16 years ago**
- **All of them are operating satisfactorily**







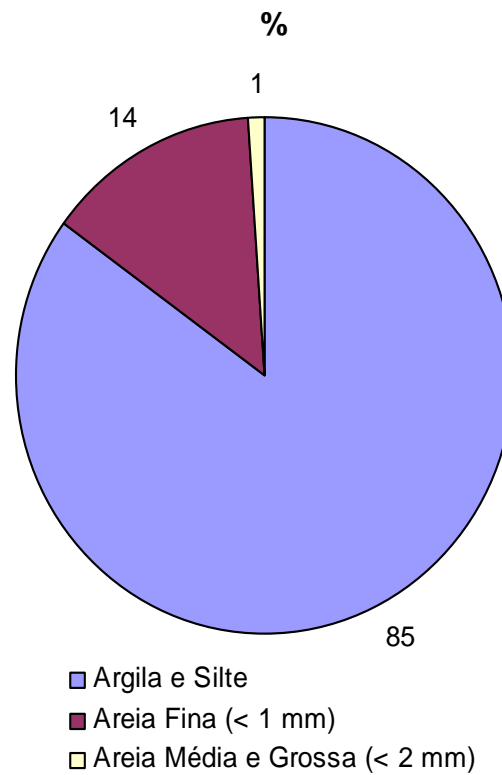
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PARTICLE SIZE DISTRIBUTION

Composição granulométrica da carga Sedimentar do
rio Madeira na região dos AHE Santo Antônio e Jirau



SEDIMENT TRANSPORT MECHANISM

- Under existing conditions and with the proposed hydro projects silt and clay component of the sediment materials are always moving in suspension
- This means that sands deposited on the river bed will always be non cohesive and will be put into suspension as soon as the local shear velocity is adequate

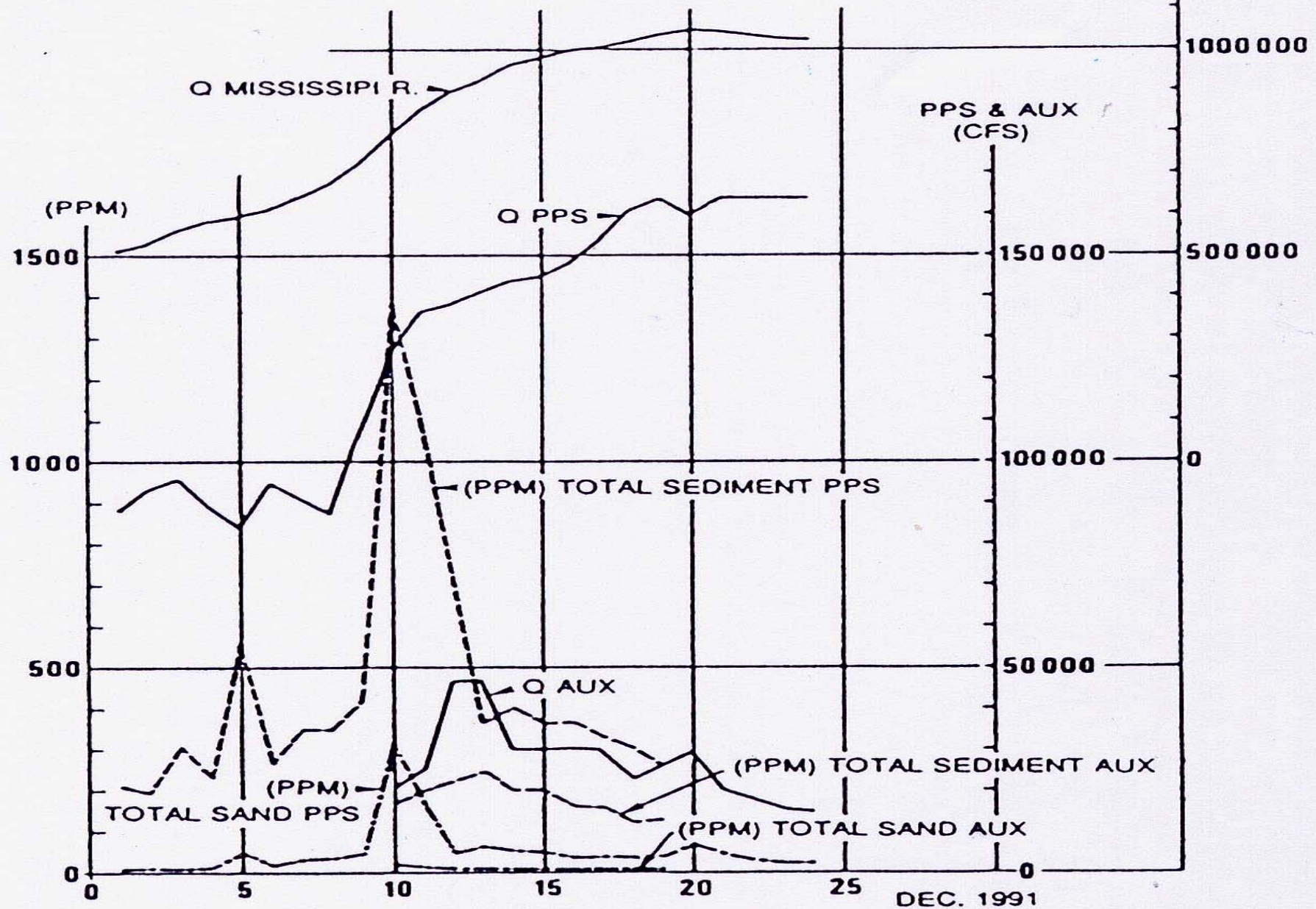


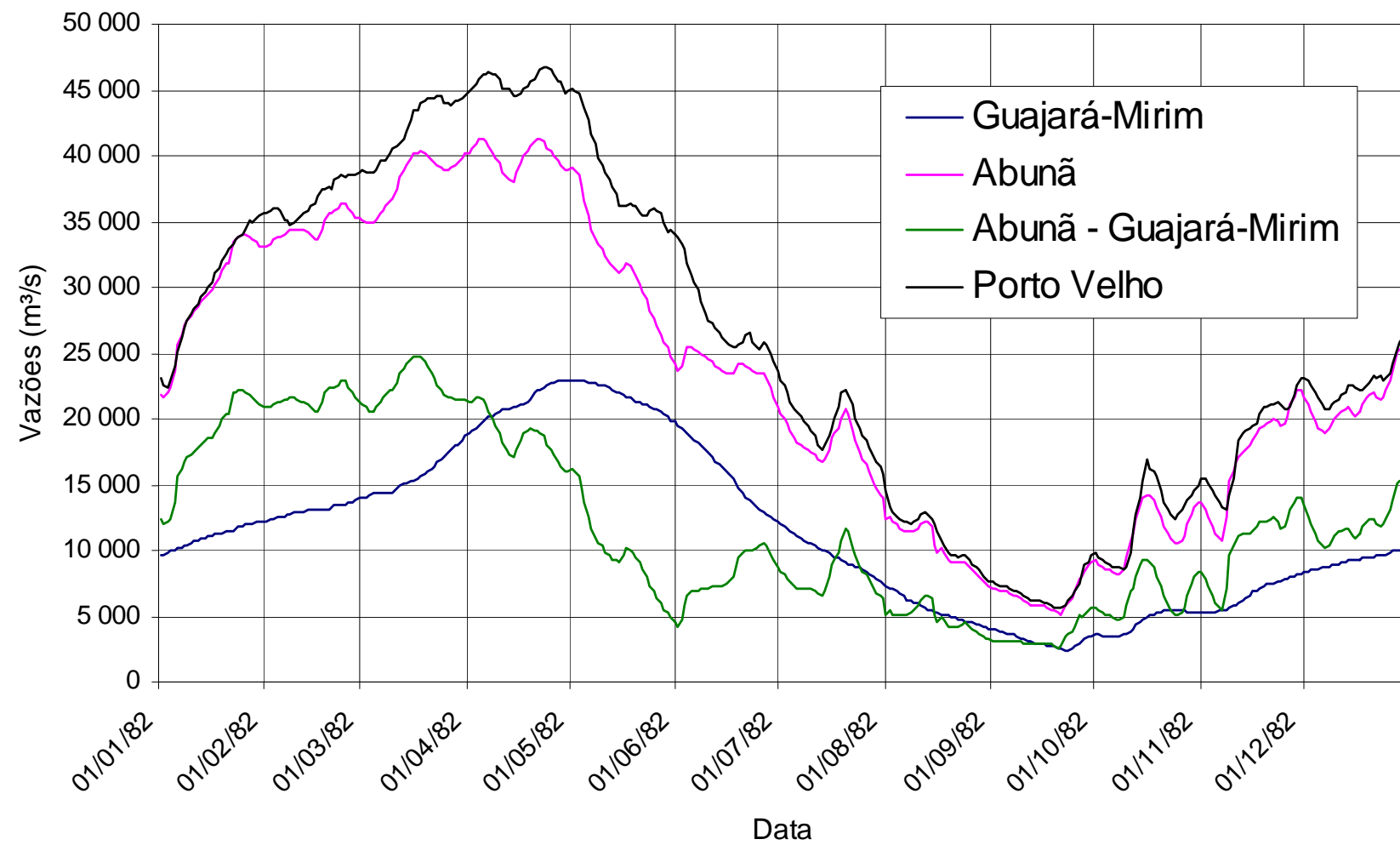
CONTINUOUS SEDIMENT SAMPLING

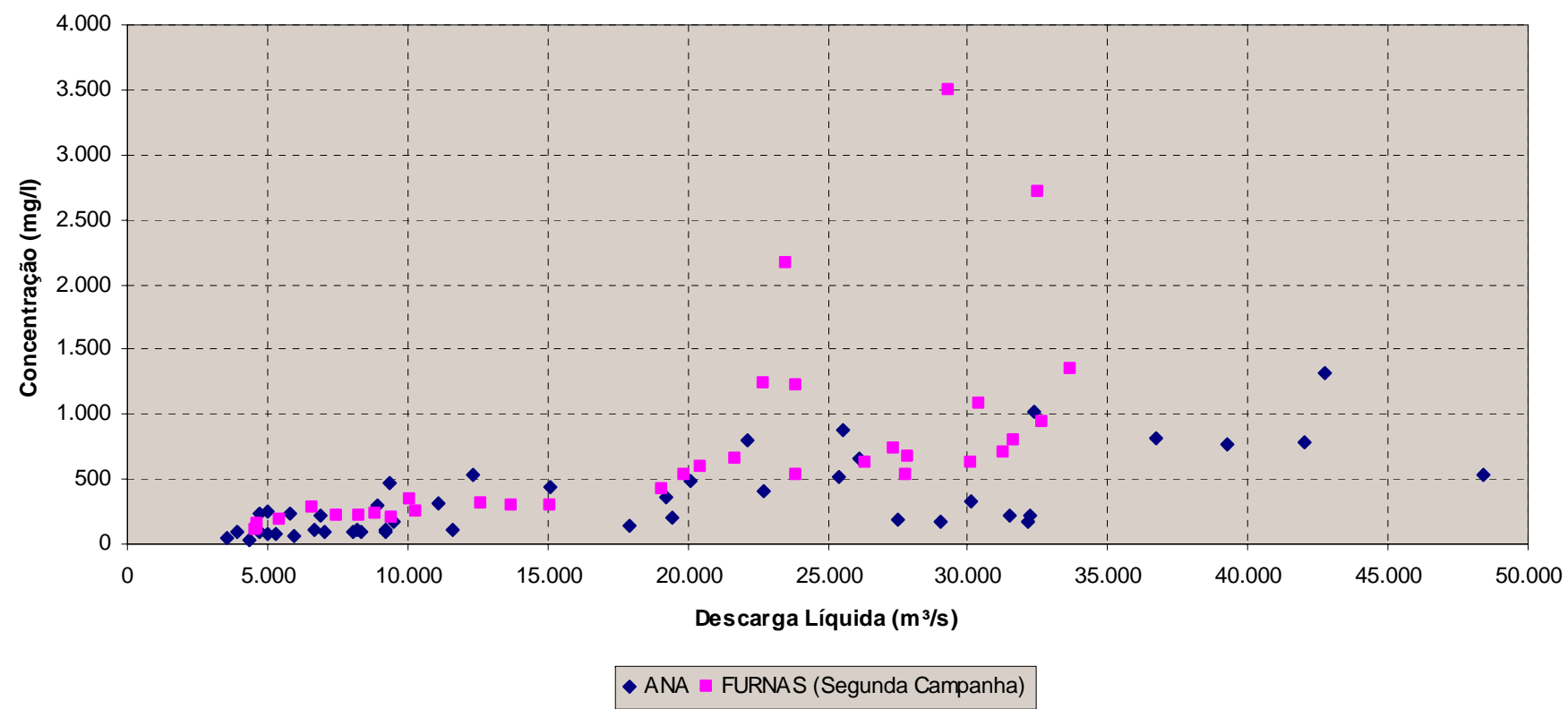
- Since 1991 a continuous sediment sampling installation is being used at Old River Complex on the Lower Mississippi River and at Sidney A. Murray run-of-river hydro station
- These installations have enabled us to obtain precise information on the total sediment transport process of the Mississippi River at this location

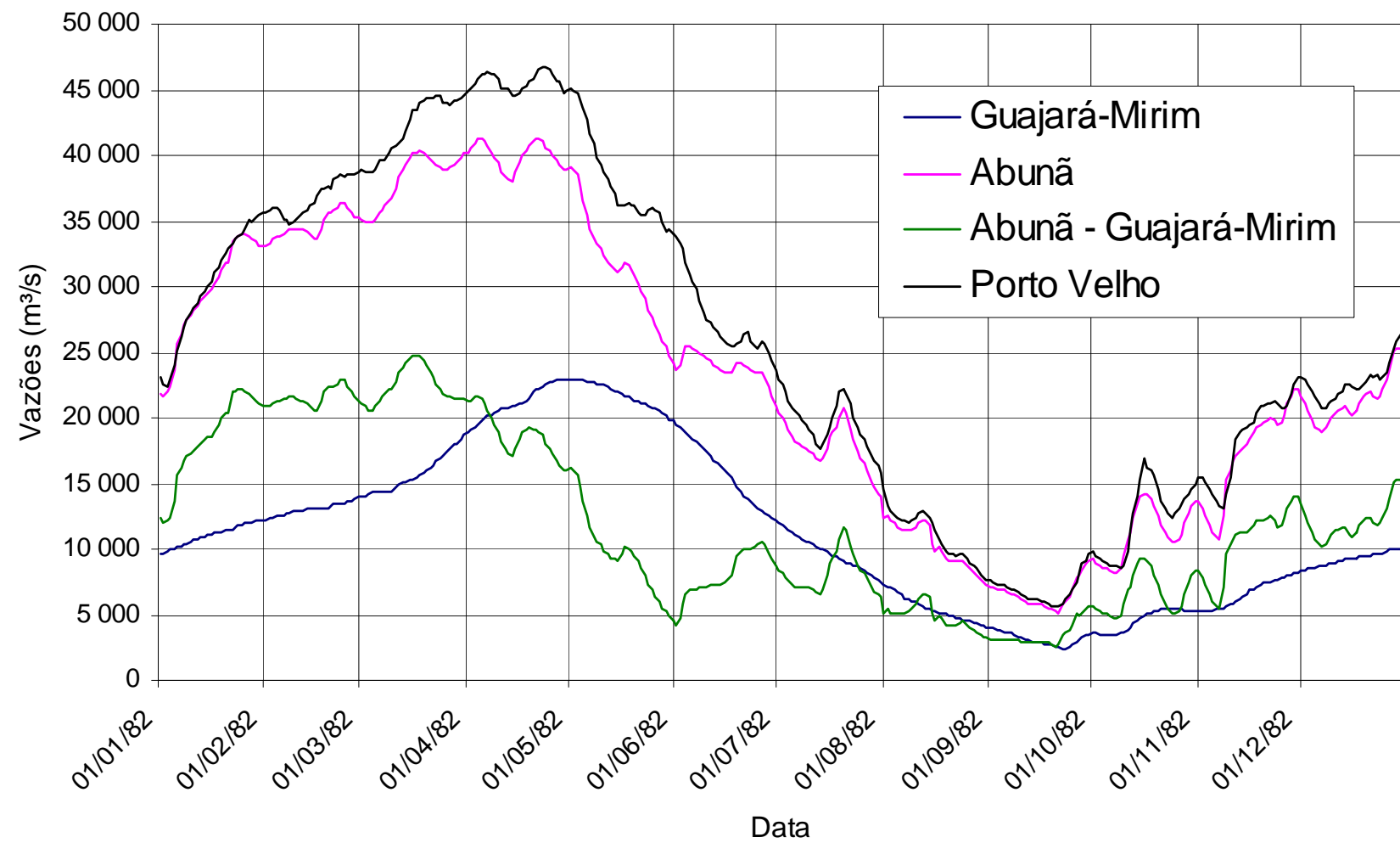


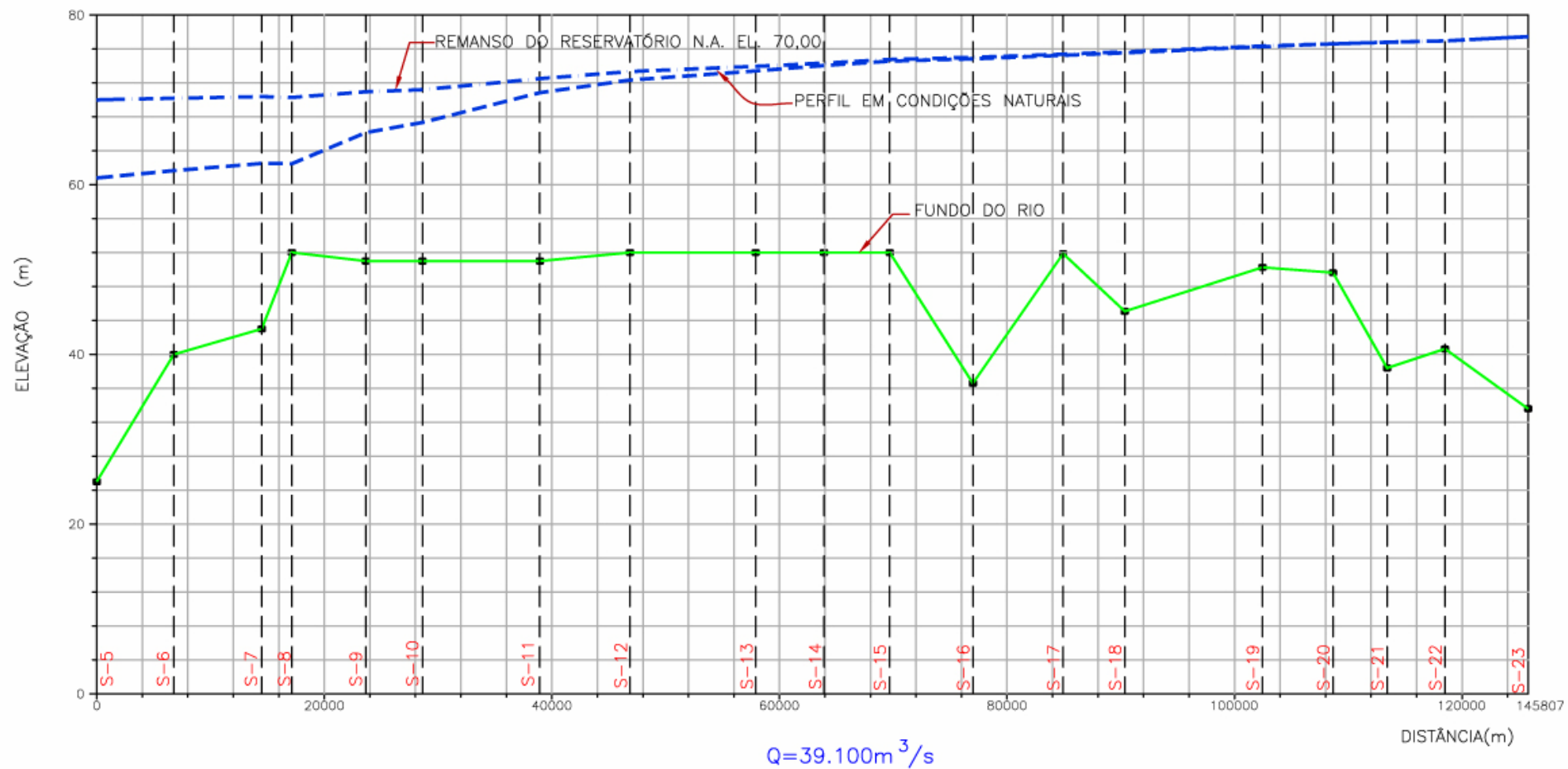
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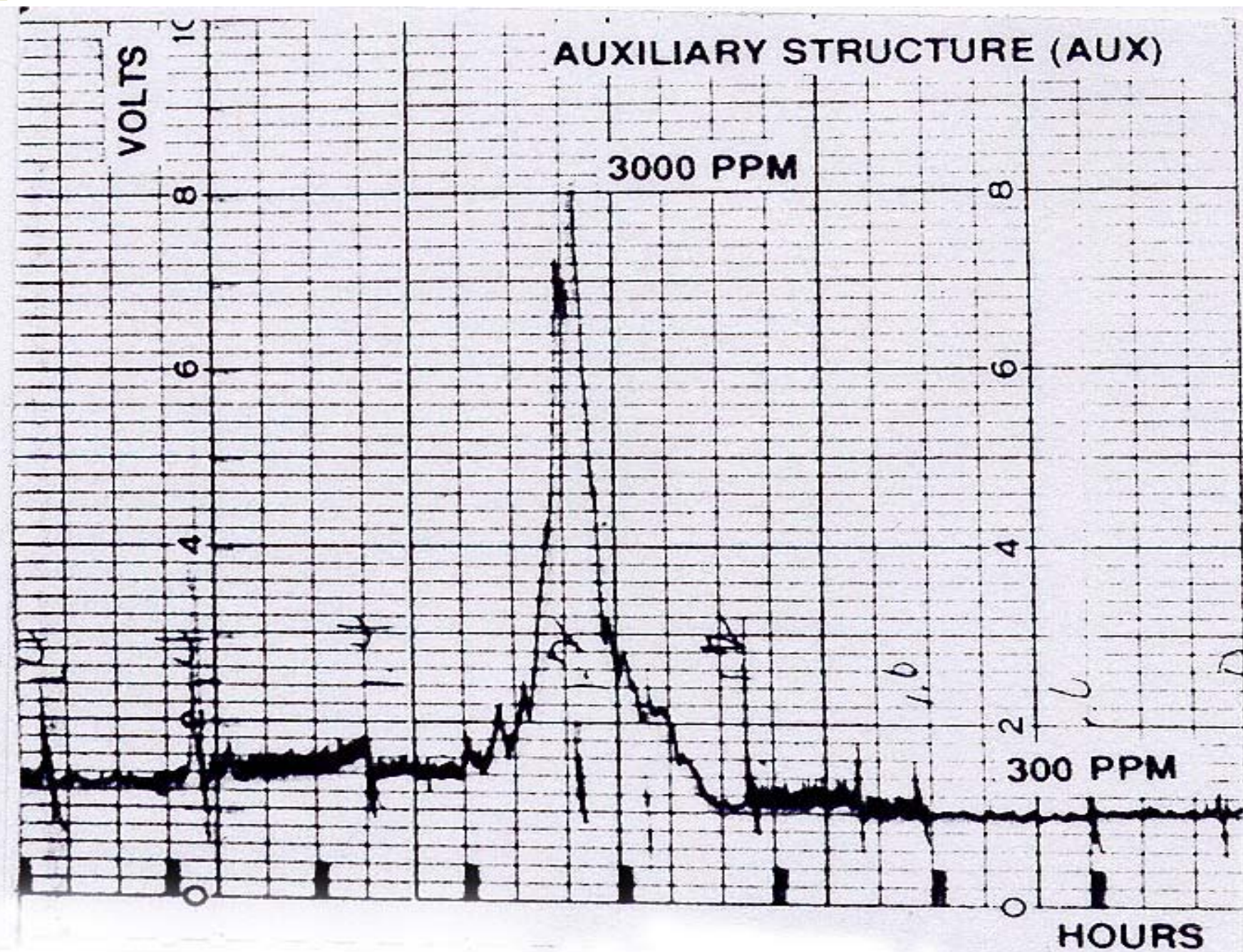
Shear velocity $u^* = (ghi)^{0.5}$

- In computing the shear velocities we have used the energy gradient i corresponding to steady flow conditions.
- For variable flow with the increasing flood discharge the instantaneous value of i and consequently u^* will be much more and sand particles will go into suspension earlier with lesser discharges
- So the values of w/u^* in the report are rather conservative

FLUSHING OF FINE SANDS

- Non cohesive fine sand can be flushed very quickly as shown by the continuous recording of the sediment concentration at the auxiliary sediment diversion channel at the Old River Complex of the lower Mississippi River





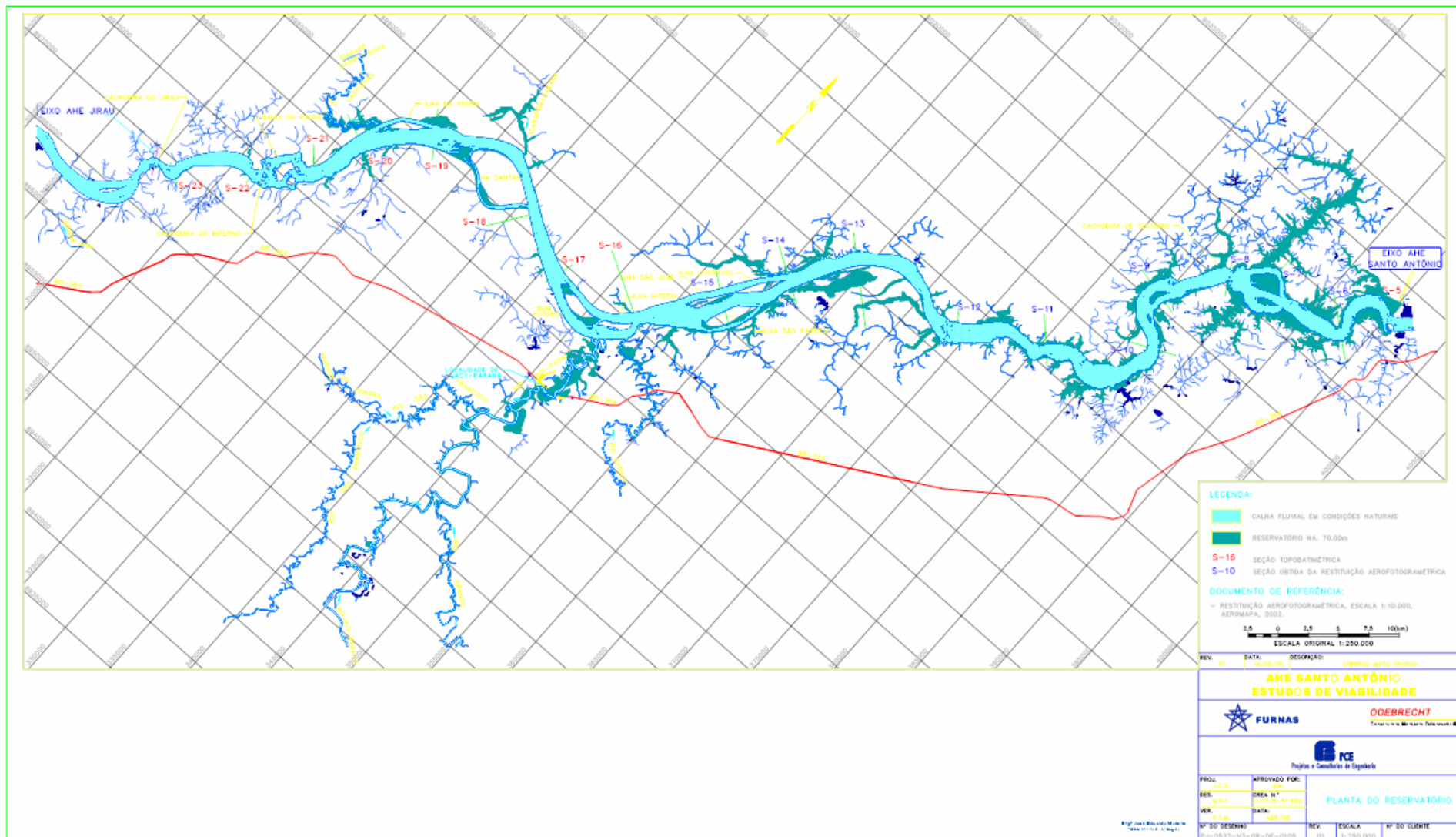


CONCLUSION

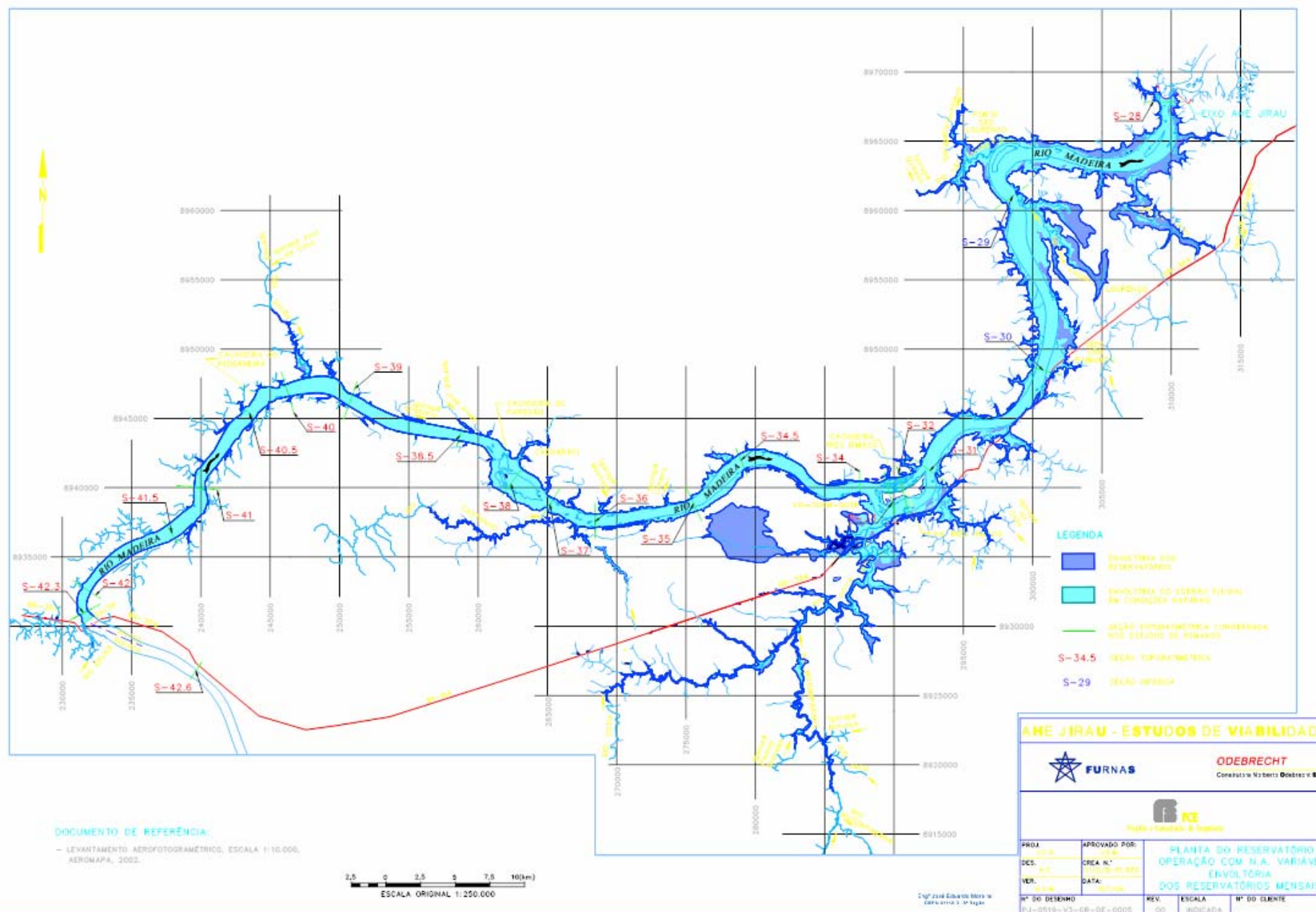
- The sediment transport patterns of Rio Madeira will not be radically modified due to the construction of the proposed low head run-of-river hydro projects
- Annual sediment deposition and erosion will continue to occur as at present and a new equilibrium of sediment transport from upstream to downstream will be established



- **As sediment and hydrological characteristics are the same at both Sant Antônio and Jirau projects they will be subjected to same kind of evolution with minimum negative environmental impacts**



PLANTA DO RESERVATÓRIO DA AHE JIRAU



MITIGATION MEASURES

- Necessary site specific measures would have to be developed to mitigate local drainage and flooding problems
- In the long run a new main channel cross section will be established with bankfull flow conditions

STATE-OF-THE-ART HYDRAULIC MODELLING

- **ADEQUATE HYDRAULIC MODEL STUDIES MUST BE CARRIED OUT TO ESTABLISH THE BEST PROJECT LAYOUT AGAINST SEDIMENTATION NEAR THE STRUCTURES**
- **TO DEFINE OPTIMUM FLOATING DEBRIS HANDLING ARRANGEMENT**
- **TO AVOID AIR ENTRAINING VORTEX FORMATION**

MANY THANKS



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