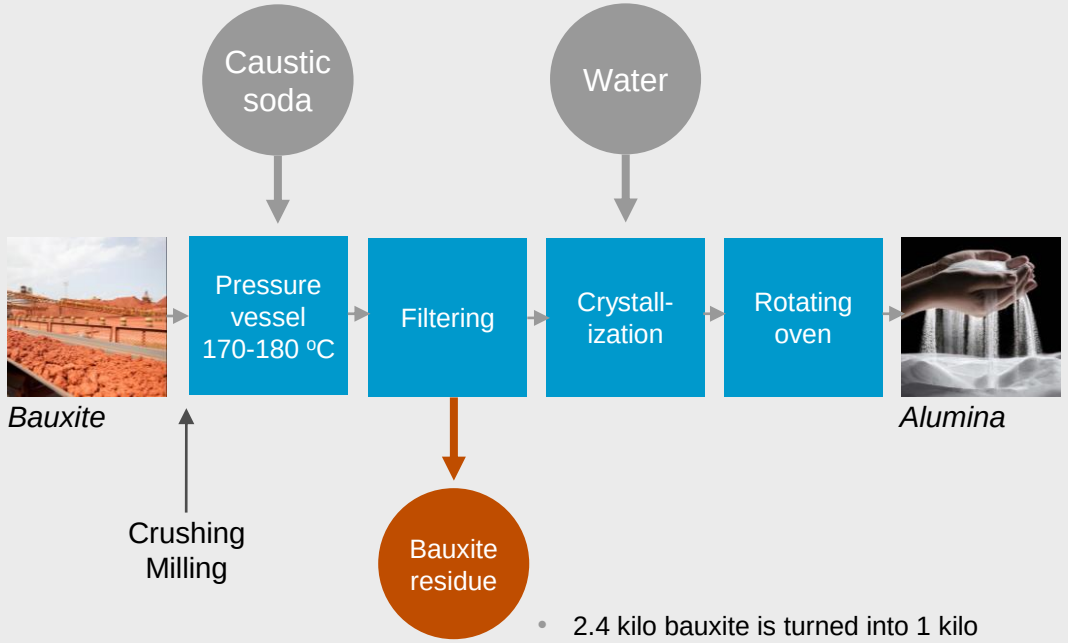
Internal Task Force

Tom Røtjer, Head of Internal Task Force
9 April, 2018

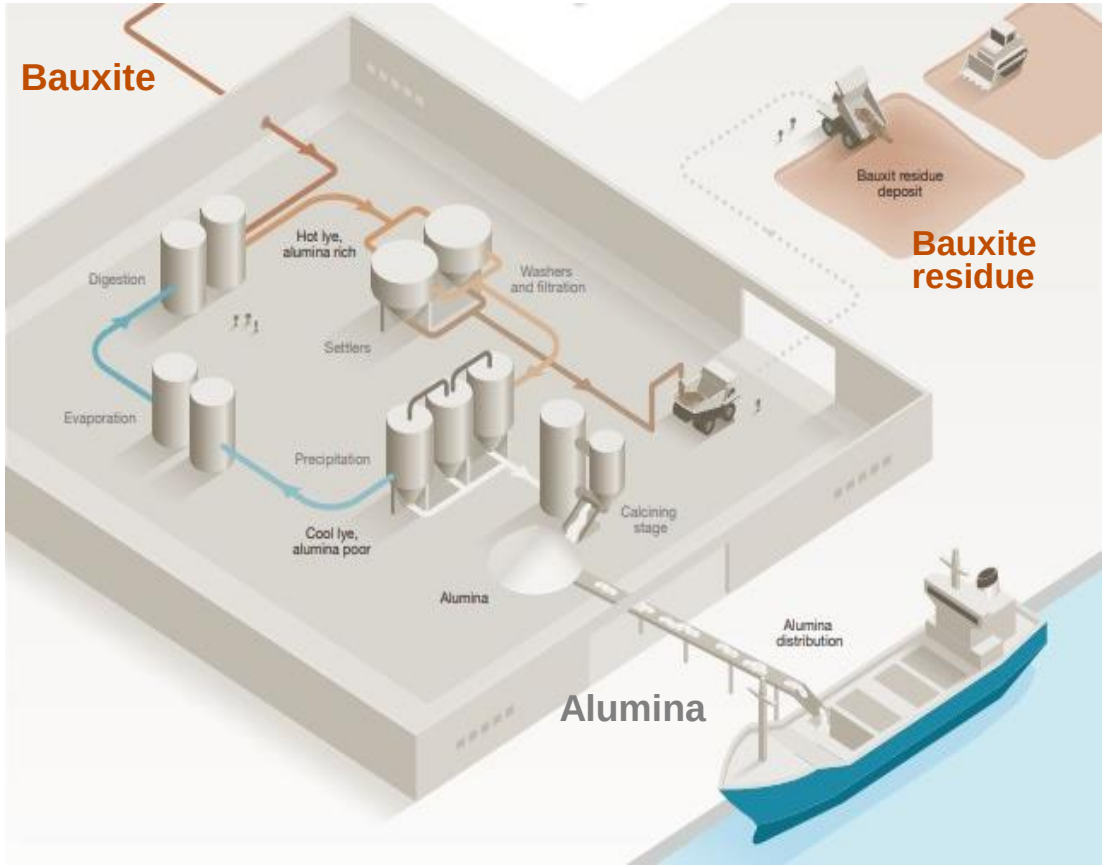
The refining process to extract alumina

The input factors, processes and output at the Alunorte alumina refinery

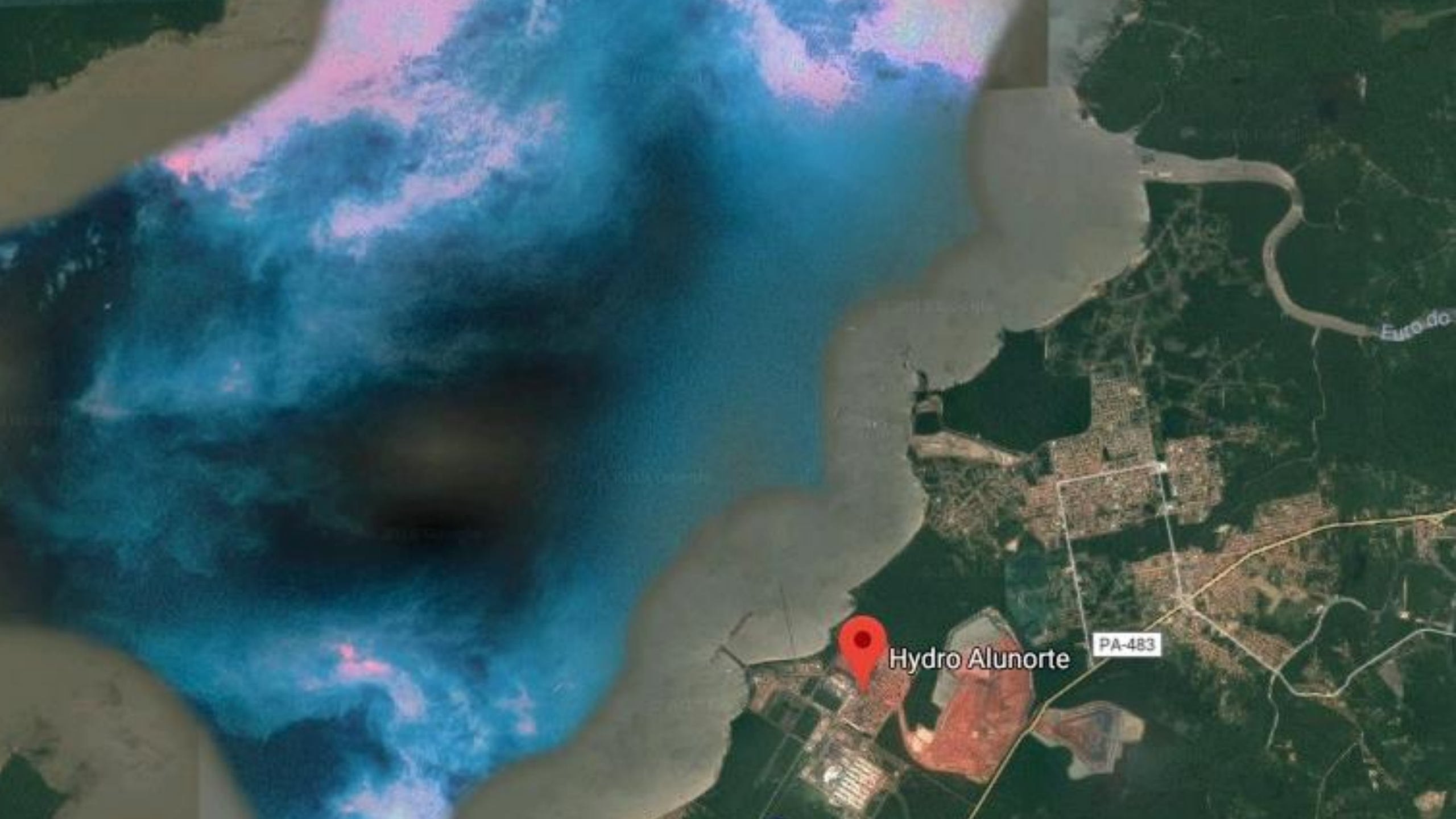
The refining process

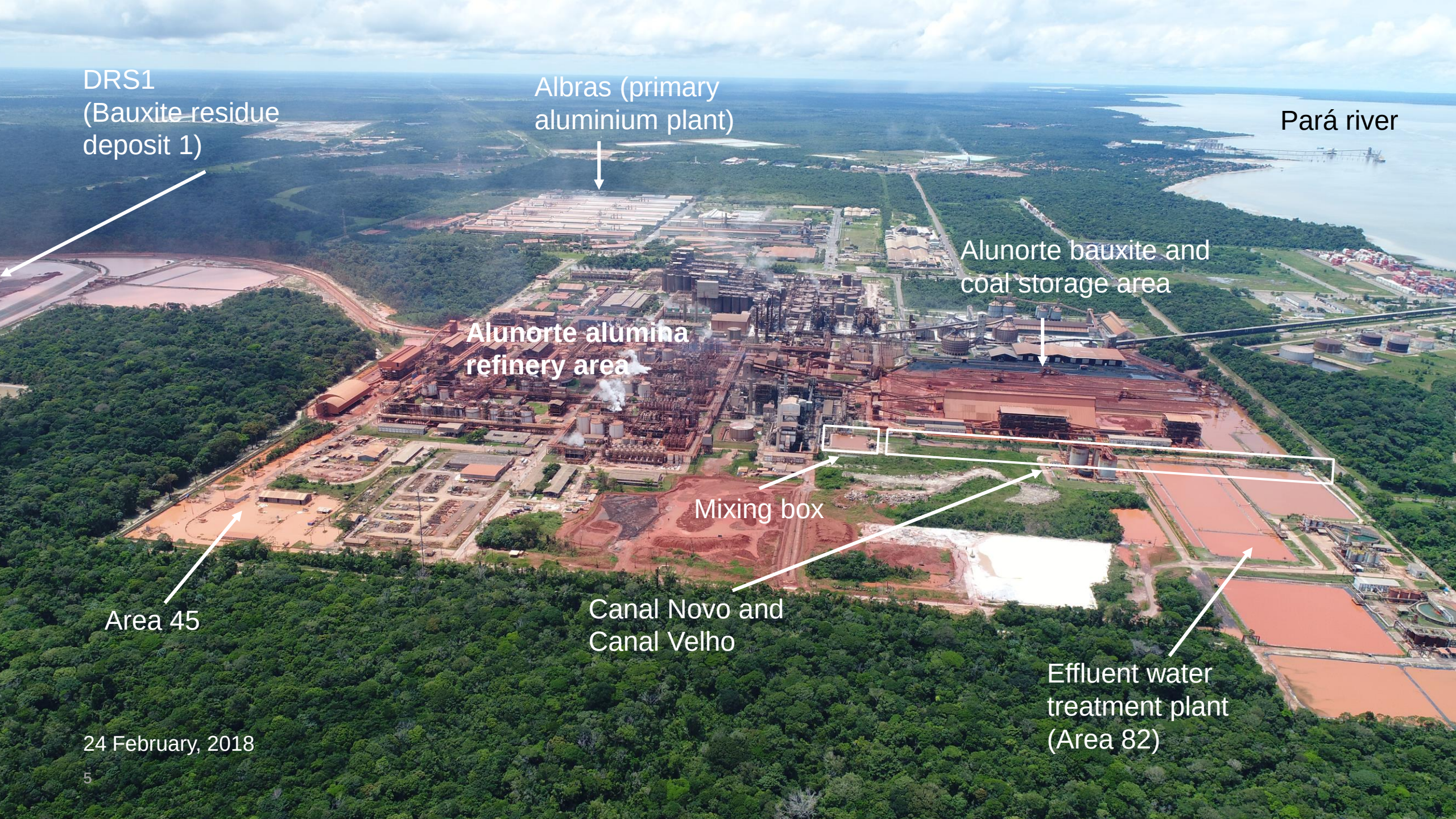


- 2.4 kilo bauxite is turned into 1 kilo alumina and 1.4 kilo bauxite residue
- Stored in bauxite residue deposits
- Process water treated before release



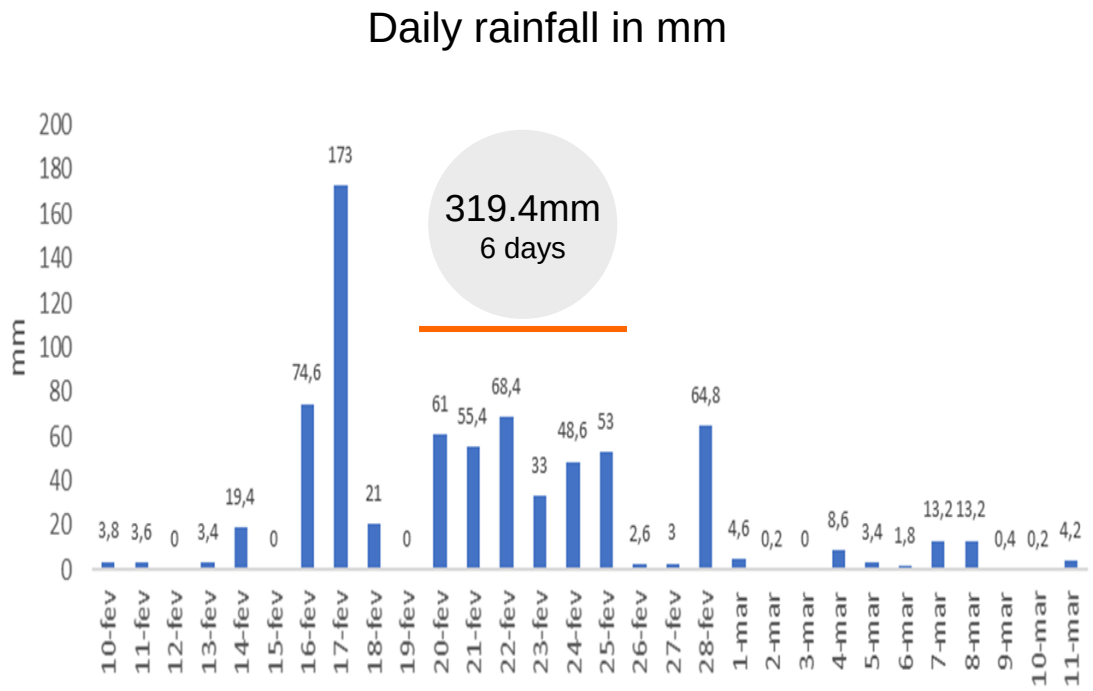
The bauxite residue deposits (1 and 2)


Hydro Alunorte
PA-483



24 February, 2018

Rainfall volumes



The event of intense rainfall 16-17 February 2018 resulted in 231mm in 12hr and 239mm in 24hr. Total February rainfall was 901mm

Key findings

- Extreme rainfall resulting in large amounts of water needing treatment upon release
- Internal power outage due to lightning reducing water treatment capacity
- External power voltage dip into refinery caused a spill of process water containing caustic soda inside the process area, that impacted the effluent water treatment plant capacity

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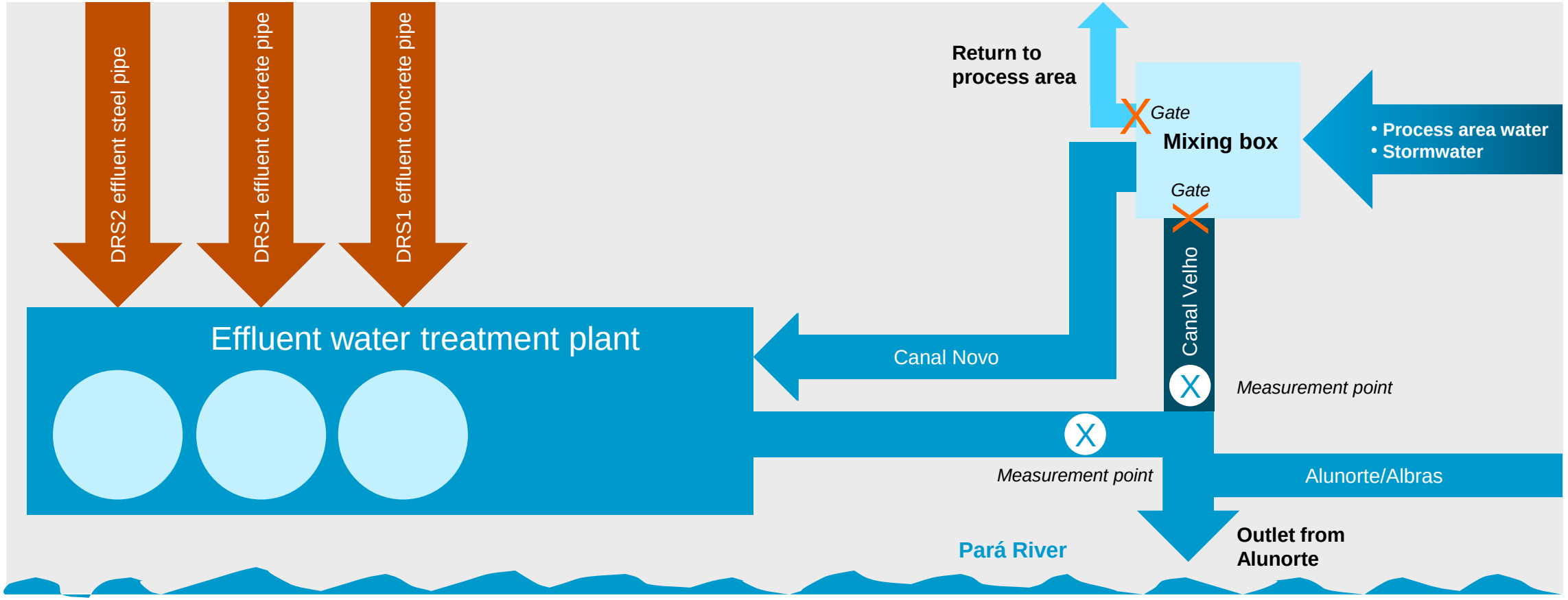
Alunorte Effluent Water Treatment System

Measurements in Pará River within average pH and Suspended Solids limits



Area 45 storm water flooding

Flooding contained within the walls of the surrounding pipe channels

- Used for contractors and laydown area.
- As part of the Alunorte Water Management improvement project that is already sanctioned, a new storm water system including new holding pond and sufficient pumping system will be constructed in Area 45

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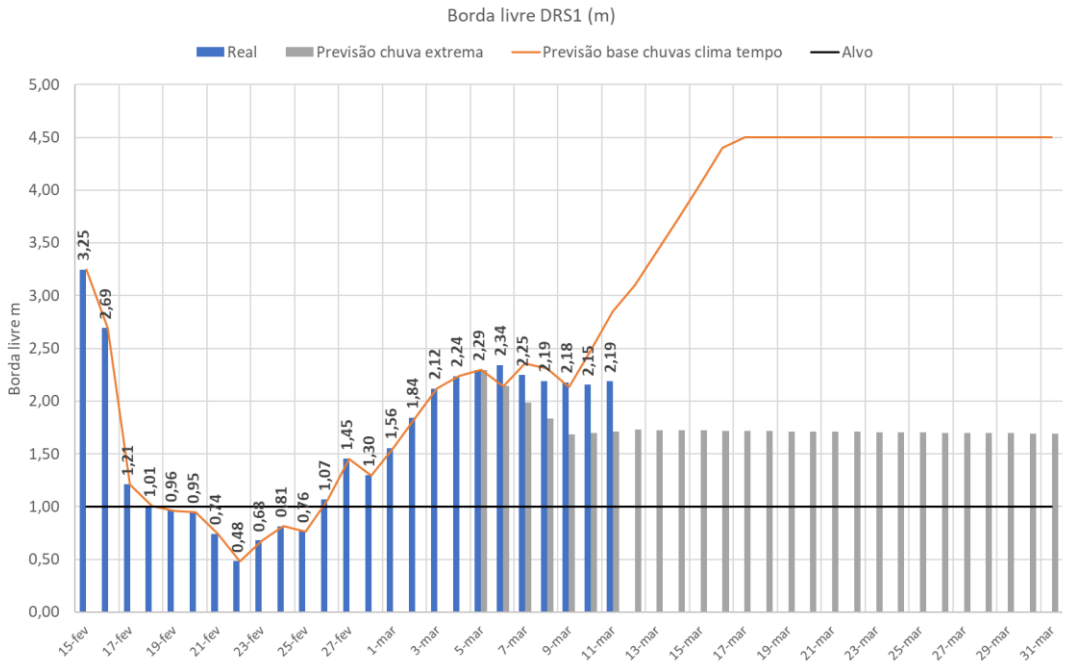
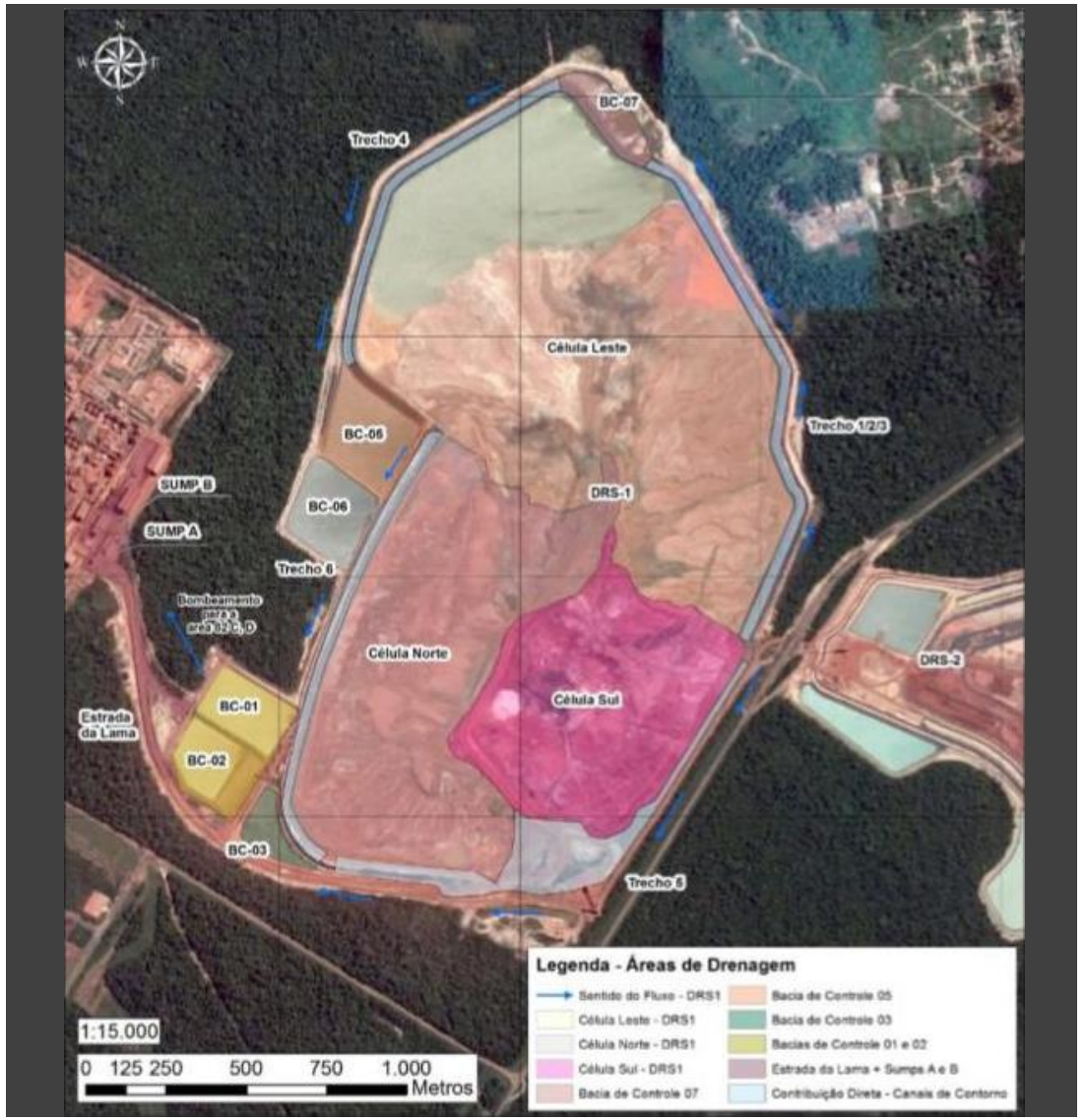
No overflow from DRS1

Freeboard development during event

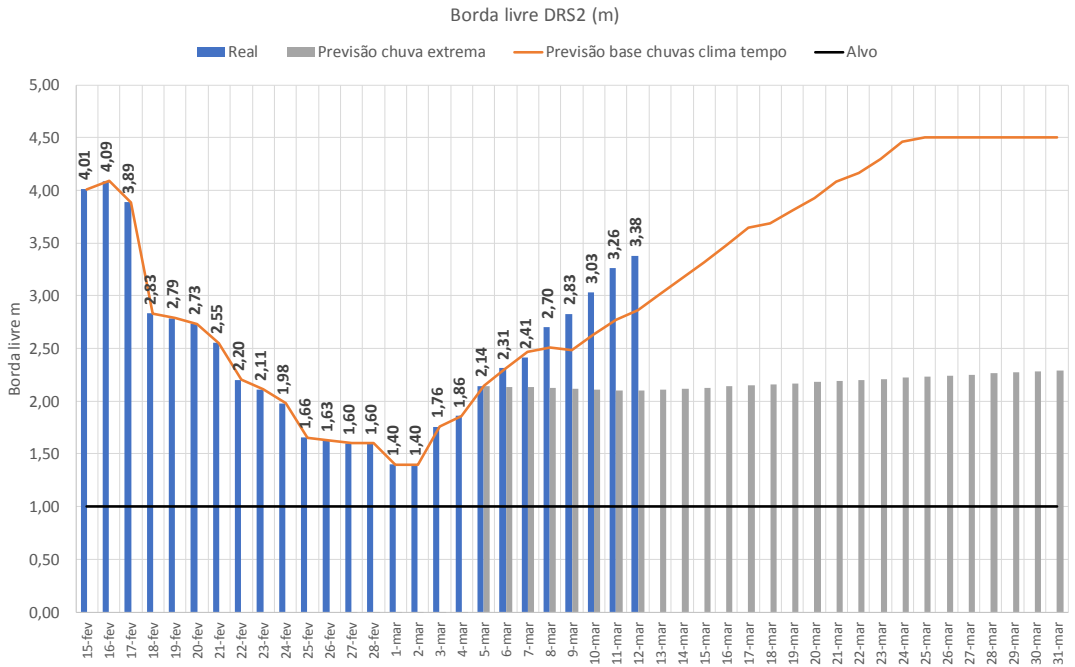




- Water retained in DRS1 in order to let Effluent Treatment Plant prioritize plant area

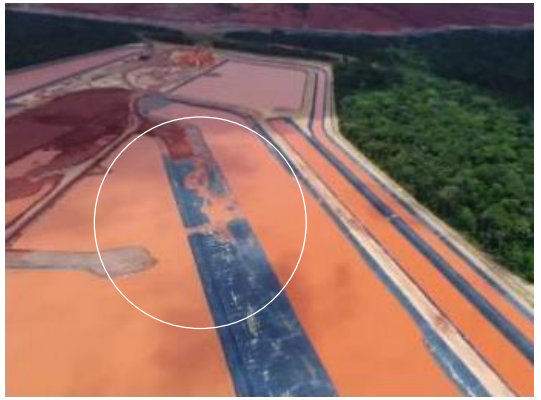
No overflow from DRS2

Freeboard development during event



- DRS2 had good capacity, and DRS2 basins contributed to relieving pressure on DRS1

Alleged «overflow» - photo «evidence» used in media to «prove» spillover from DRS2.



The same «overflow» showing that water moves from a dry zone to a wet zone within the deposit, as it is supposed to.

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Summary

No overflow from the Bauxite residue deposits

- The operational integrity of the bauxite residue deposits 1 and 2 was maintained during the event, and there were no overflow from the deposits
- In order to avoid risks of harm to the environment, not fully treated effluent was released through Canal Velho into the Para River
  - Average effluent concentration in the river was within the prescribed limits between pH 6-9
- Recommendations have been identified to increase capacity and improve the integrity of the overall effluent water treatment system of Alunorte

Recommendations

Plant improvements

Increase effluent treatment capacity:

- By 50% before next rainy season
- Holding basin and pump capacity Area 45
- New transfer pipes and pumping facilities (DRS1 to ETP)
- Integrate holding basins at the Bauxite Residue deposits
- Upgrade mixing box system
- Better separation of clean storm water from water needing treatment

New Water Balance Study

Update emergency plans and training

Finalize closure of DRS1

Ensure good dialogue with authorities

Environmental improvements

Initiate and perform an environmental baseline and effect study as basis for future monitoring

Invite academia in Pará Brazil/Norway to high quality environmental R&D program

Review and improve the environmental monitoring

Reduce external water consumption through reuse of internal water

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