

Queensland's Pumped Storage Sites



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Overview of Presentation

- Queensland's needs for pumped storage
- North Queensland pumped storage sites
 - Tully River 1,000MW
 - Burdekin Falls 1,000MW
- South Queensland pumped storage sites
 - Mount Byron 2,000MW
 - Borumba 1,000MW
- way forward

Hydro & pumped storage: “dancing partner” for wind and solar?

- **Reliable and Secure**

- ✓ *Stable*: high synchronous inertia and fast frequency response
- ✓ *Flexible*: dispatch and load following capability
- ✓ *Back-up Storage*: large scale for excess solar

- **Affordable**

- ✓ *Cheap*: 1/10th the cost of battery storage (in \$/MWh)
- ✓ *Long Lasting*: 10 x the life of batteries
- ✓ *Low Cost*: lowest cost delivery of new ancillary services

- **Clean – Low CO₂**

- ✓ *But not zero impact*

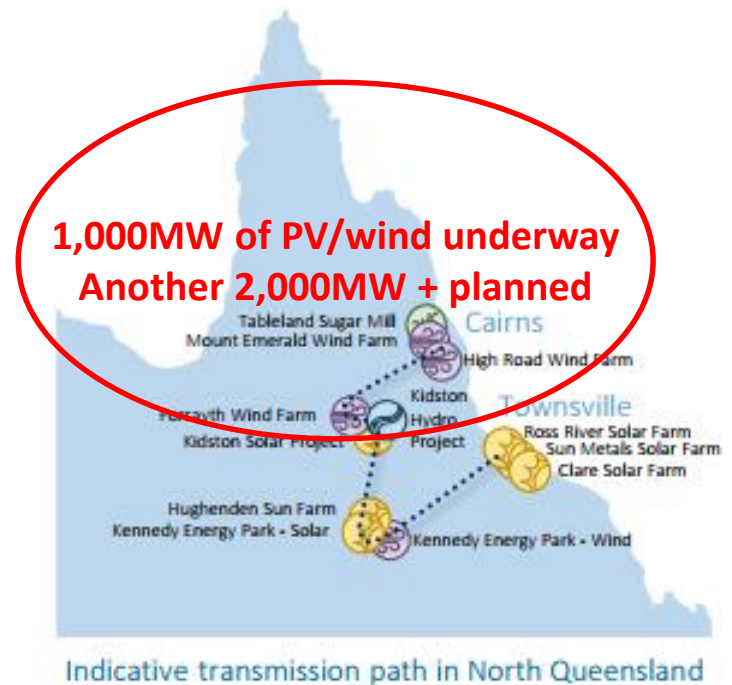
Energy Storage Needs

- Queensland will need lots of energy storage in a 50% renewables scenario to
 - avoid spilling excess solar PV and windpower energy (especially NQ)
 - cover longer duration lulls in wind or solar activity
- Hydro pumped storage – low-cost, large storage, long life, synchronous generation and inertia, flexible, proven
- Queensland's energy storage needs
 - ~ 2,000MW storage capacity
 - with 10 to 20 hours energy storage
 - located in NQ and SEQ regions

Qld Govt NQ Energy Plan

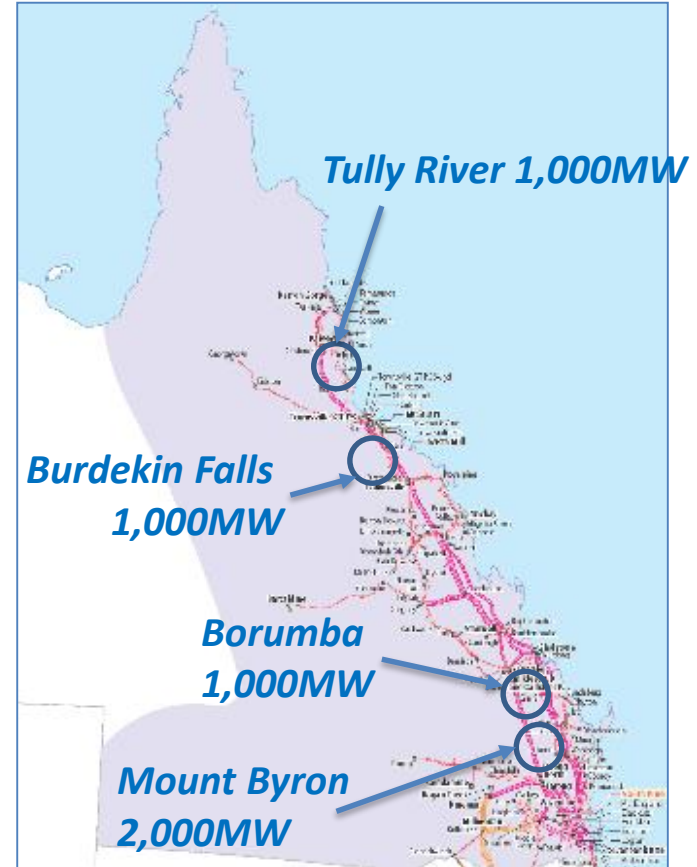
- NQ peak load only 1,100MW
- already ~200MW of hydro & 600MW gas/oil
- >1,000MW of NQ renewables underway
- NQ self sufficient when renewables run
- NQ hub to attract another 2,000MW?
- NQ-CQ-SQ transmission grid long and weak
- CQ has 4,600MW coal fired generation

need ~1,000MW of pumped storage in NQ

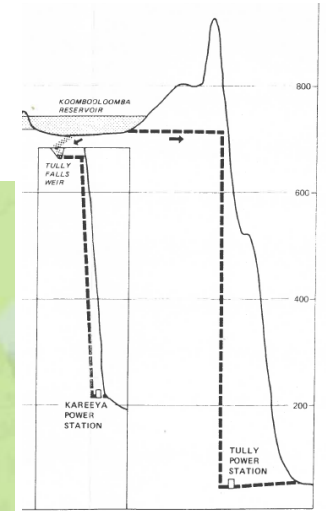
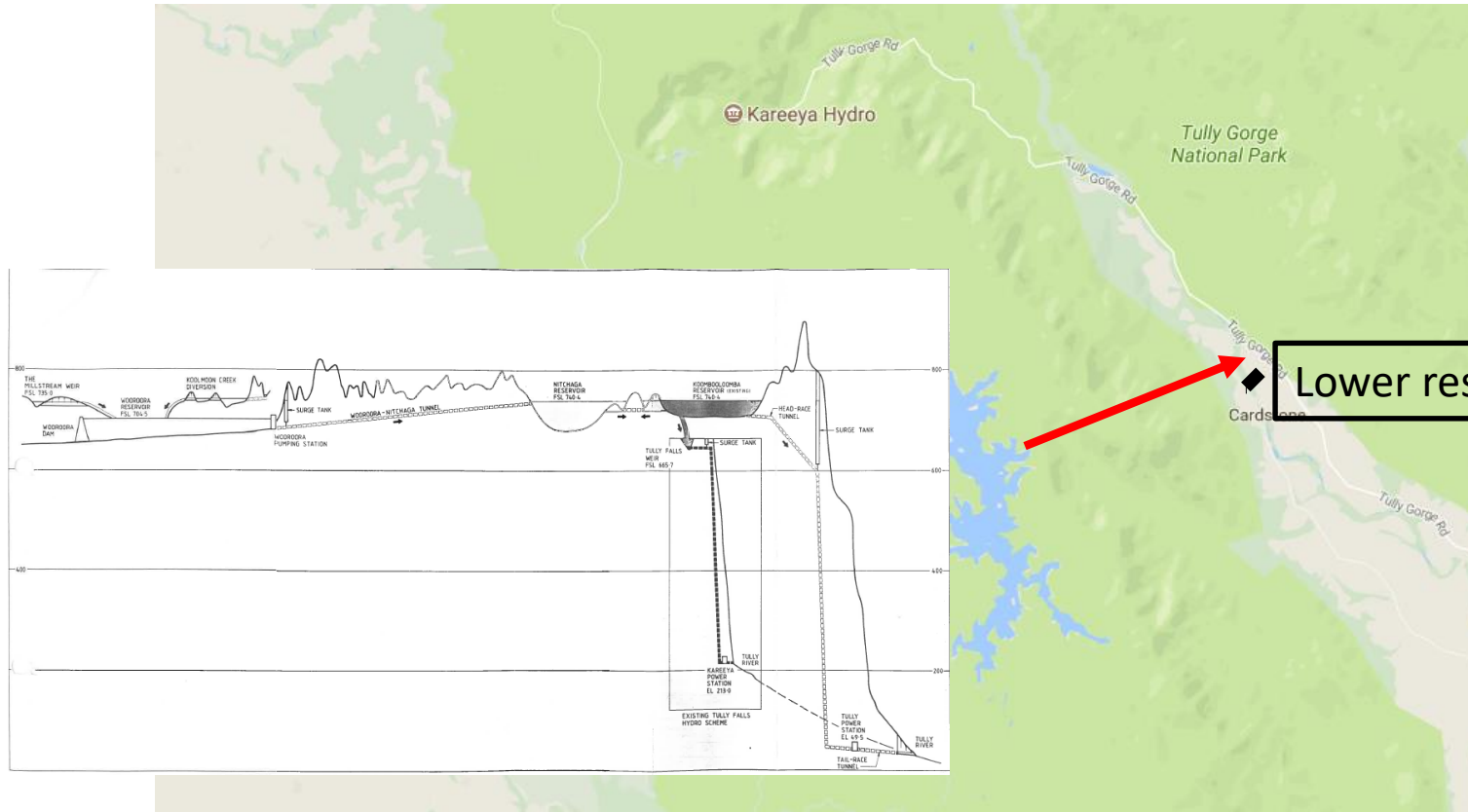


Where are Queensland's pumped storage sites?

- ✓ *Rigorous screening*: by SECQ 1980's
- ✓ *Large capacity*: energy storage
- ✓ *Low cost, high response*: high hydraulic head
- ✓ *Reserved sites*: for future development
- ✓ *Low Impact*: (not zero)
- ✓ *Existing dams*: or off-stream reservoirs
- ✓ *Infrastructure*: close by



Tully Millstream pumped storage scheme

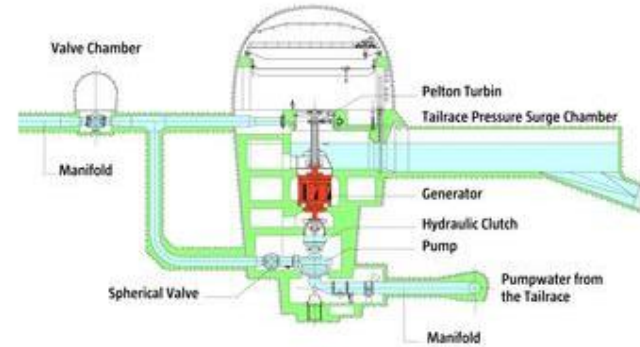
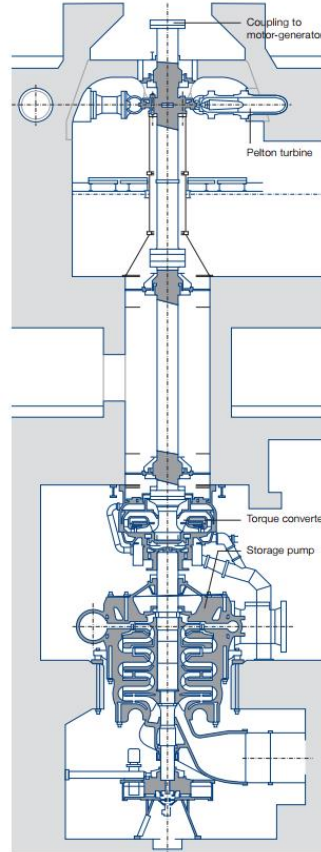


Lower reservoir

Designed for flexibility and rapid response



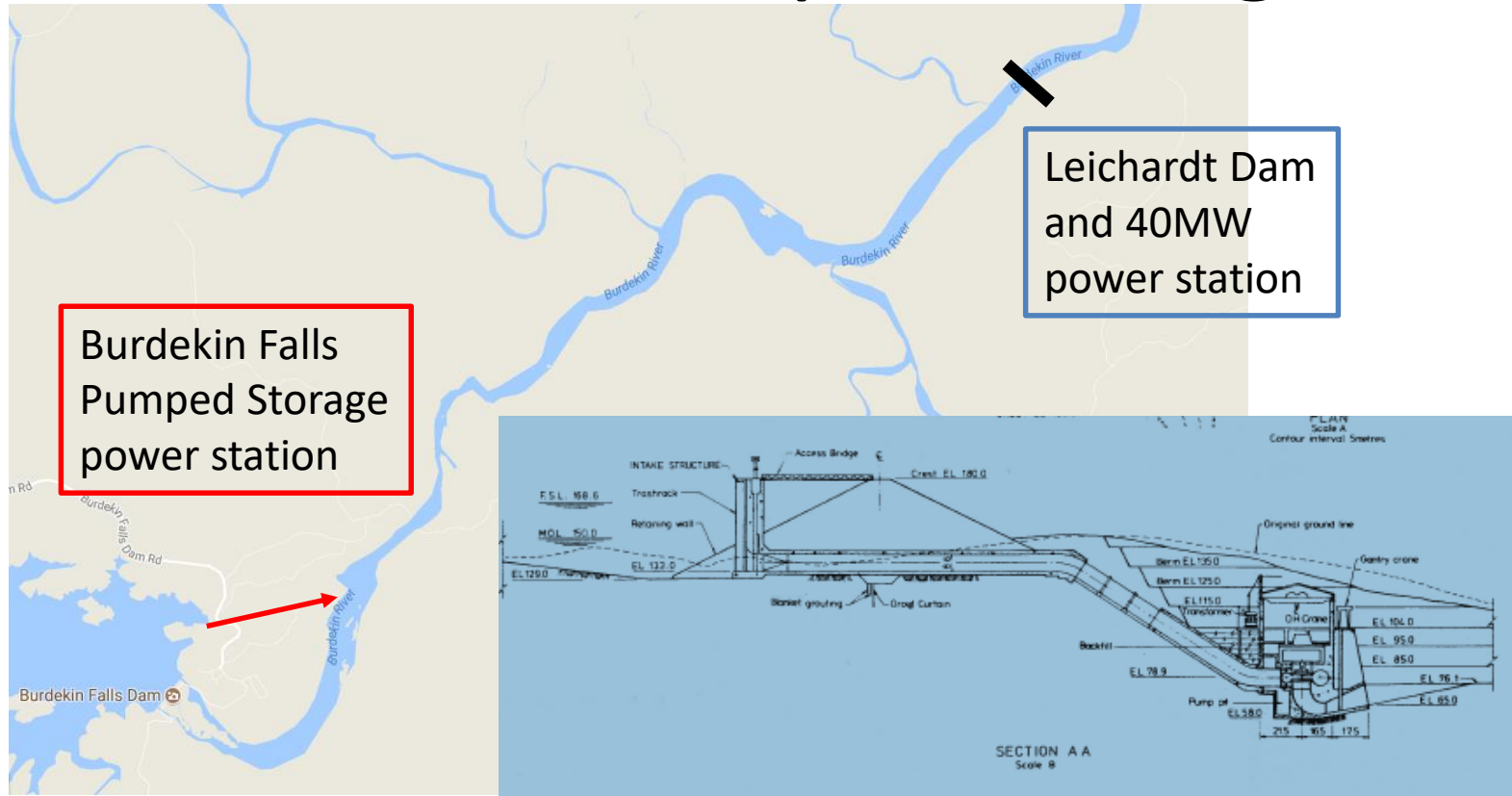
Course of the pressure water tunnel at the Kops II pumped storage power station (Fig.: Vorarlberger Illwerke)

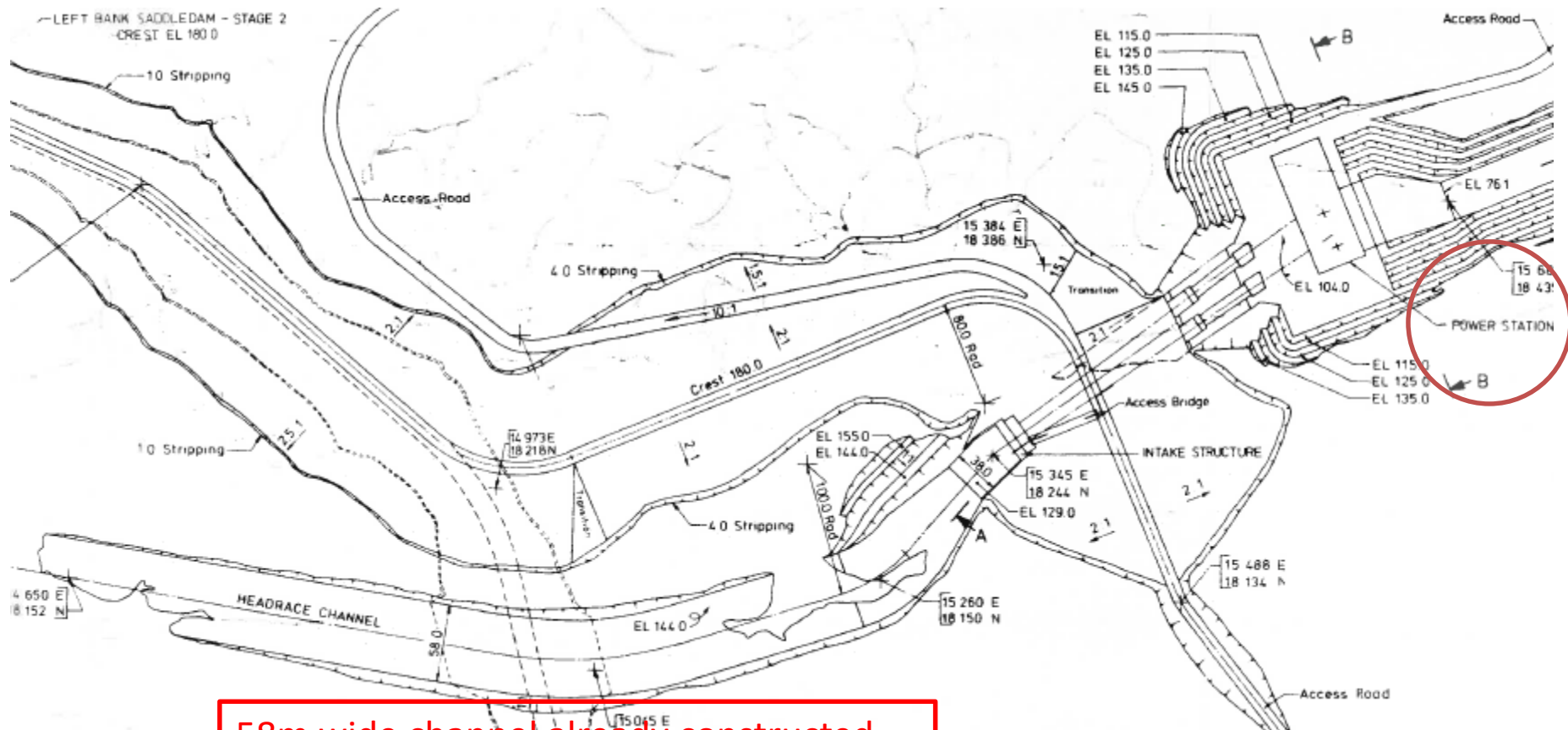


Tully River Options and Costs

Option	Capacity (MW)	Energy (Gwh pa)	\$million
Tully Millstream (T-M)	600MW hydro	1,000 Gwh pa	\$1,000m
Tully Cardwell	600MW p/s	600 Gwh pa	\$850m
Tully Cardwell	1,000MW p/s	625 Gwh pa	\$1,100m
Tully Millstream	1,000MW p/s	1,050 Gwh pa	\$1,300m

Burdekin Falls Pumped Storage



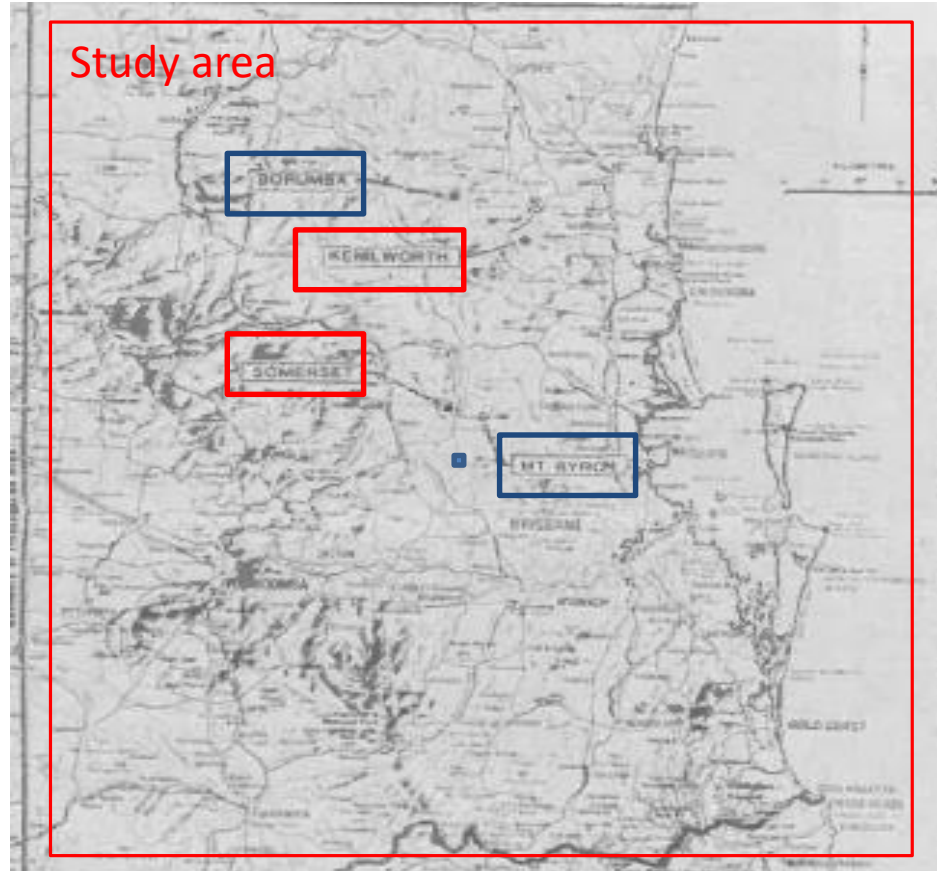


58m wide channel already constructed
for 1,500MW power station

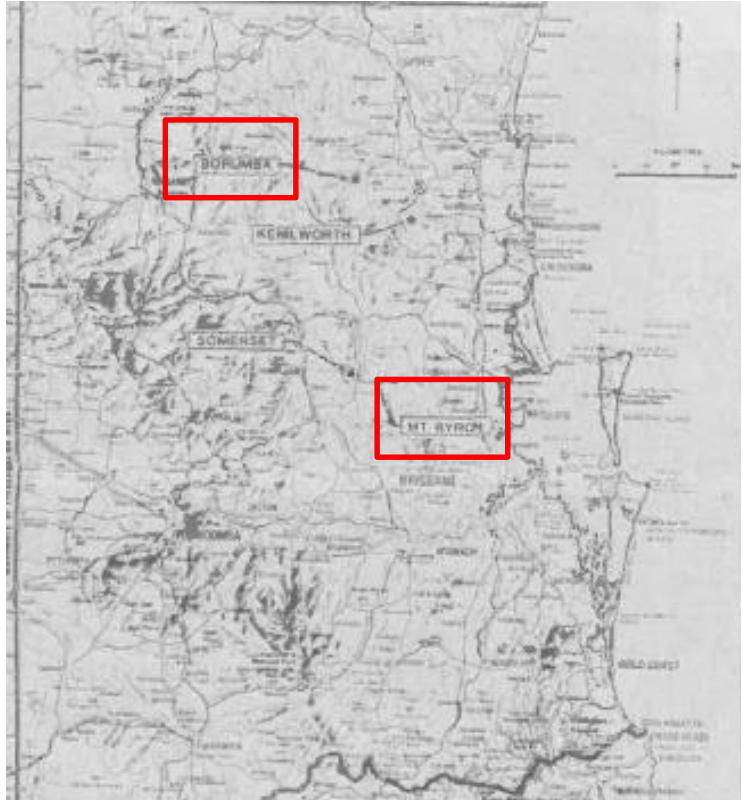
Burdekin Falls Options and Costs

Option	Capacity (MW)	Energy (Gwh pa)	\$million
Burdekin Falls hydro	500MW hydro	830 Gwh pa	\$800m
Burdekin Falls p/s	500MW p/s	1,200 Gwh pa	\$1,100m
Burdekin Falls p/s	1,000MW p/s	1,200 Gwh pa	\$1,400m
Burdekin Falls p/s	1,500MW p/s	1,200 Gwh pa	\$1,700m

South east Queensland pumped storage investigation 1983-85



South-east Qld Pumped Storage Investigation



Those studies concluded that only four sites had sufficient potential to justify more detailed investigations. Those sites (shown in Figure 1) were:

- Mt Byron - east of Somerset Dam
- Somerset - Somerset Dam
- Borumba - Borumba Dam
- Kenilworth - south west of Kenilworth

As a result of the programme of investigations, the number of sites which it is considered necessary to reserve at this time is two. These are Mt Byron and Borumba.

These two sites are preferred because of:

- More suitable geology
- Adequate water supply is available for the schemes to be self sufficient in water
- Minimal regional environmental impacts
- Lower overall costs of development compared to other schemes
- Large energy storage potential

Sites reserved	Capacity	Energy
Borumba	1,000 MW	30,000 GWh
Mount Byron	2,000 MW	50,000 GWh

Way Forward

best pumped storage sites in Qld and possibly Australia

- Tully-Millstream hydro/pumped ~1,000MW
 - Burdekin Falls hydro/pumped storage up to 1,500MW
 - Borumba pumped storage up to 1,000MW and 30 Gwh
 - Mount Byron pumped storage up to 2,000MW and 50 Gwh
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- Qld Govt acquired the land for Tully-Millstream, Borumba and Mount Byron sites 30 years ago and has built Burdekin Dam
 - Time is approaching when ~ 1,000MW of large scale storage will be needed in each of north Queensland and south east Queensland with energy storage of 10 – 20 hours