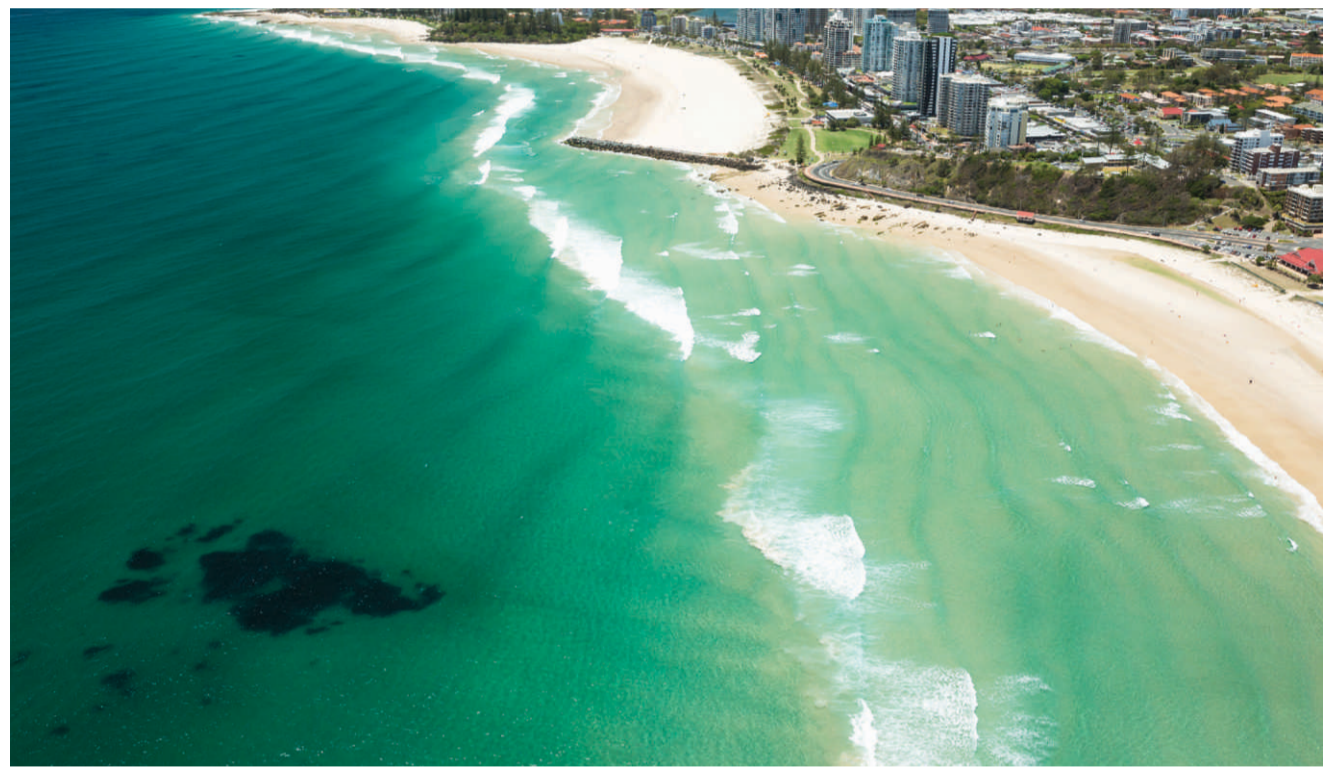


TWEED SAND BYPASSING

KIRRA BEACH



Kirra Reef located offshore of Kirra Beach - December 2014



Kirra Point and Kirra beach before groyne extension - October 2012



Kirra Point and Kirra Beach after groyne extension - December 2014

Sand naturally flows north from Coolangatta Beach around Kirra Point and continues to travel in a northerly direction towards Bilinga. Between 2002 and 2008 there was an accumulation of sand along the Kirra to North Kirra coastline. This was due to the delivery of a large quantity of sand from the initial stages of the Tweed River Entrance Sand Bypassing Project (TRESBP) to supplement the lack of sand supply in previous years.

The supplementary sand did not disperse north as quickly as predicted. This was due to the region experiencing a decade of calmer than usual storm seasons, particularly a lack of cyclonic events from the North East. In May 2009 there were a series of large storm events which saw a loss of over 200,000 cubic metres of sand from the upper beach and offshore area between the Kirra Point and Miles Street groynes. By mid 2009, the seabed had lowered in depth by about 2 metres and Kirra Reef became more exposed. In addition to natural processes, the Queensland Government completed the Kirra Beach restoration project which saw Gold Coast City Council relocating 136,000 cubic metres of sand from the intertidal zone to form a low profile back beach dune. These works were successful in further reducing beach widths at Kirra.

Since 2009 Kirra sand volumes have continued to reduce. As a result the beach width has reduced and exposure of Kirra Reef has further increased. However, conditions will continue to naturally fluctuate reflecting the seasonal variation of sand flow into Coolangatta Bay, around Kirra Point groyne and through Kirra and central Kirra Beach areas. Severe storm activity can alter these patterns at any time. Gold Coast City Council extended the length of Kirra Point groyne in December 2013 by about 30 metres. Miles Street groyne was covered by sand in 2003 and remained buried for about 10 years until wave action exposed the head of the groyne in October 2013. The head of the groyne was covered again for a while but has remained exposed since September 2014.



KIRRA REEF

Kirra Reef is a rocky outcrop located a few hundred metres offshore of Kirra Beach in 5-7 metres of water. Since the reef is close to shore, and within the potential influence of wave action, it is subject to shifting sandbanks that move along the seabed, intermittently covering and uncovering the reef.

This process is influenced by three key factors. The first is the amount of sand that is present in the coastal system; the second are geological structures such as headlands and groynes and the third is the prevailing wave conditions.

The exposure of Kirra Reef has varied over the last 50 years due to changes in the coastal environment. These have included alterations of the geological control through the extension of the Tweed River entrance training walls and construction of the Kirra Point and Miles Street groynes, as well as alterations to the amount of sand facilitated by the TRESBP. The wave conditions generally follow seasonal and longer term patterns but are also subject to constant change.

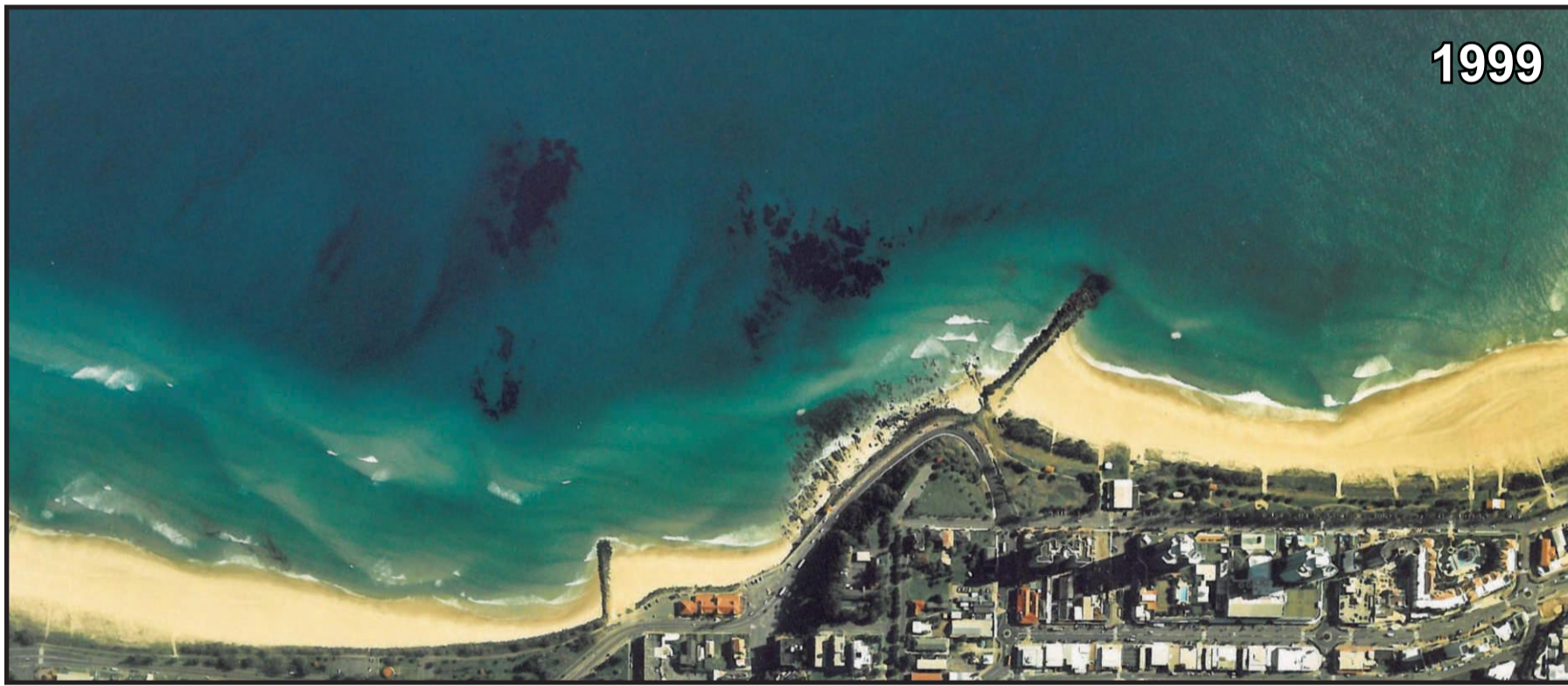
The aerial photos below provide a pictorial representation of how the reef has varied since the 1930's



Pre 1960's Prior to the extension of the Tweed River entrance training walls and the construction of Kirra Point Groyne.
- Substantial sand coverage on both Coolangatta and Kirra beaches
- Kirra Reef partially covered by sand



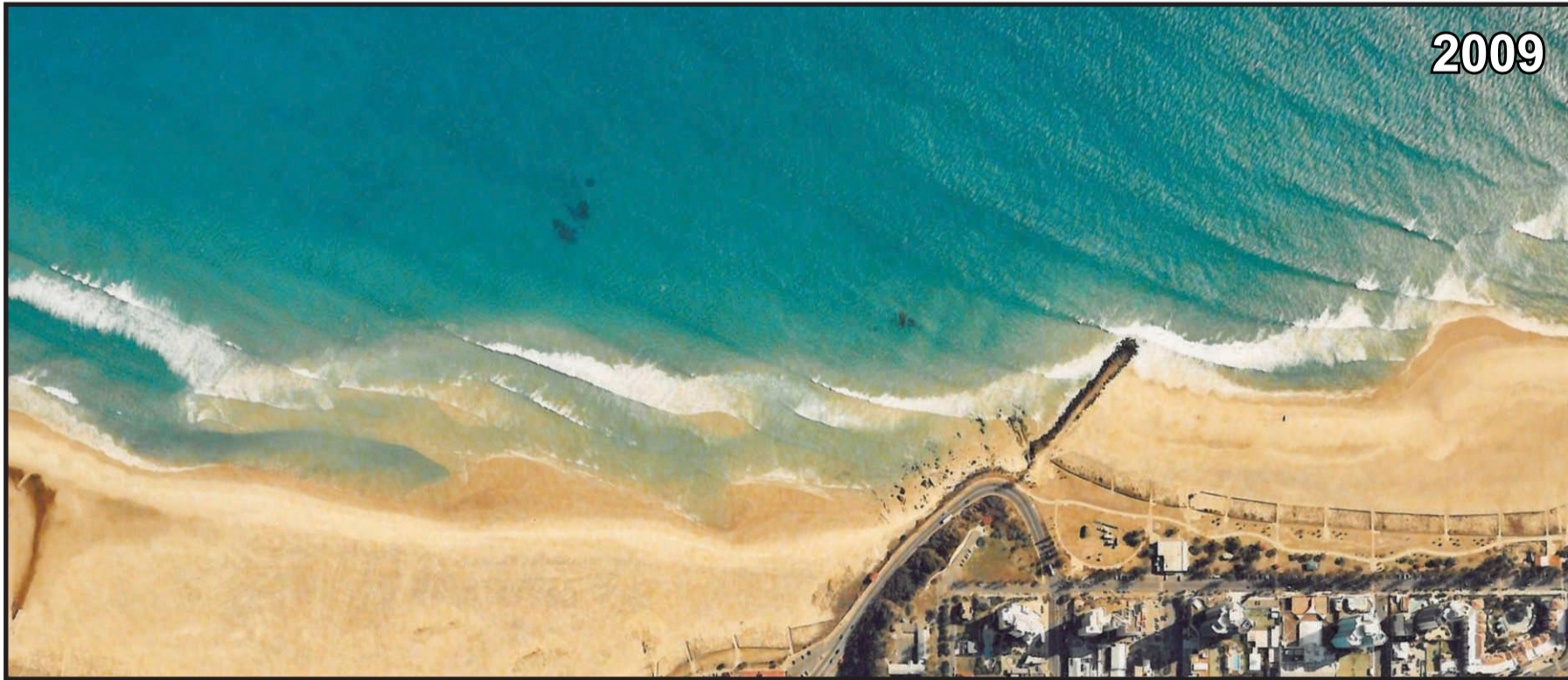
1962 – 1971 After the extension of the Tweed River training walls (1962-1965) but prior to Kirra Point Groyne being constructed.
- Depleted sand supply causing both Coolangatta and Kirra beaches retreat
- Kirra reef becoming increasingly exposed



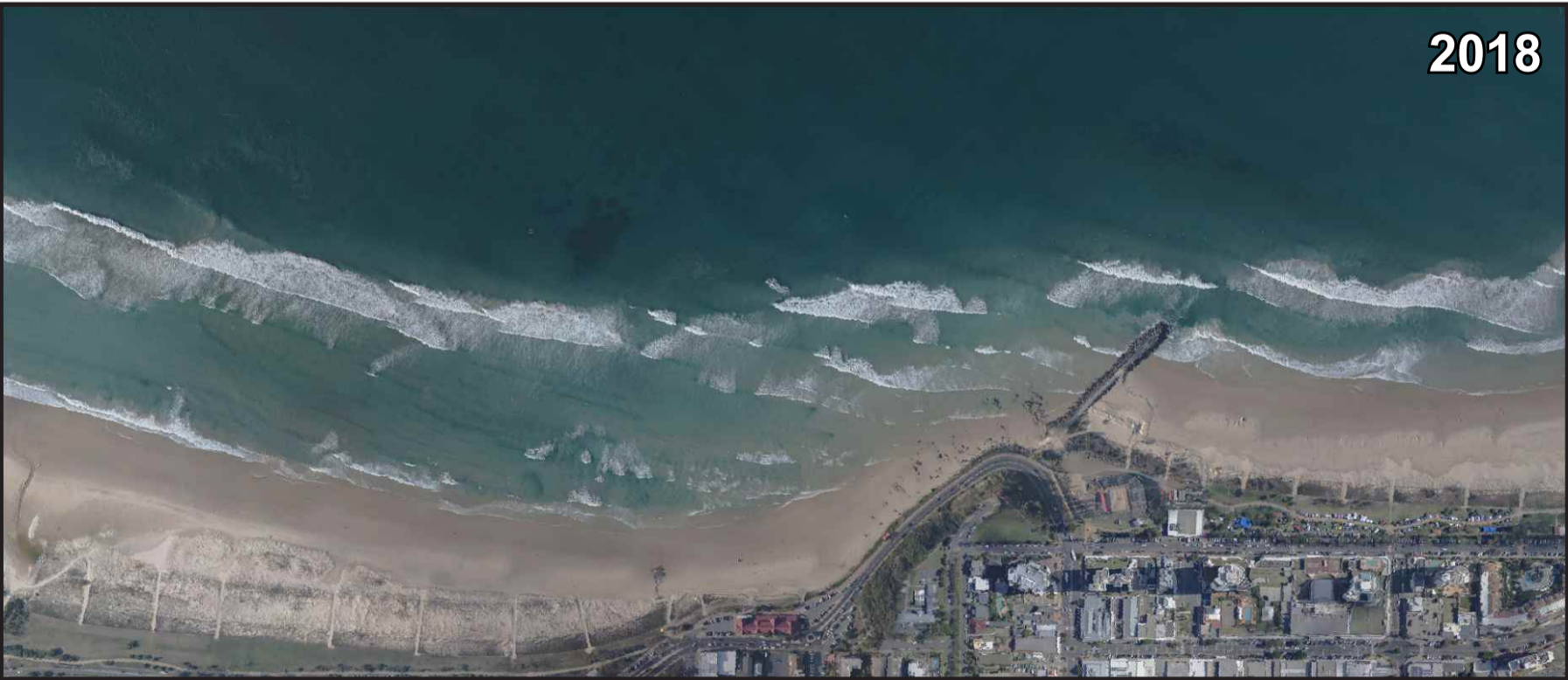
1972 – 2001 After the construction of Kirra Point Groyne (1972) but prior to the commencement of Tweed Sand Bypassing
- Coolangatta beach expands as sand accumulates updrift of Kirra Point Groyne.
- Kirra beach retreats and Miles Street groyne is constructed in 1974.
- Kirra reef is at its most exposed in recent years.



2002 – 2008 After initial commencement of Tweed Sand Bypassing
- Coolangatta and Kirra beaches widen as large supplies of sand are delivered as part of the initial stages of Tweed Sand Bypassing.
- Kirra Reef becomes inundated by sand, especially the inner and eastern reefs



2009 Eight years after Tweed Sand Bypassing commenced
- A series of severe storms in May 2009 shift approximately 200,000 cubic metres of sand towards Bilinga and Tugun beaches to the north, uncovering Kirra Reef.



2009 – 2018 Nine years after the May 2009 storms
- The overall sand volumes at Kirra continue to reduce and Kirra reef is exposed.

KIRRA BEACH COASTAL MANAGEMENT STRATEGIES

Kirra beach is located on the southern Gold Coast, bordered by Kirra Point to the south and Miles Street groyne to the north.

Human interventions such as the influence of man-made coastal structures have modified natural processes, further altering the condition of the beach. In the 1930's and 1940's seawalls were built at Kirra Beach to protect its foreshore infrastructure from storm events.

In the 1960's the Tweed River entrance training walls were extended, interrupting sand supply to the southern Gold Coast beaches, and Kirra Beach was severely eroded. In the 1970's the Kirra Point and Miles street groynes were built and the beach was nourished to mitigate erosion which peaked in the 1980's.

Tweed Sand Bypassing was implemented in the mid 1990's and commissioned in 2001 to maintain the Tweed River entrance and restore the coastal sand supply to the southern Gold Coast beaches.



1930's Kirra Beach and foredune comprised a total width of approximately 200 metres



1940's There were a series of catastrophic storms, and during this time Kirra and other beaches of the southern Gold Coast were in a severely eroded condition. Seawalls were built to protect the infrastructure.



1950's Kirra had recovered from storm events in the previous decade and was in an accreted condition.



1960's The Tweed River training walls were extended between 1962 and 1965 to maintain a navigable entrance. During 1967 the Gold Coast experienced several cyclones and the erosion effects due to the disruption in longshore sand supply became apparent.



1970's In 1972 the Kirra Point Groyne was built, followed by a seawall in 1973 and Miles Street groyne in 1974. In 1975 a total of 765,000 cubic metres of sand was pumped from the lower reaches of the Tweed River to nourish Kirra.



1980's Erosion at Kirra reached a peak in 1982 and rock exposure at Kirra headland and Kirra reef was greatest during this period. In 1985 a further 315,000 cubic metres was placed at North Kirra beach.



1990's The initial stages of the TRESBP provided 3.6 million cubic metres between Kirra and Tugun to offset severe erosion and allow for new beaches to be established.



2000's The Tweed River Entrance Sand Bypassing Act was passed in 1995 in NSW and 1998 in Qld with the permanent bypassing system officially commissioned in 2001.



2018 Since 2009 Kirra Beach has significantly reduced in width.