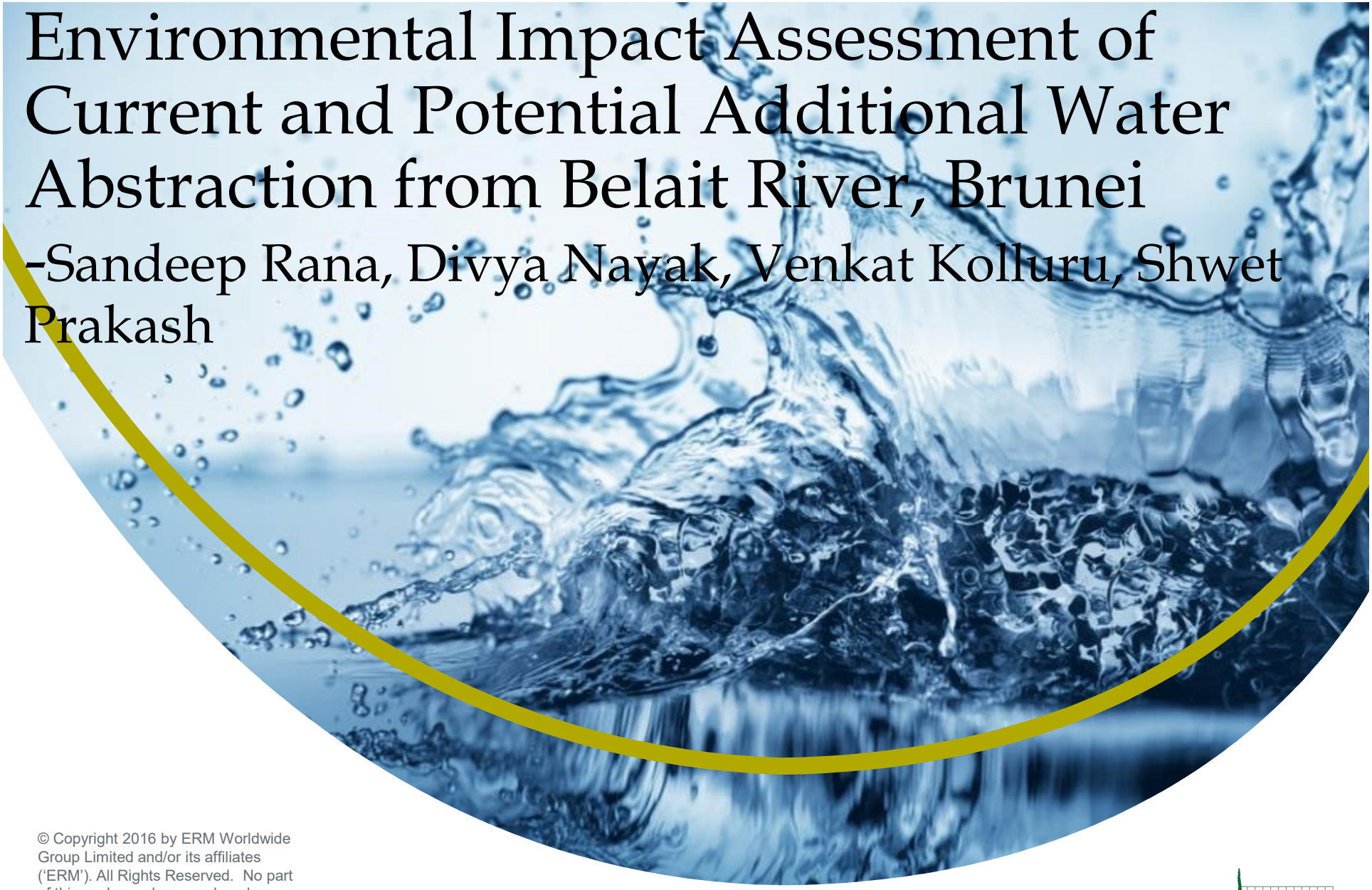
Environmental Impact Assessment of Current and Potential Additional Water Abstraction from Belait River, Brunei

-Sandeep Rana, Divya Nayak, Venkat Kolluru, Shwet Prakash



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Outline

The outline of the presentation is as follows:

- Objective
- Project Description
- Study Area
- Hydrology
- Model Selection
- Geospatial Data
- Results and Discussions
- Conclusions

Objective

- ERM was approached by Brunei Shell Petroleum Company Sdn Bhd (BSP) to carry out preliminary environmental impact assessment associated to additional water withdrawals from Belait River.
- Two (2) scenarios were considered:
  - an increase of withdrawal from the river above current uses;
  - longer term sustainability of the river to provide water for both current uses plus future anticipated increase.
- No calibration was done as no gages are present on Belait.

Project Description

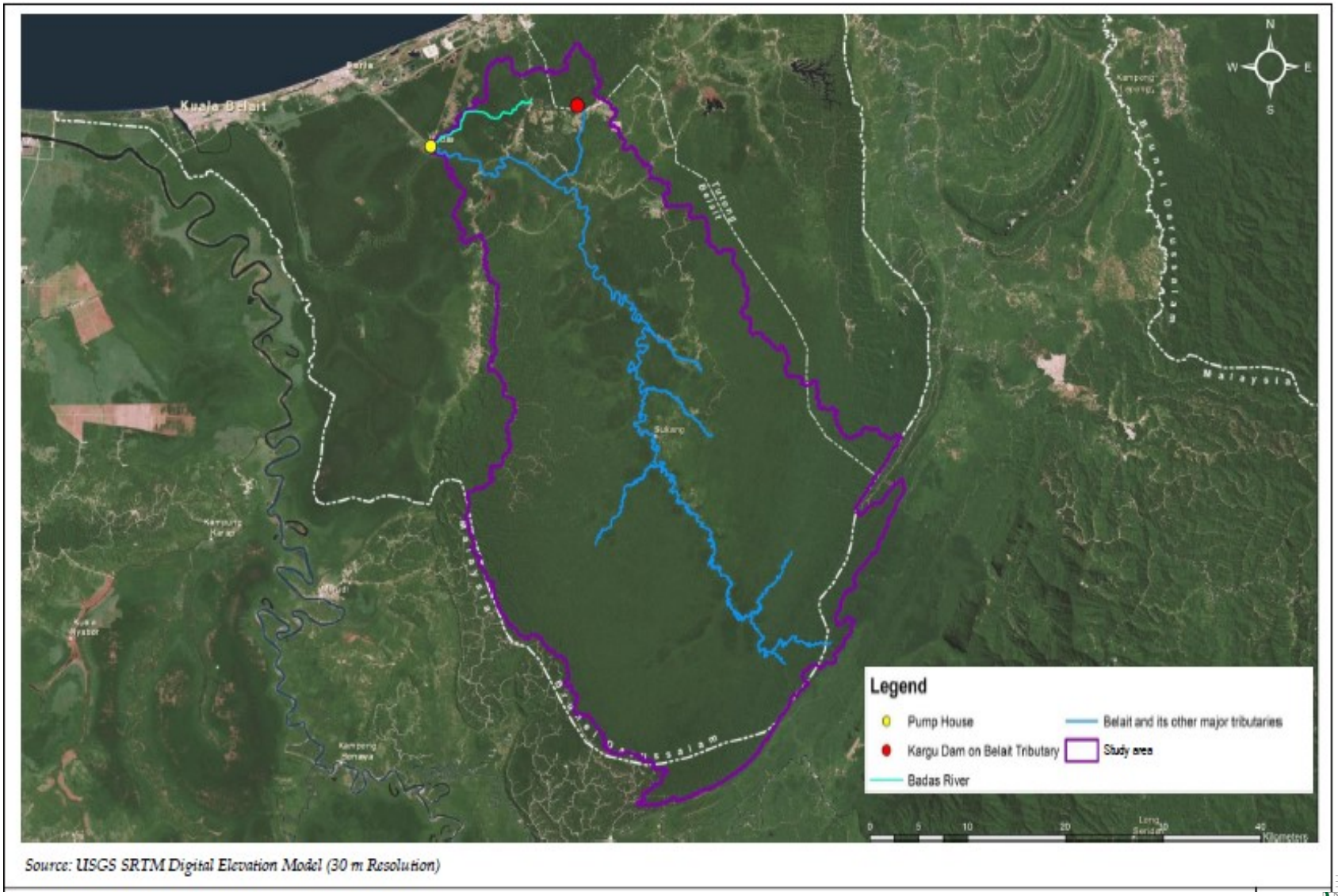
- The BSP currently abstracts **12,700 m^3/day** water from the Belait River.
- BSP is considering withdrawal of an additional **5,000 m^3/day** to meet anticipated additional water demand.
- Increased withdrawal can result in a multitude of downstream effects:
  - reduction in water levels that could reduce available habitat;
  - reduction in flow rates resulting in reduced water availability for downstream users;
  - reduced assimilation capacity for any downstream discharges.

Project Description

Study Area

- Study area: section of the Belait River from its origin to the pump house, length : ~ 129 km and catchment area: ~ 1,835 km^2
- The upper catchment area is an upland comprising of evergreen forests.
- The lower catchment comprises of an extensive peat swamp forest.
- Topography varies between 0 and 385 m above mean sea level.
- The topography evaluated to be gradually descending from south-east to north-west.

Hydrology Map



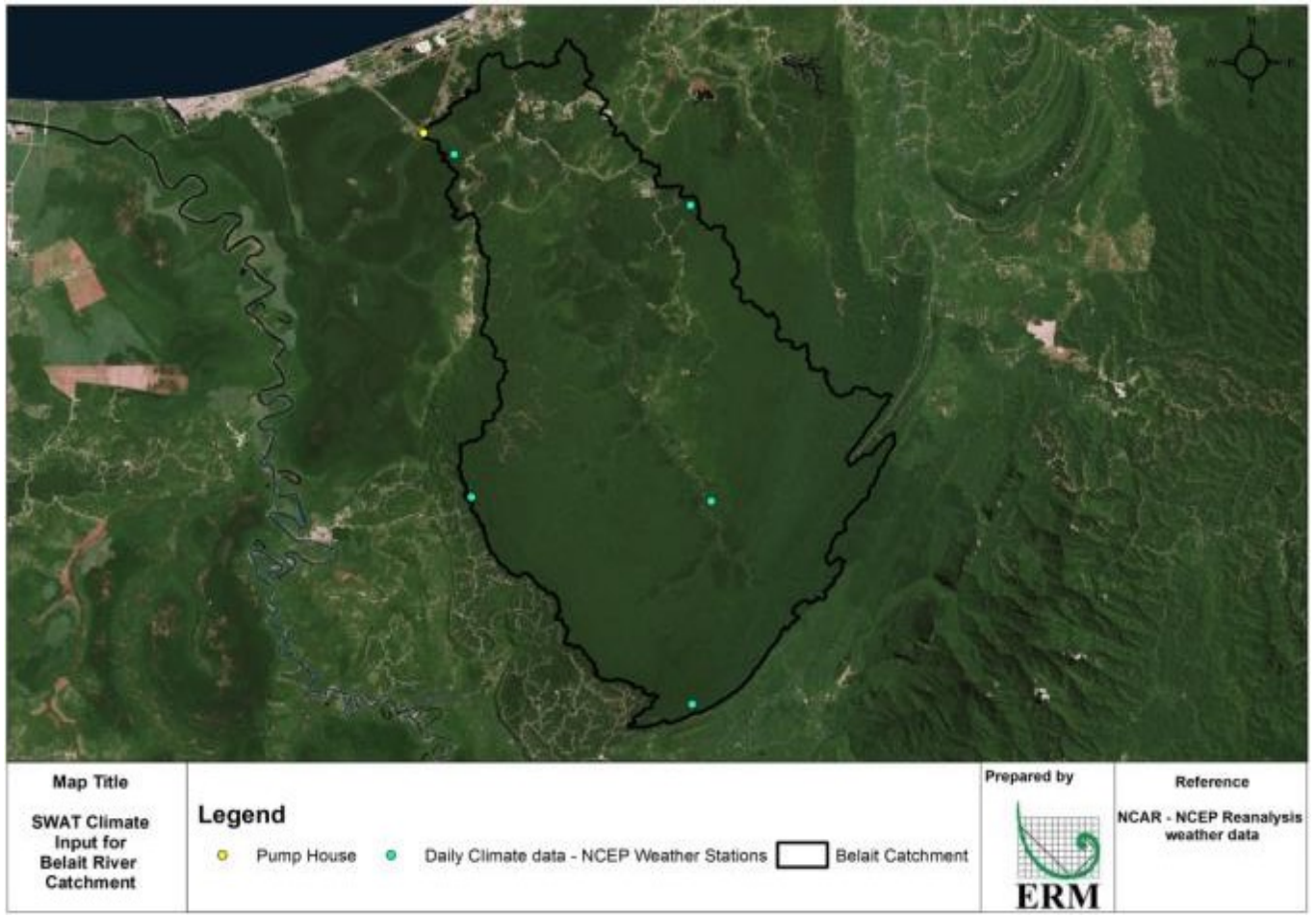
Model Selection

- Measured water levels by Public Works Department was not made available.
- SWAT was setup using publicly available global data sources.
- Simulation period : 1 Jan 1995- 31 July 2014

Data Type	Data Source	Type
Climate Station	Global Weather Data, National Centres for Environmental Prediction Climate Forecast System Reanalysis (NCEP-CFSR)	~38 km spatial resolution
Topography Grid	United States Geological Survey (USGS) Shuttle Radar Topography Mission (SRTM) DEM	30 m resolution
Soil Grid	Food and Agricultural Organisation (FAO) of the United States	1:5,000,000 scale
Land Cover Grid	FAO	1:5,000,000 scale

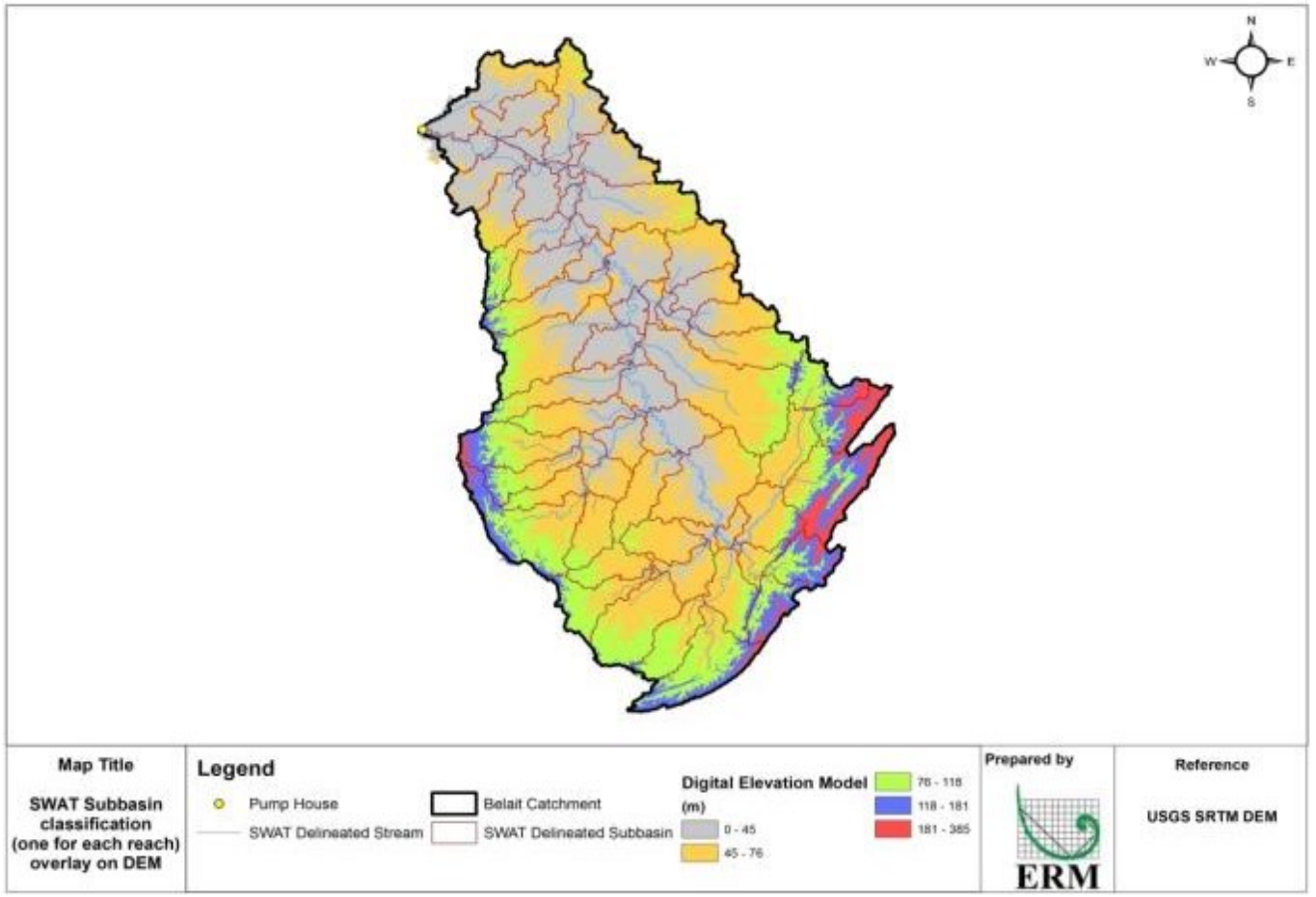
Geospatial Data

Climate:



Geospatial Data

Topography:



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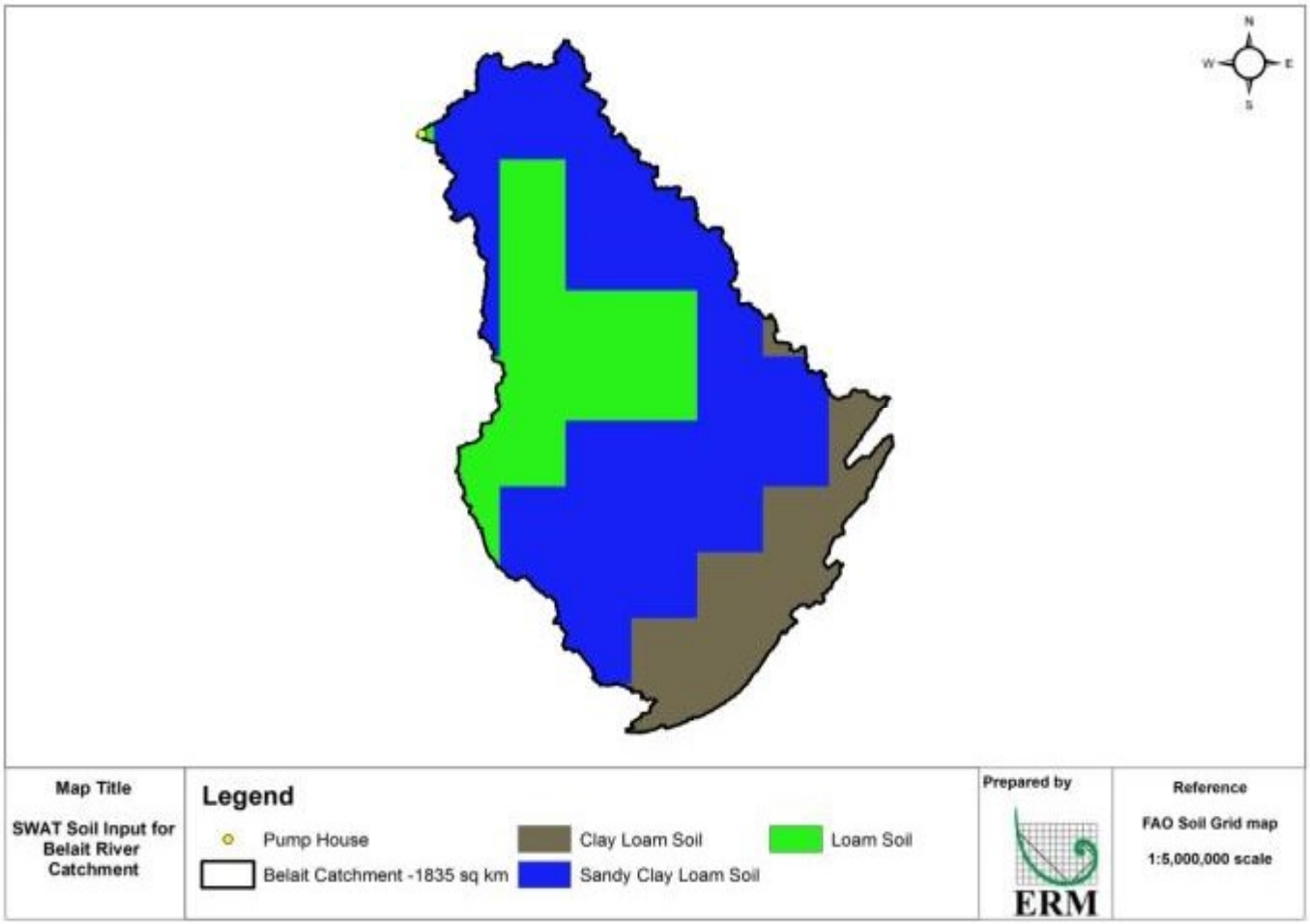
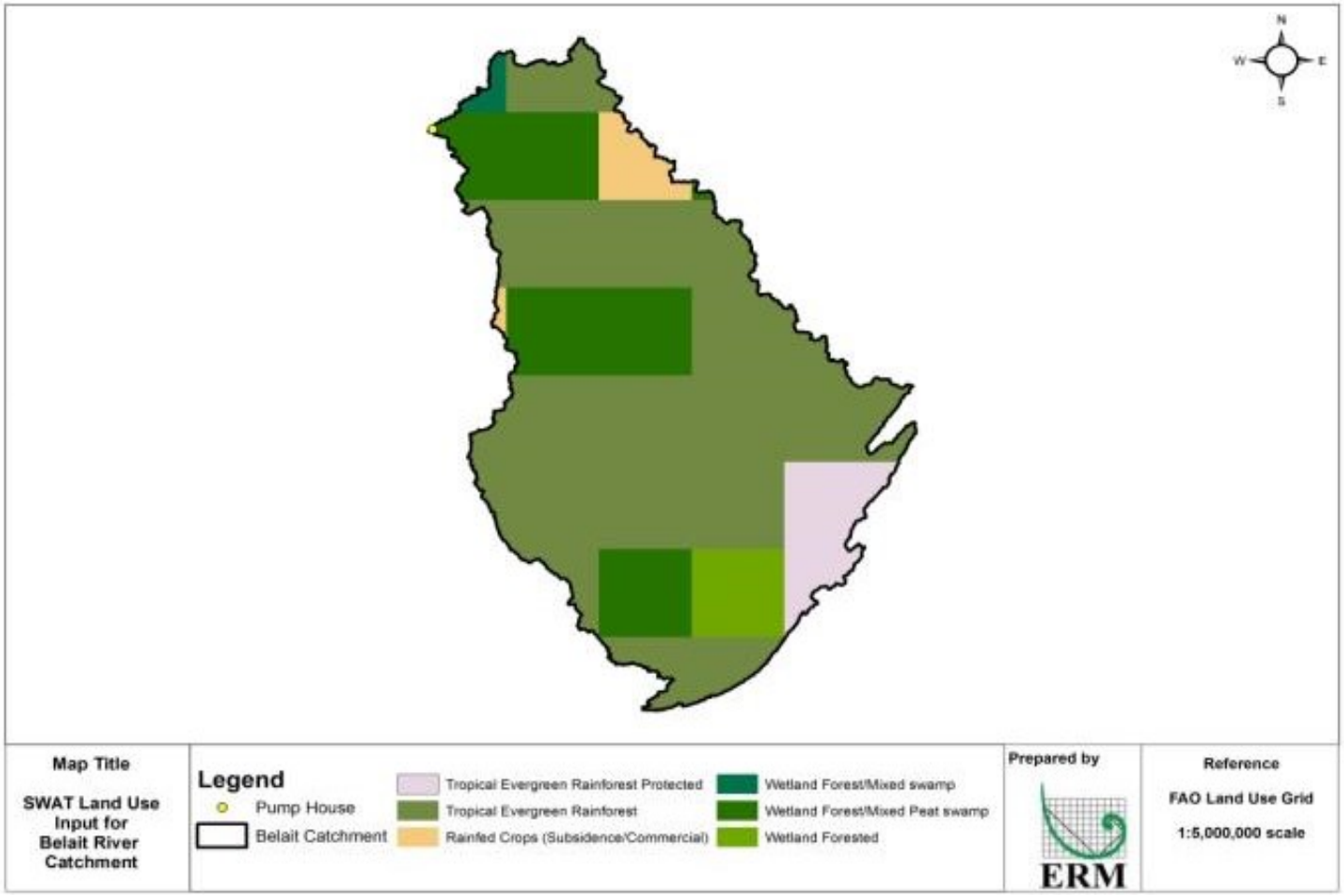
Geospatial Data

Soil:

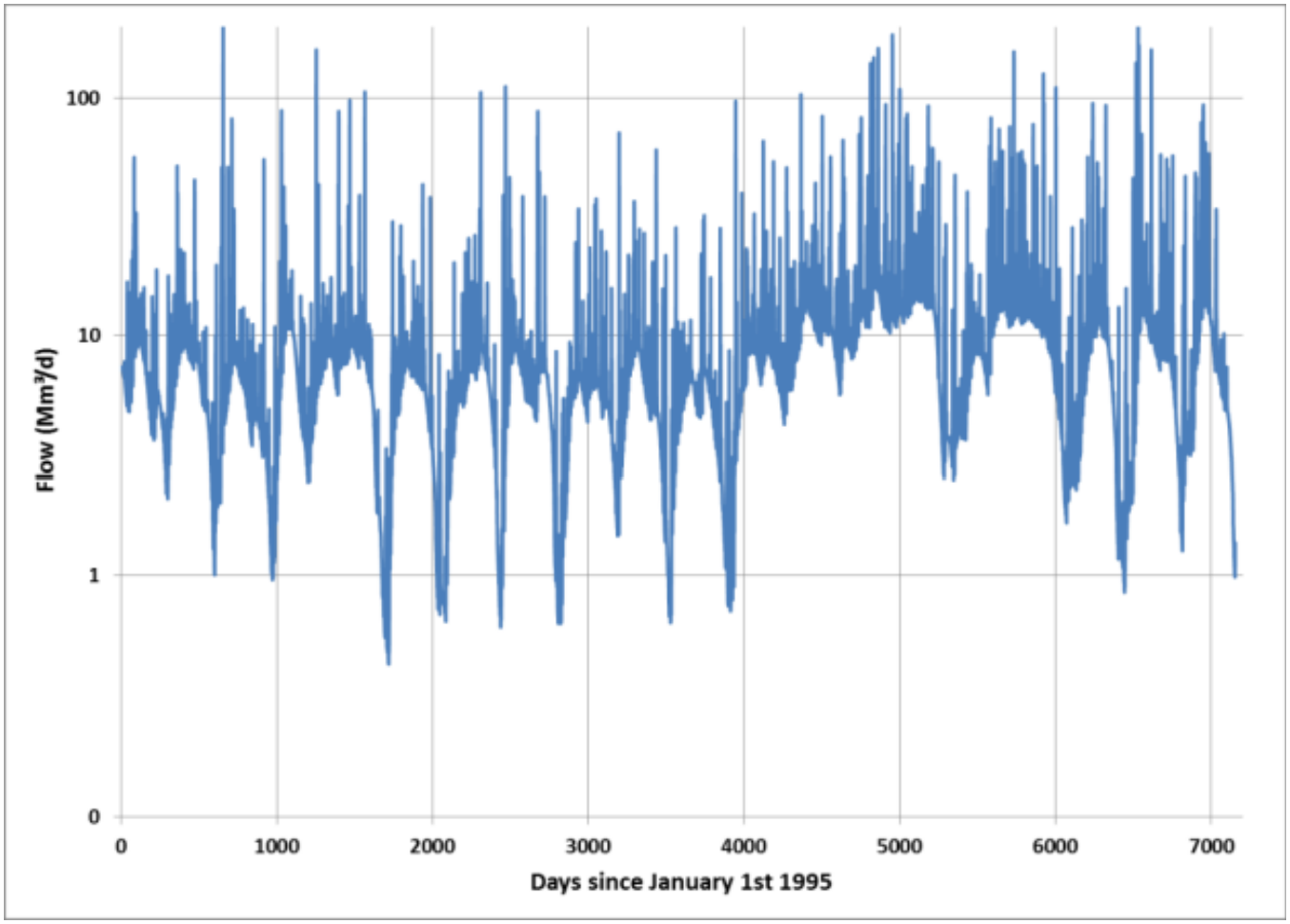


Geospatial Data

Land Cover:

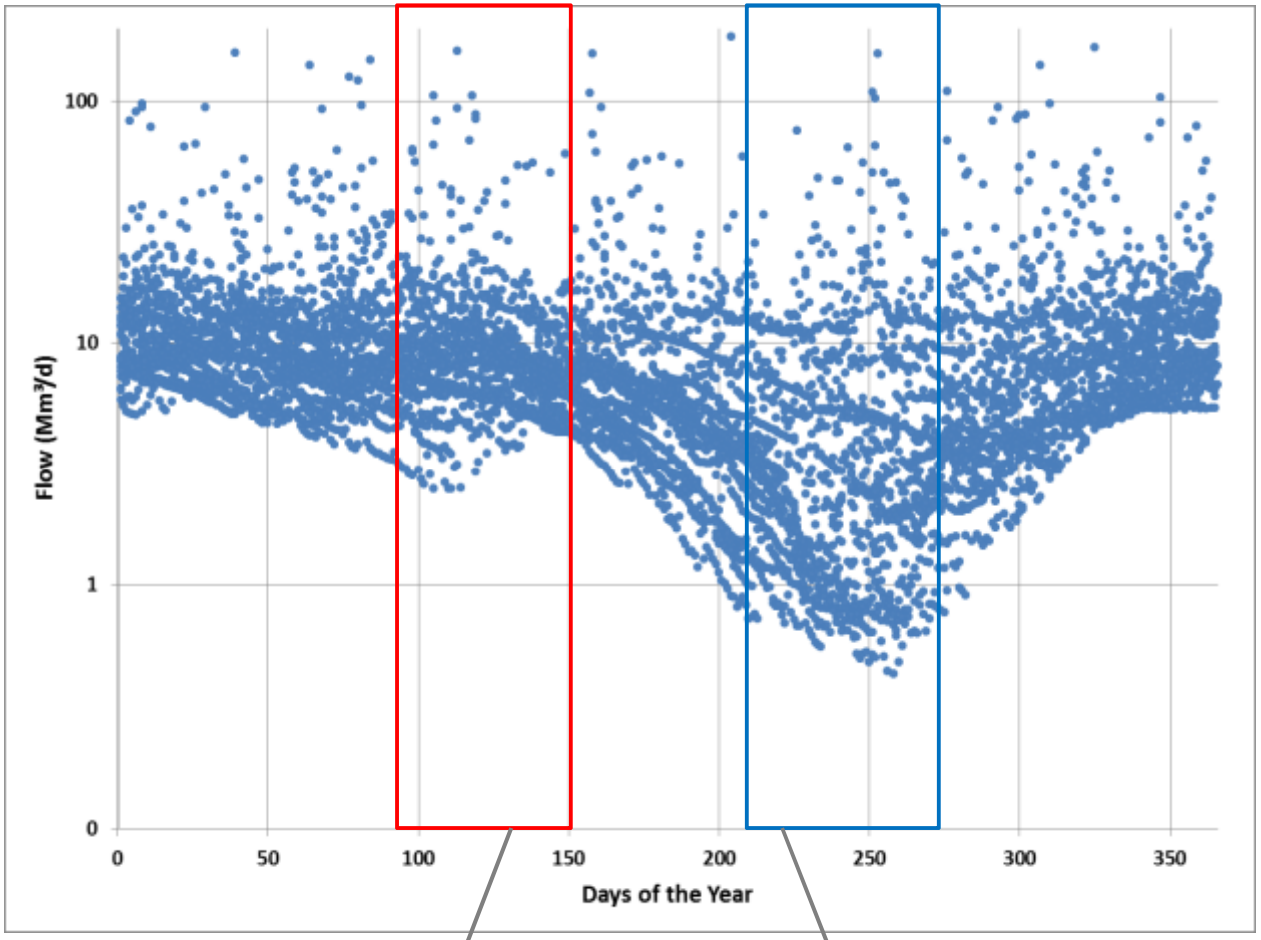


Model Output



Daily Flow: average-107 m^3/s (9.25 Mm^3/day), minimum-5 m^3/s (0.43 Mm^3/day), maximum – 3,600 m^3/s (311 Mm^3/day)

Seasonal Variation in Daily flow



March-April
Monsoon

July-August
Dry

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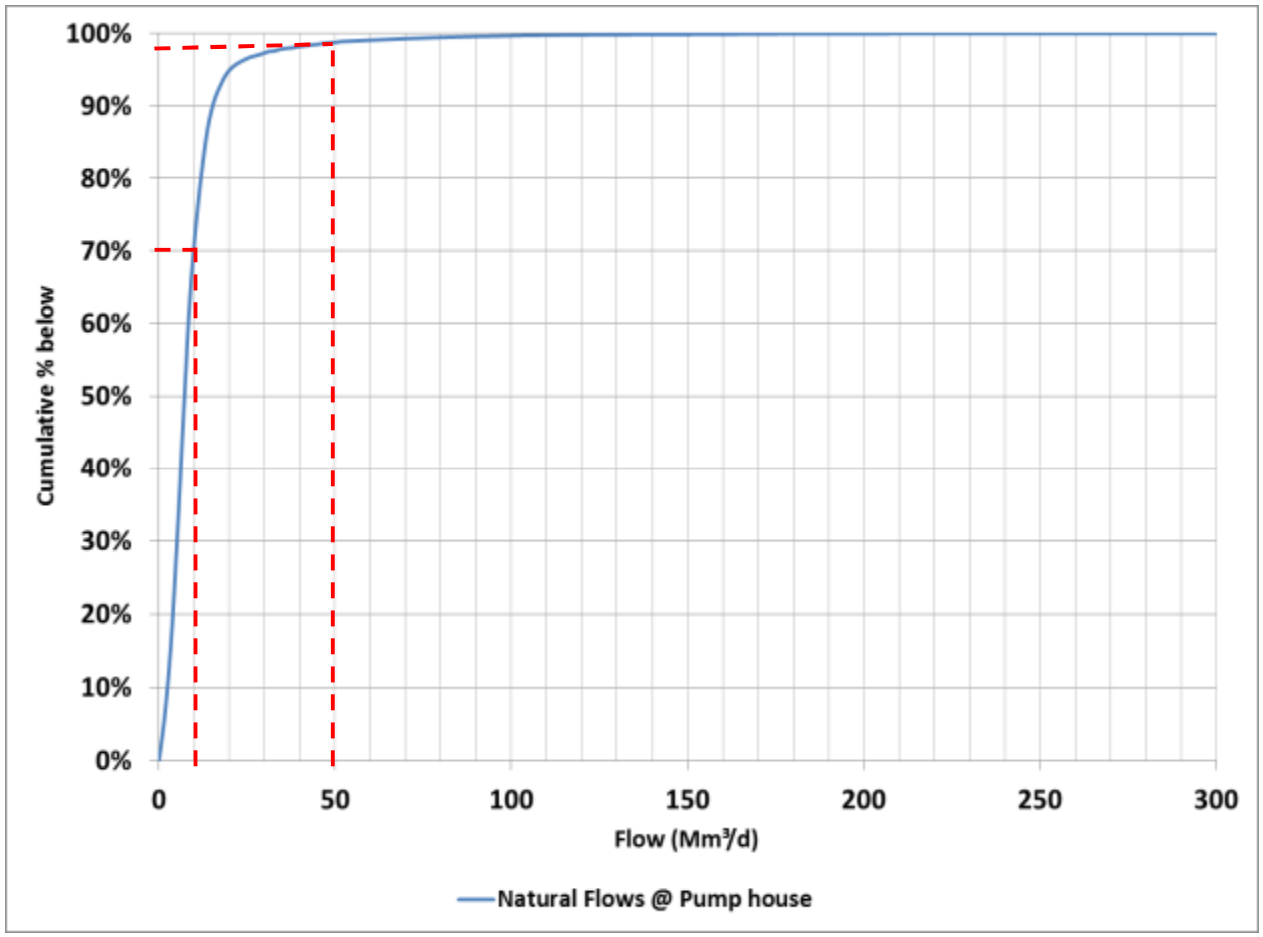
Cumulative Frequency Distribution



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Low Flow Analysis

- The low flow statistics are some of the most commonly used environmental flow measures for evaluation of extreme flow conditions in a river.
- The definition of 7Q10 is the lowest average discharge over a period of one (1) week with a recurrence interval of 10 years.

Flow Condition	Flow (m^3/s)	Flow (Mm^3/d)
7Q10	6.89	0.60
7Q20	5.49	0.47
7Q30	4.92	0.43

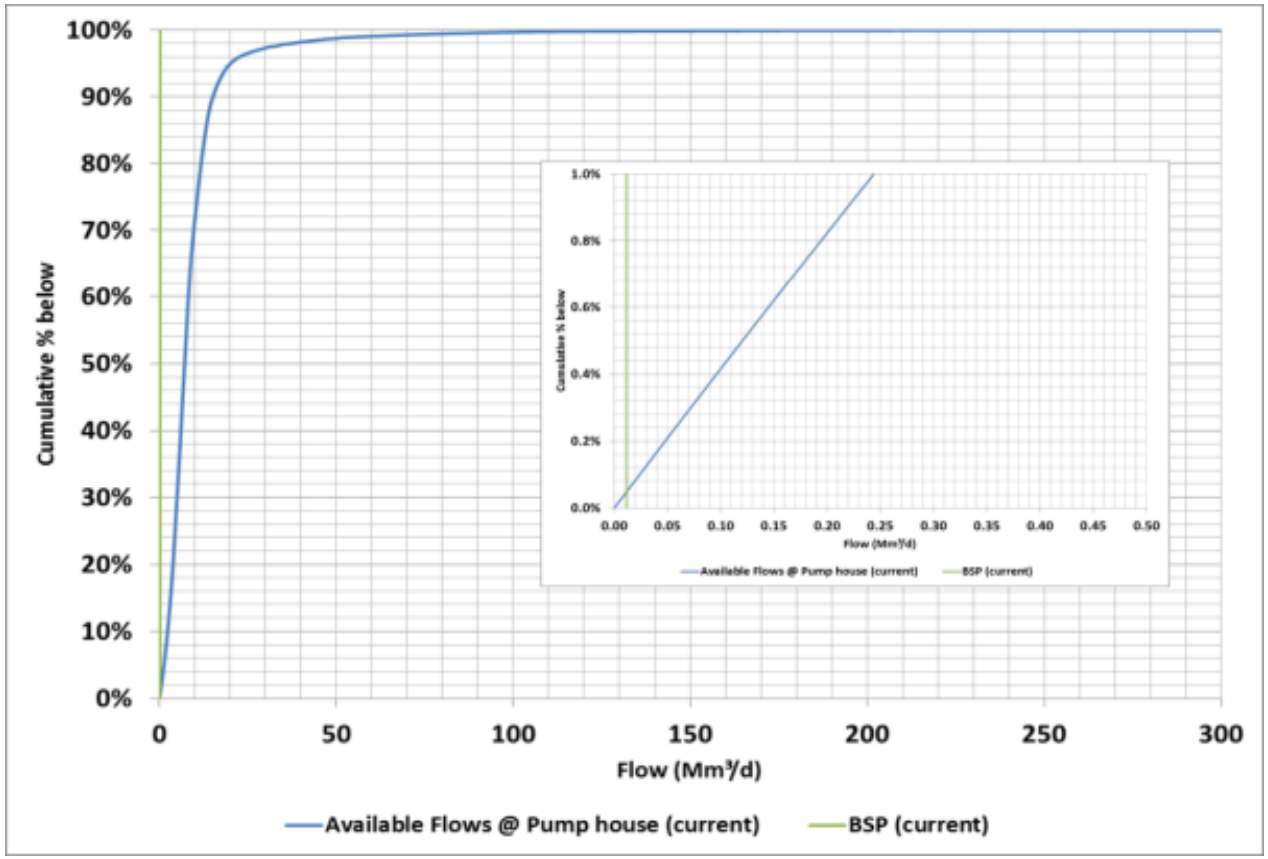
High Level Issues Identification

- ERM has developed an analysis that evaluates:
  - long-term availability of natural flows in the river;
  - inventories the competing water demands in the region; and
  - assesses the availability of natural flows under extreme flow conditions.
- The analysis is presented in two (2) sections:
  - Water availability
  - Downstream effects

Operator	Current Withdrawal (m^3/d)	Future Expansion (m^3/d)
JKR (Government)	86,000	122,000
Brunei Methanol Company (BMC) at SPARK	12,000	12,000
Brunei LNG (BLNG)	60,000	60,000
Agriculture Development	-	55,000
Total	158,000	249,000

Water Availability - Current Operations

- River flows are less than the BSP needs only less than 0.05% of the time (4.5 hours per year); 99.95% of the time, river flows are higher than current BSP needs.



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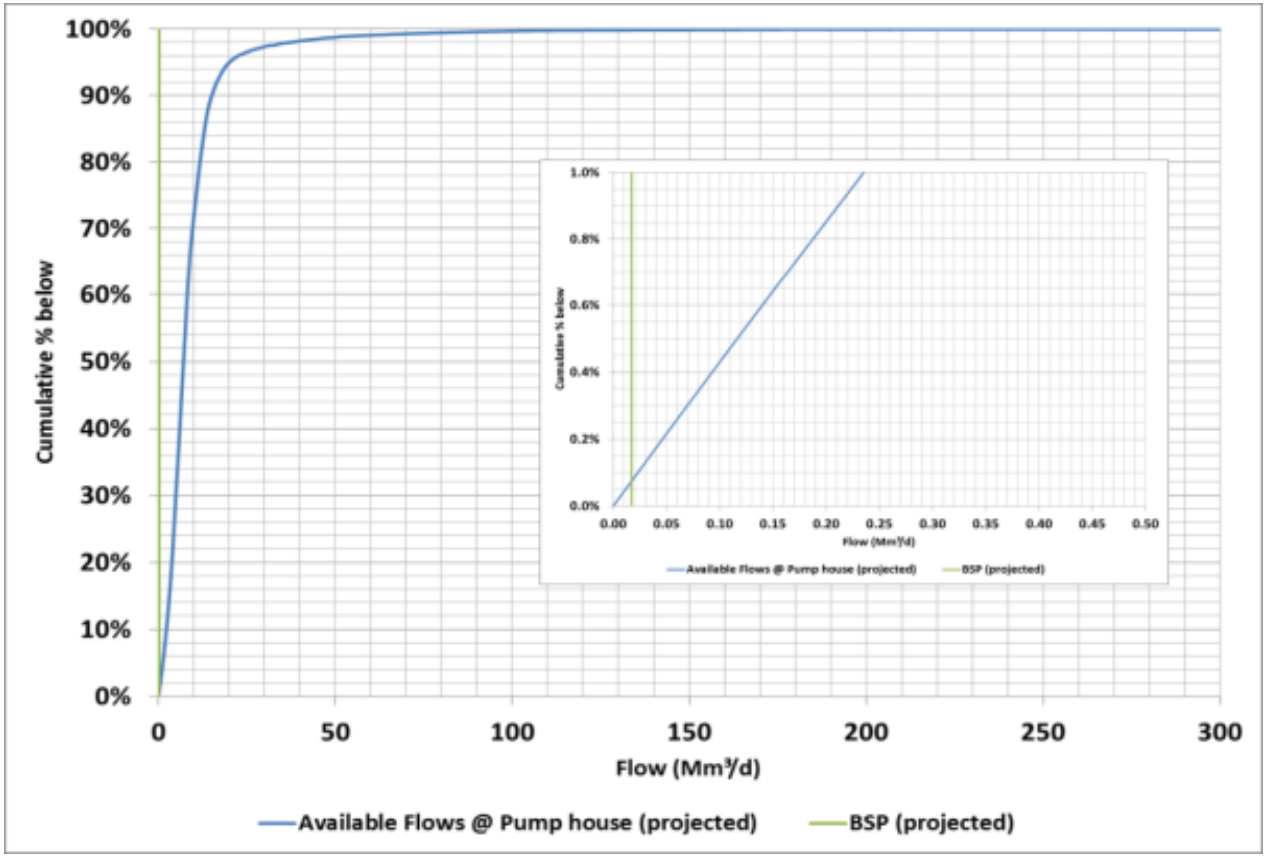
Water Availability - Future Operations

- River flows are less than the BSP's projected needs only less than 0.08% (7 hours per year) of the time; 99.92% of the time, river flows are higher than projected BSP needs.



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Downstream Effects – Assimilative Capacity

- The change in assimilative capacity indicates how concentrations of any pollutant, if introduced into Belait River, will increase due to the increased demand from BSP.

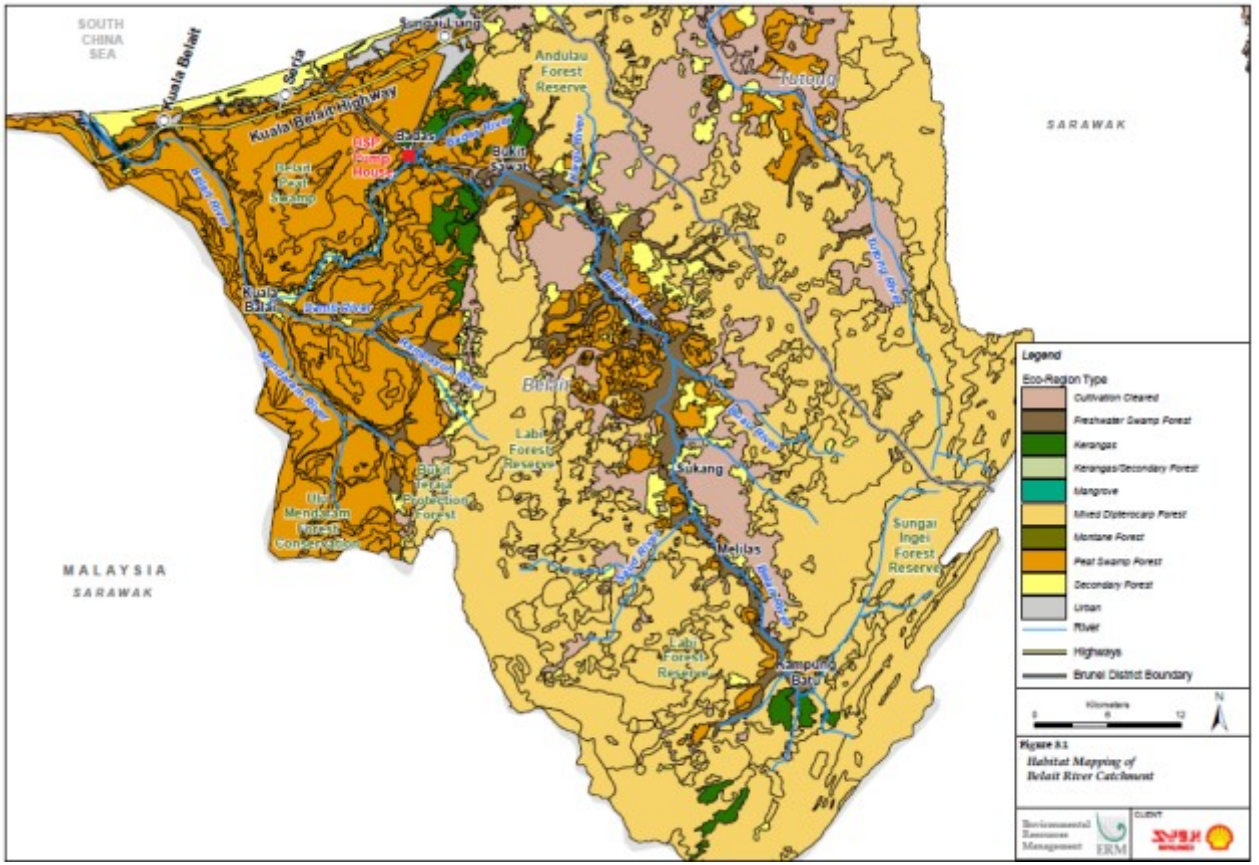
- Minimal loss in assimilative capacity will occur if BSP increases its abstraction, even in the future when the competing demands are higher.

Changes in Assimilation Capacity

Competing Demand (m^3/s)	Flow Condition	River Flow (Mm^3/d)	Reduction in Assimilative Capacity (%)
Current (158,000 m^3/day)	7Q10	0.60	1.2%
	7Q20	0.47	1.6%
	7Q30	0.43	2.0%
Projected (249,000 m^3/day)	7Q10	0.60	1.5%
	7Q20	0.47	2.3%
	7Q30	0.43	3.1%

Downstream effects – Loss of habitat

- The increase in withdrawal (5,000 m^3/d) is relatively small compared to typical river flows (50% flow is approximately 7 Mm^3/d).
- Expected changes in water elevation are within the range of typical river elevations suggesting that no appreciable loss in habitat will occur.



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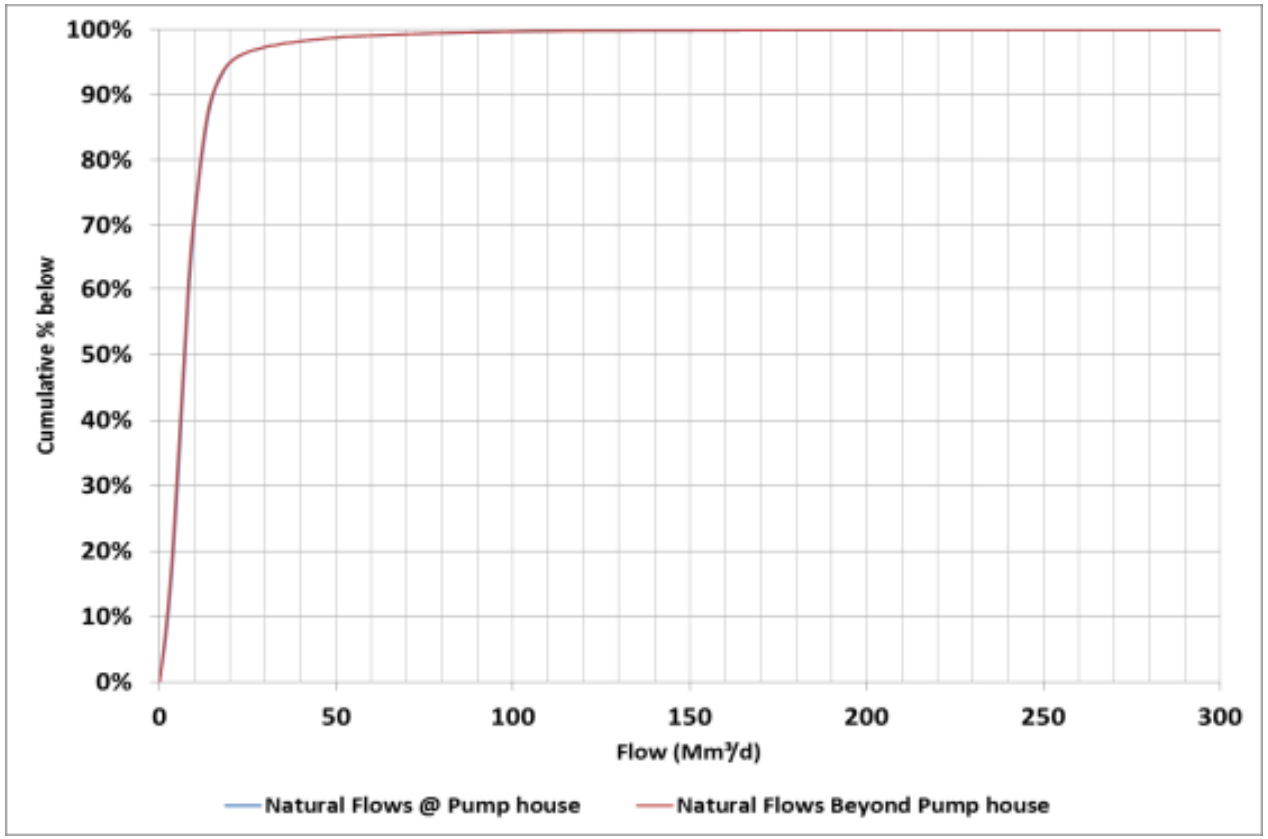
Downstream effects – D/s water availability

- Very small change in flow frequency suggesting minimal changes in water availability d/s.



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Conclusions

- BSP will mostly likely face minimal water availability challenges. However, withdrawal from Belait River are not regulated, and are subject to a large amount of uncertainty from future facility upgrades that may not be validated against overall water availability.

- The estimates of d/s effects consisted of evaluating changes in river's assimilative capacity, ecological risks and loss of habitat.

- Assimilative capacity of the river will experience minimal decrease with the maximum decrease of 3.1% only under the 7Q30 flow condition.

- Data needed to assess increase in d/s ecological risks, habitat loss and changes in water availability were not present. However, the level of increase in withdrawal are minimal and suggest minimal concerns.

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