A journey through the earth history of
Australia's Coastal Wilderness

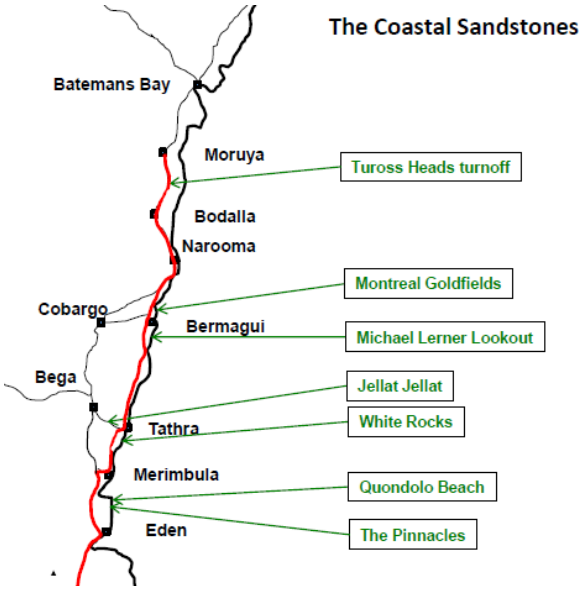
Part 9 The red and white coastal sandstones and the tale of a 'stolen' river

The Pinnacles – Ben Boyd National Park

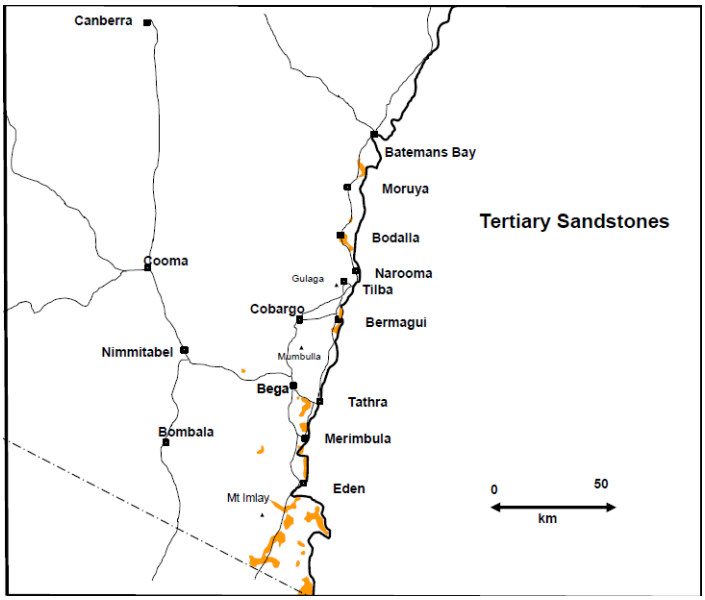
Long Beach Sandstones, Tura Beach

Bega River Mouth, Tathra

9. The red and white coastal sandstones and the tale of a stolen river



The coastal journey will reveal sandstones that are a lot younger than the Ordovician, Devonian and Cretaceous rocks. Pause at the Tuross Heads turnoff on the Princes Highway south of Moruya where that first full view of Gulaga can be seen. At this site there is a basalt flow sandwiched between two outcrops of sandstone. Minerals in the basalt have been dated at approximately 31 million years, the middle Tertiary period.

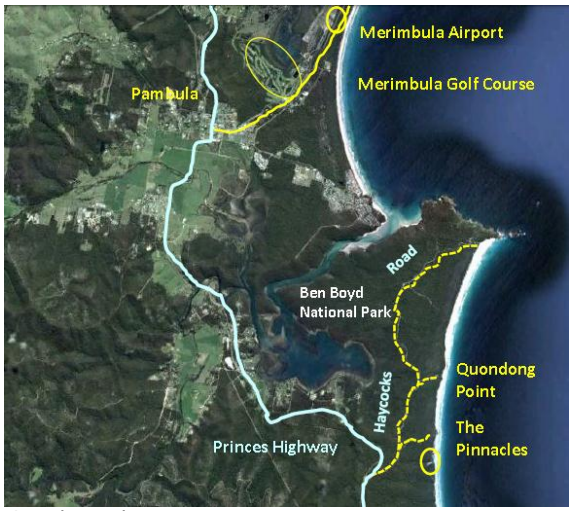


Good exposures of the sandstone can be seen from the Michael Lerner Lookout 3km south of Bermagui, forming the cliffs to the south of the town.

The textbook image of the Tertiary Sandstones is at the Pinnacles in the northern section of Ben Boyd National Park. The red iron rich sandstones are from the Long Beach Formation.

The Pinnacles, Ben Boyd National Park

The other formation of older silica rich sandstones can be seen at nearby Quondolo Beach.

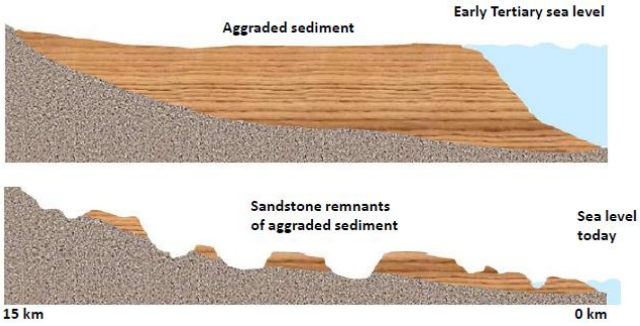


Google Earth

Both of the coastal sandstone formations are considered to be aggraded deposits. *Aggradation* is the term used in geology (Wikipedia) for the increase in land elevation due to the deposition of sediment. Aggradation occurs in areas in which the supply of sediment is greater than the amount of material that the river system is able to transport away. This clearly reflected a time of very high erosion due to the high rainfall conditions, high sea level, and the creation of the escarpment during the formation of the Tasman Sea.

A typical aggraded landscape – debris filled valley

Typical aggradational environments include lowland alluvial rivers, river deltas and alluvial fans. Aggradational environments often undergo slow subsidence under the weight of the accumulating sediment which balances the increase in land surface elevation due to this aggradation.

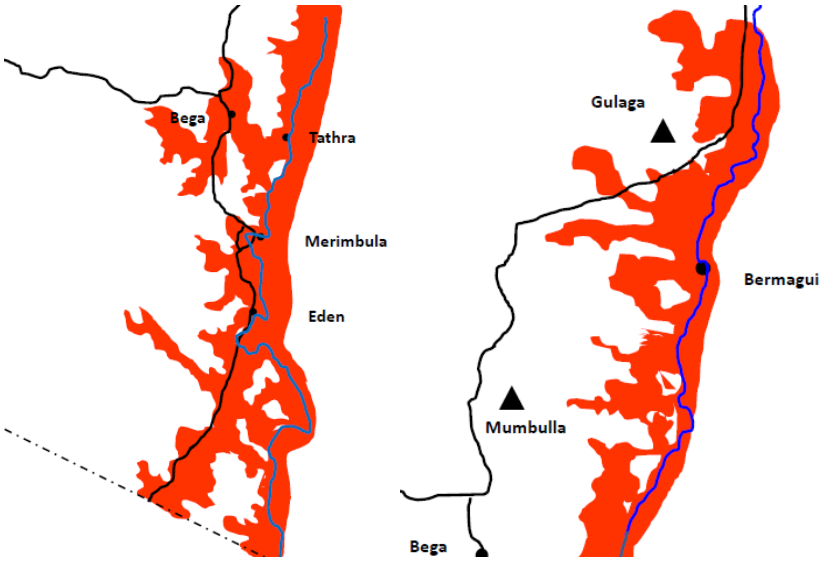


The timing of the deposition of these two sandstone formations is thought to be quite different. There are uncertainties about the age of the Quondolo Formation but studies suggest it is Paleocene to Early Eocene, about 55–50 million years ago (Mya).

Deposition of the Long Beach Formation is thought to have occurred during the Oligocene to Early Miocene (23-30 Mya). This is in accord with the 31 million year date for the Coila Basalt, a volcanic flow that is sandwiched between two similar sandstone formations in the Tuross Head part of the region.

Aggradation of the south coast mid-Tertiary sandstones is thought to be attributed to an increase in sea level rise during the Oligocene to Early Miocene rise resulting in the development of coastal barriers of transported sediment at higher levels than today.

The outcrops seen today are a remnant of the original extent of the sandstones. The diagram below matches up the contours of current outcrops and remnants that could conservatively indicate the extent of the aggraded sediments which, in the forming basins, consolidated into sandstone.



The original extent of these sandstones is indicated in red in the images above. When they were laid down in the early to mid-Tertiary, the landscape was covered by rainforest and might have looked like the debris filled valley in the photograph above.

Studies have identified four phases of weathering during the Tertiary recognized in these deposits. Firstly, there is deep kaolinization (formation of soft white clay under high rainfall, well preserved in the deeply weathered volcanics (rhyolite) at White Rock south of Tathra. This can be seen on the Kangarutha Walking Trail which extends from near Wallagoot Lake entrance north to Tathra.

White Rock, Bournda National Park

The second phase of weathering was silicification (formation of silica deposits), exemplified in the Quondolo Formation.

Whilst the connection is speculative, it is interesting to note that the local deposition and silicification coincided with a major worldwide increase in silica accumulation (following extensive global volcanism), known as the *Silica Burp*, and a significant global warming event (the Paleocene-Eocene Thermal Maximum at about 55 Mya). It is also noted that the region was then in the 60º latitudes but it was warm and humid, with a mean annual temperature of 16-22ºC and precipitation over 1.5 metres per year. The vegetation comprised richly mixed rainforests, with plant groups related to those that exist today in the wet tropics rainforests of north Queensland.

The traveler's most common reminders of the region's Gondwanan heritage is the presence today of the same tree ferns.

Tree Fern – *Dicksonia antarctica*

Rough Tree Fern – *Cyathea australis*

With a touch of botanical irony, the Norfolk Island pines that form an almost compulsory addition to Australian beach resorts are ancient Gondwanans. Their Araucarian relatives would have graced the region's landscapes in the Cretaceous and early Tertiary periods.

Norfolk Island Pines, Bermagui

Silicification was followed by two weathering phases of ferruginization, as recorded in the Long Beach Formation. Ferruginization is a complex chemical reaction in a weathering soil profile where iron silicates are altered to iron oxide (haematite) and quartz (silica). The process is usually indicative of a hot arid climate but it also can occur in climates that alternated between warm and humid and dry conditions. The latter is the likely mechanism for the formation of the south coast red Tertiary sandstones.

Ferruginized layer, the Pinnacles, Ben Boyd National Park

The boundary between the red and the white sandstones that lies within the Long Beach Formation marks the line of an ancient water table.

The existing outcrops are the eroded remnants of a far larger extent of the Long Beach formation.

Australia was a very different place when the Quondolo Formation was deposited, similar to the temperate rainforests of Tasmania today:

Tasmanian rainforest

Around 41 Mya the continent had finally separated from Antarctica south of Tasmania and accelerated its northward drift. By 30 Mya our region had reached about 50º latitude. The separation of Antarctica had, for the first time, set up the

circumpolar current and ice sheets had started to form, lowering global sea level. Rainforests persisted in Antarctica until the late Oligocene. Central Australia was starting to dry out.

This region's climate was still warm and wet and covered by rainforest but flowering plants started to dominate the species mix, particularly *Nothofagus*, the southern beech. It is a classic Gondwanan remnant, with 13 species of *Nothofagus* found in New Guinea, 10 in Chile-Argentina, 5 in New Caledonia, 4 in New Zealand and 3 in Australia. Fossils of *Nothofagus* are found in Antarctica.

Nothofagus is found today in Tasmania, northern NSW and Queensland but not in this part of the state. Pollen is abundant in many mid-Tertiary sediments in our region, including the red sandstones and under the Monaro basalts. Beech wood has been found under a blockstream in Kosciuszko National Park.

As the drying of Australia continued with its drift northwards, the modern plants started to emerge, particularly the eucalypts and acacias.

The early relatives of many of familiar present-day animals had evolved including possums, kangaroos, koalas, bats, crocodiles, snakes, lizards, frogs, millipedes, beetles and many kinds of birds. Many less familiar animals also lived in Australia during the Miocene such as, marsupial lions, flesh-eating kangaroos, cleaver-headed crocodiles, thunder birds and horned turtles.

How Tathra stole the Bega River

The beautiful drive from Bega to the coast at Tathra down the Bega River Valley embodies an interesting mystery. The Bega River is present in its grandeur at Bega and immediately downstream from the town. By the time you come to Jellat Jellat the river has disappeared from view. Jellat Jellat was clearly once the river bed but all that remains are a few lakes and swamps. The pre-Miocene mouth of the Bega River was at what is now Wallagoot Lake.

Jellat Jellat, lower Bega Valley

Horse Shoe Lagoon, lower Bega Valley

Wallagoot Lake, Bournda National Park

During the period that the Long Beach formation was laid down, the heavy aggradation of sediment in the area now occupied by the Sapphire Coast Race Course, impeded river flow.

Sapphire Coast Race Course, Kalaru

The river would have backed up in times of flood including backing up into tributary streams. The climate was a lot wetter then. At some stage the backup overtopped

the source of one of the streams, causing the flow down that stream to the coast north of Tathra. Each repeat of this flood event would have cut down the new stream until it became the main channel. This process is called river 'capture'.

The captured river course can be seen in the incised gorge in mid-horizon of the photograph marked by the dashed line from the heights behind Tathra.

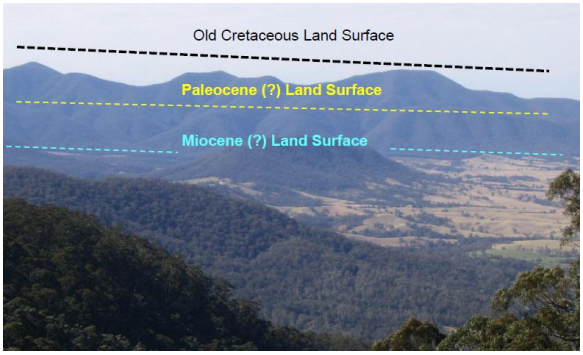

Riverview Drive, Tathra

The process was probably accentuated by the progressive drop in sea level as Antarctica started to accumulate ice. This steady drop would have lowered the river base line and thus increased water flow speed and erosive power. This produced the valleys in the lower reaches of the region's waterways, for example Pambula Lake.


Pambula Lake

One interesting observation one can draw from this process is the amazing age of the region's landscape. Clearly, there has been little topographic change in the last 30 million years.

This age is worth reflecting (and speculating) on. The first period after the formation of the Tasman Sea was a time of huge erosion. The interesting point about the Bega Valley is not so much what is here, but what is not here. Given that the landscape was stable after 30 Mya and the escarpment formed as a hinge on the down sloping Cretaceous Plain, a huge amount of material has been eroded away in the early years of the Tasman Sea. What is missing can be envisaged from almost anywhere in the valley, for example from Pipers (Brown Mountain) Lookout.



The location and dates of the surfaces are quite speculative. These old surfaces and probable changes in erosion rates appear across the landscape in a large number of places including on the flanks of the mountains.

Today's coastal sandstones would only represent a fraction of this eroded material. The rest must be off the continental shelf, awaiting investigation.

The Montreal Goldfields

One interesting Tertiary sandstone area worth a visit is the Montreal Goldfields 5 km north of Bermagui (see http://www.montrealgoldfield.org.au/getting_here.html)

Montreal Goldfield, Wallaga Lake

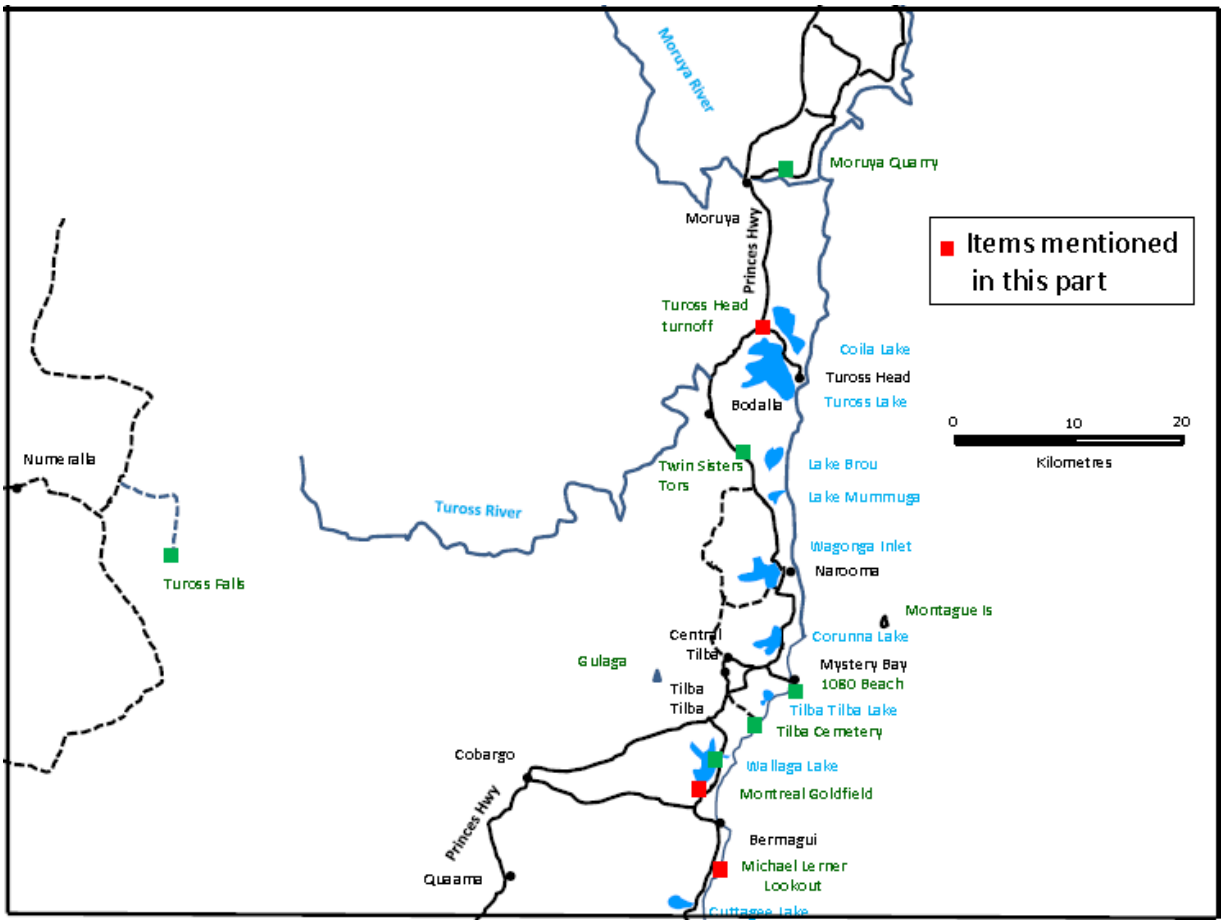
Alluvial gold was first found in the nearby region (Dignams Creek) in 1860. The main source was vein deposits of gold in the high slopes and crest of Mt Dromedary. These were worked in tunnel and sluicing operations in three main mines over the period 1878-1920. Whilst rainforest has reclaimed the highly disturbed crest of the mountain the impact of the mining can still be clearly seen.

Erosion of the igneous intrusion washed gold into the creek systems and alluvial gold was found in a number of locations including Dignams Creek. Over 1880 to 1883 a significant alluvial gold site (Montreal Goldfield) was opened up in the coastal area north of Bermagui.

The gold is found in an old river bed under a thick aggraded barrier of Tertiary sandstone, probably dating from the same time as the Bermagui sandstone (about 30 million years ago). The sandstone includes a considerable amount of quartz duricrust. This was a silica rich crust precipitated in the Paleocene – Eocene rainforest soil profiles during the region's period of warm humid climate and heavy rainfall (1.5 metres pa). At nearby sites the finer grained component in the sandstone has been eroded out leaving the blocks of quartz duricrust accumulated in heaps. The best example is in the cutting on the Wallaga Lake Road near the Bermagui-Cobargo intersection just north of Bermagui.

Bermagui-Cobargo Road intersection

The cap sits on a highly eroded profile of Ordovician sandstone.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Tuross River
Wagonga Inlet
Narooma
Tuross Falls
Montague Is
Central Tilba
Corunna Lake
Gulaga
Mystery Bay
1080 Beach
Tilba Tilba
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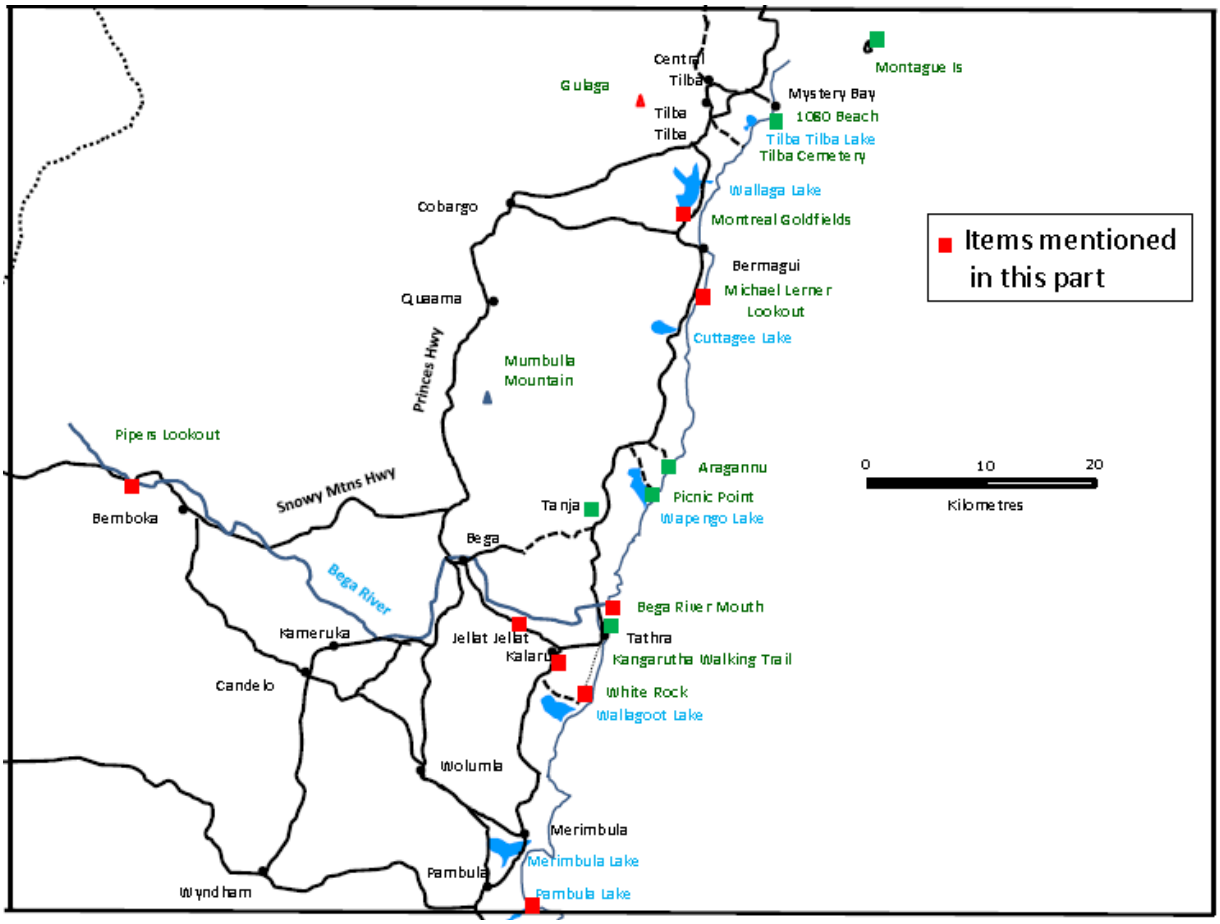
Michael Lerner Lookout
Quaama
Cuttagee Lake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Tanja
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Bemboka
Bega
Bega River
Bega River Mouth
Kameruka
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Tathra
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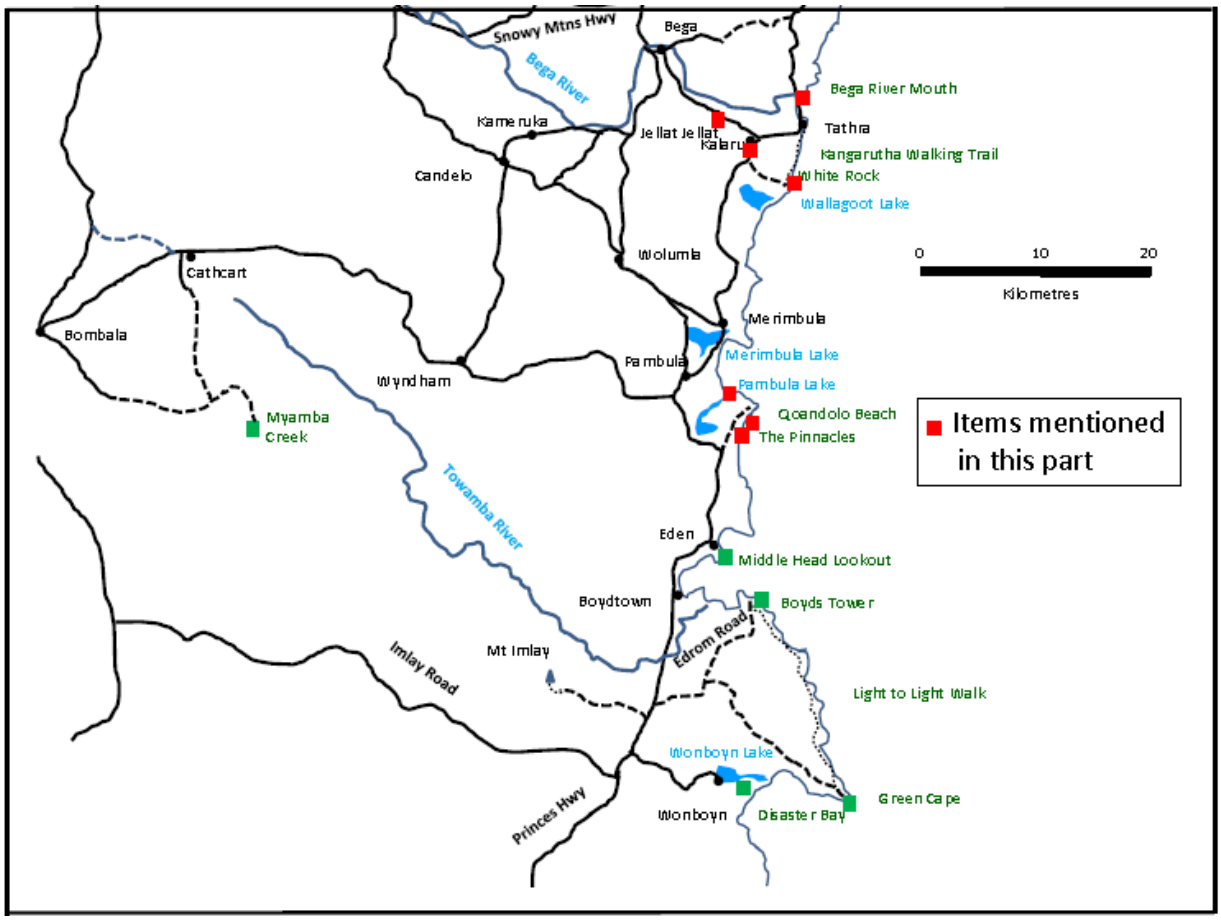
Snowy Mtns Hwy
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Pambula
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Myamba Creek
Coondolo Beach
The Pinnacles
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Middle Head Lookout
Boydtown
Boyds Tower
Edrom Road
Mt Imlay
Imlay Road
Light to Light Walk
Wonboyn Lake
Princes Hwy
Wonboyn
Disaster Bay
Green Cape