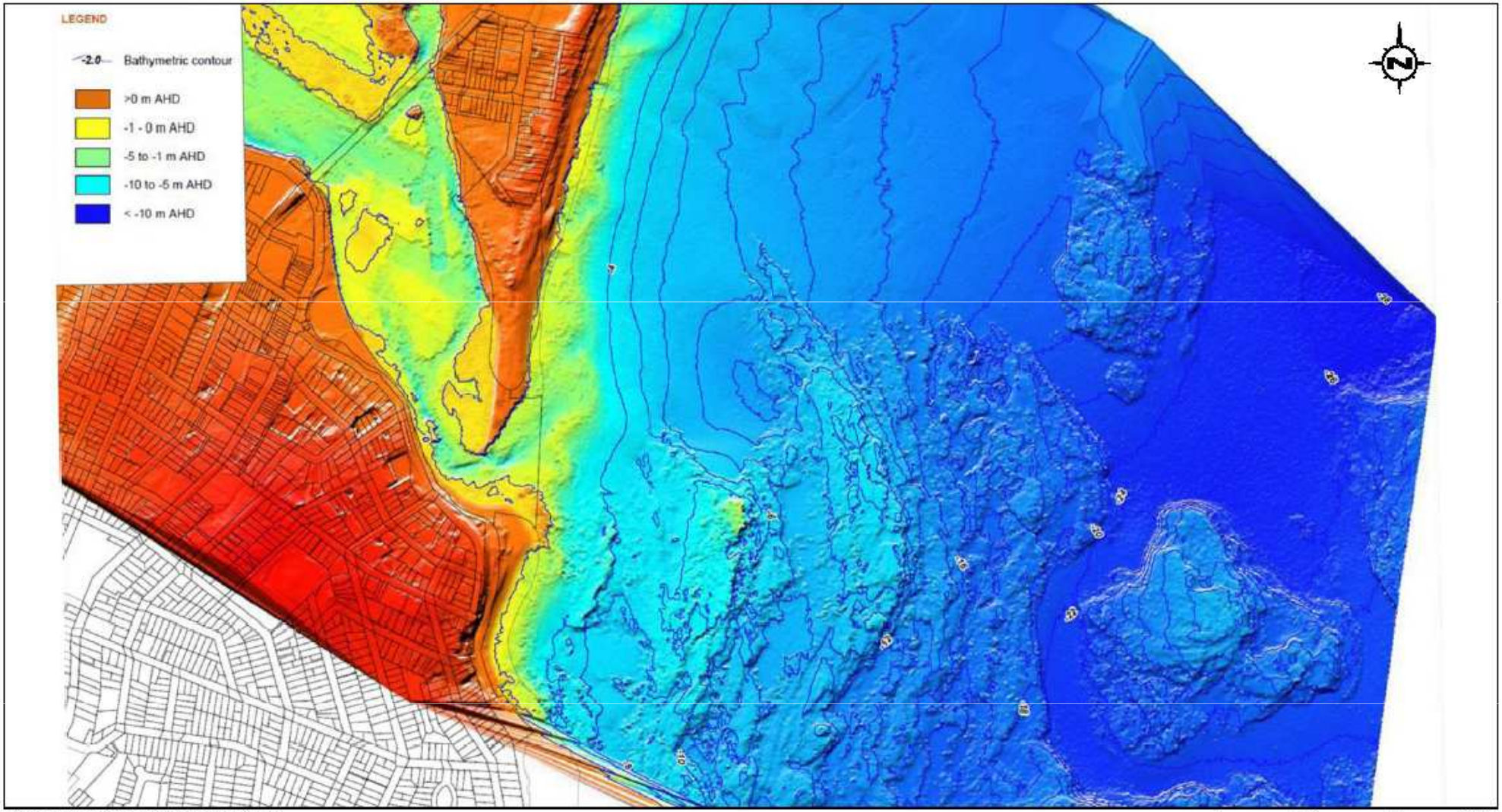


Source: SMEC Australia Pty Ltd (2010)

FIGURE 1.1

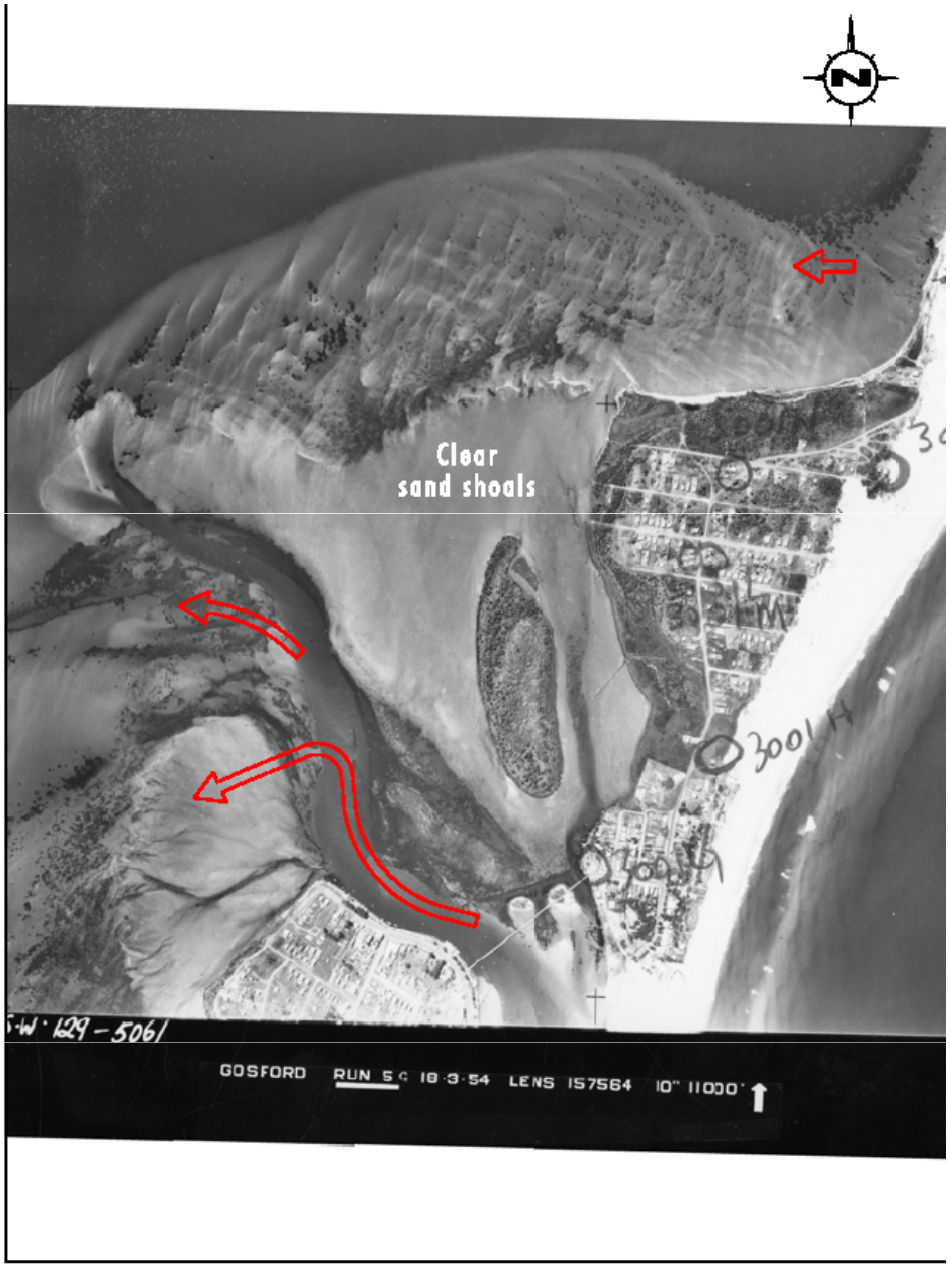
Detailed LADS Bathymetric Data

1941

- Active blowout transferring sand from North Entrance Beach (Curtis Pde area) across the barrier to outer edge of tidal delta
- Entrance closed. Long shore sediment transport building The Entrance Beach
- Very wide beach at North Entrance

1954

- Entrance open on southern side
- Sand stripped from The Entrance Beach and from outer tidal delta
- Extensive tidal flats off main channel on western side of tidal delta
- Limited delta activity to northern side



1954

- Active blowout continues at North Entrance
- Sand from blowout moving west across outer margin of delta
- Eastern side of delta strongly shoaled
- Wide beach at North Entrance, but low sand volume at The Entrance Beach

1961

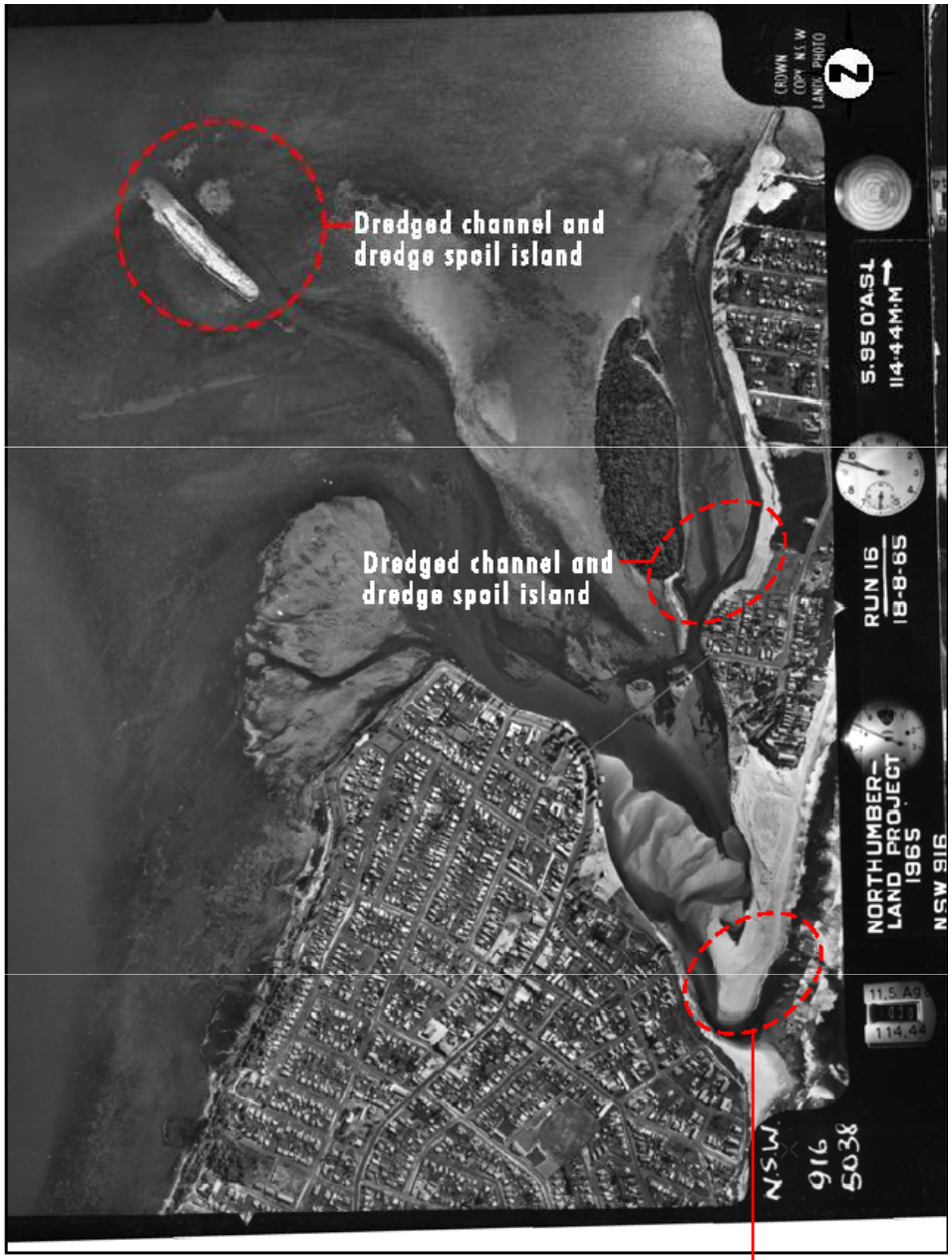
- **New alignment of lake shore at North Entrance, with sea wall**

- **large bars in nearshore, storing sand; large rip cells off Hutton Rd and in front of blowout**

1961

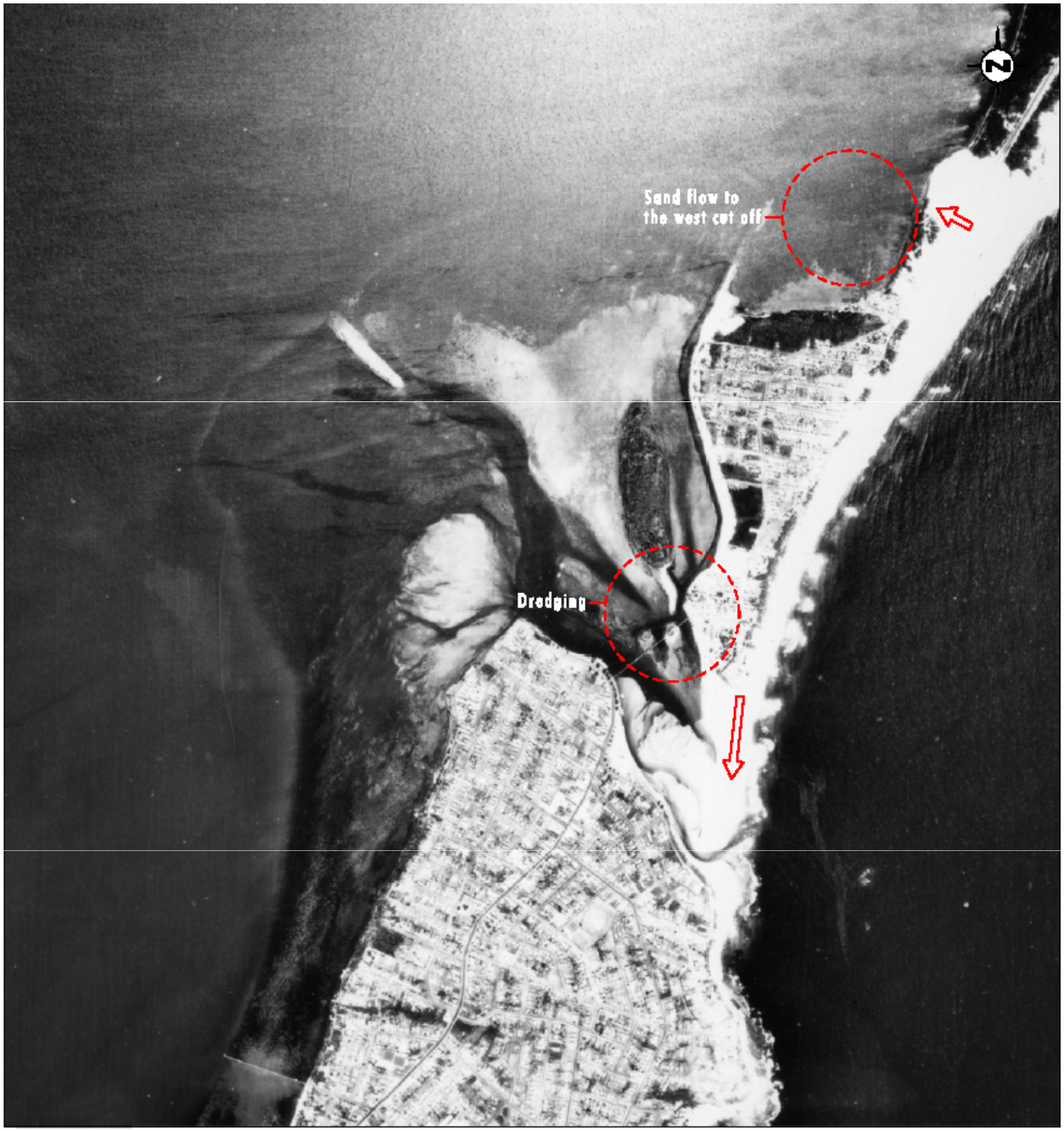
- Limited sand on The Entrance Beach; isolated from North Entrance by entrance channel

- Limited stabilisation of the sand spit across The Entrance - spinifex colonisation?



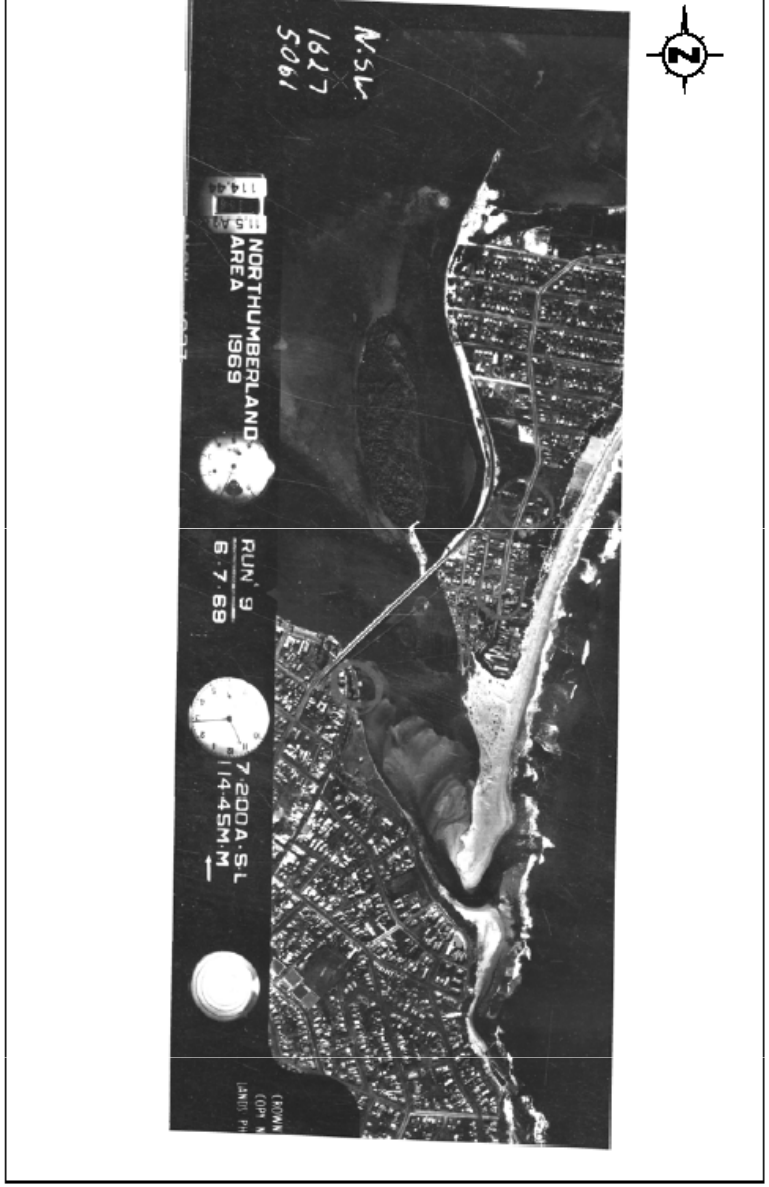
1965

- Entrance shoal and spit trimmed by migrating channel
- Many small beach cusps, reduced rip cell circulation



1966

- Dune blowout at North Entrance still active, diverting sand from the beach back to the lake shore
- Entrance channel almost closed, sand moving south along the southern part of North Entrance Beach and spit, but limited transfer to The Entrance Beach



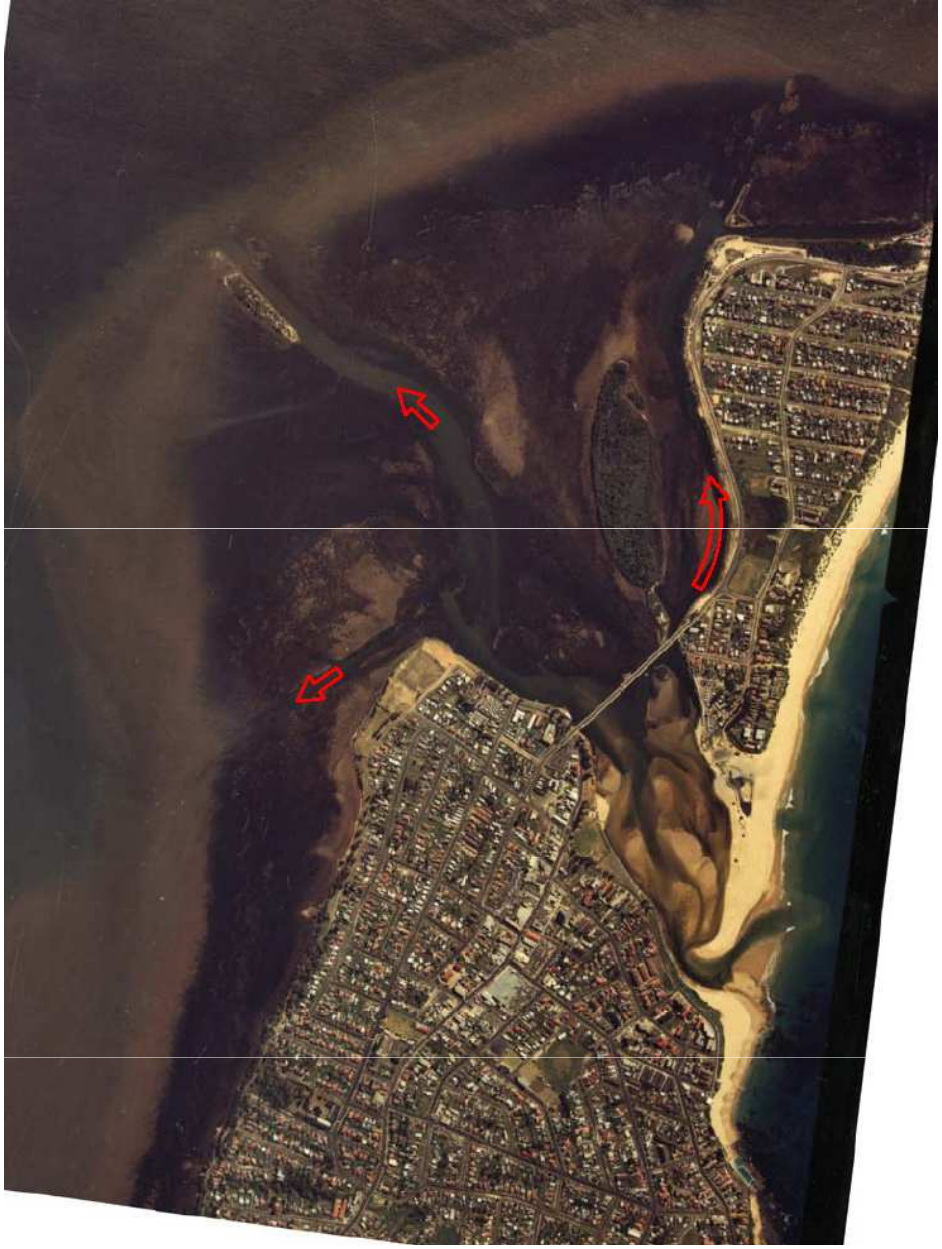
1969

- Entrance open with wide channel on southern side
- Erosion of shoals in outer tidal delta
- Reduced sand volume south of entrance channel
- Open channel trimming spit to north
- Closely spaced rip cells on southern part of beach. Many cusps in surf club area

0 0.25 0.5
1:20 000

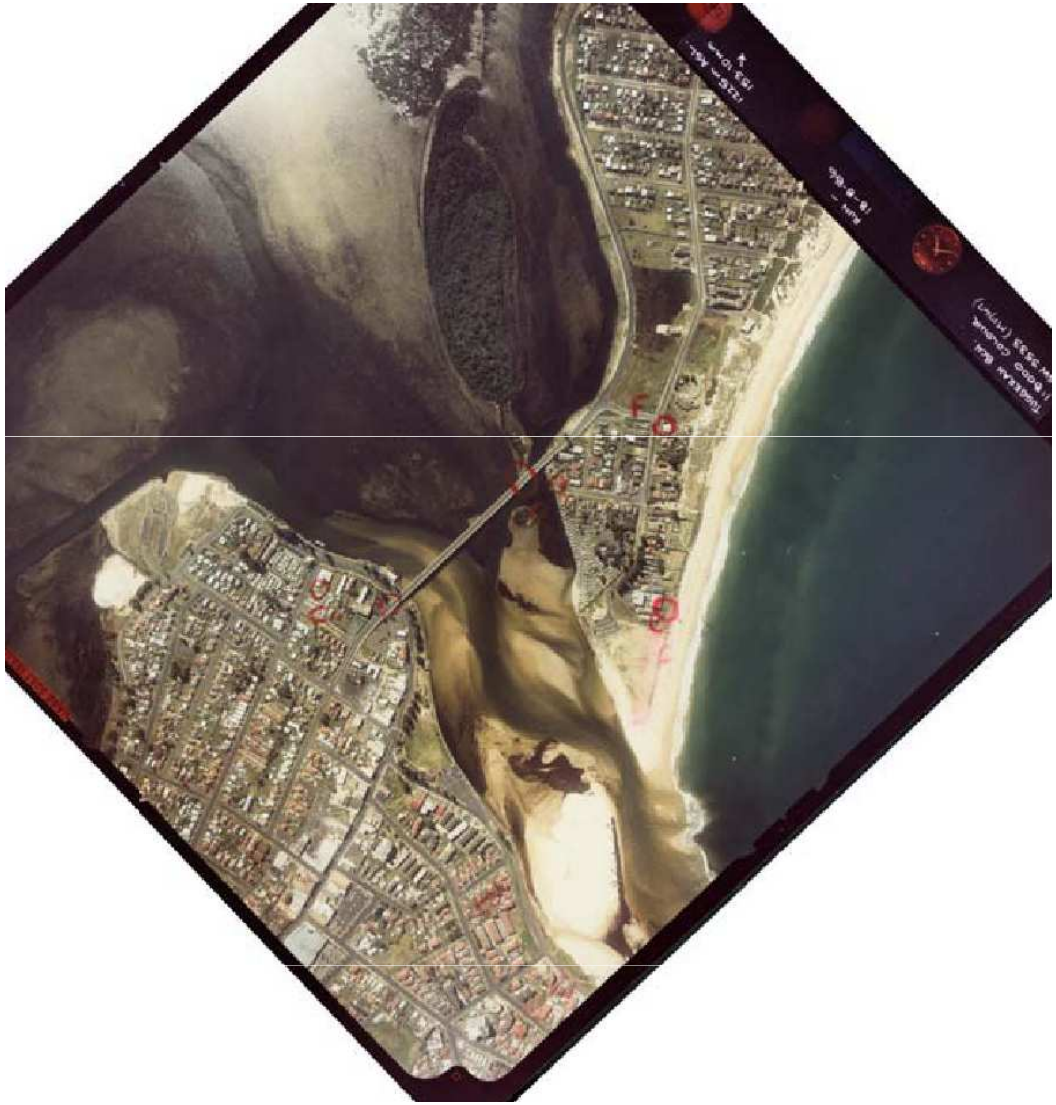
1978

- Entrance open with wide channel
- Sand spit severely depleted from entrance channel migration and storm bite into the frontal dune



1982

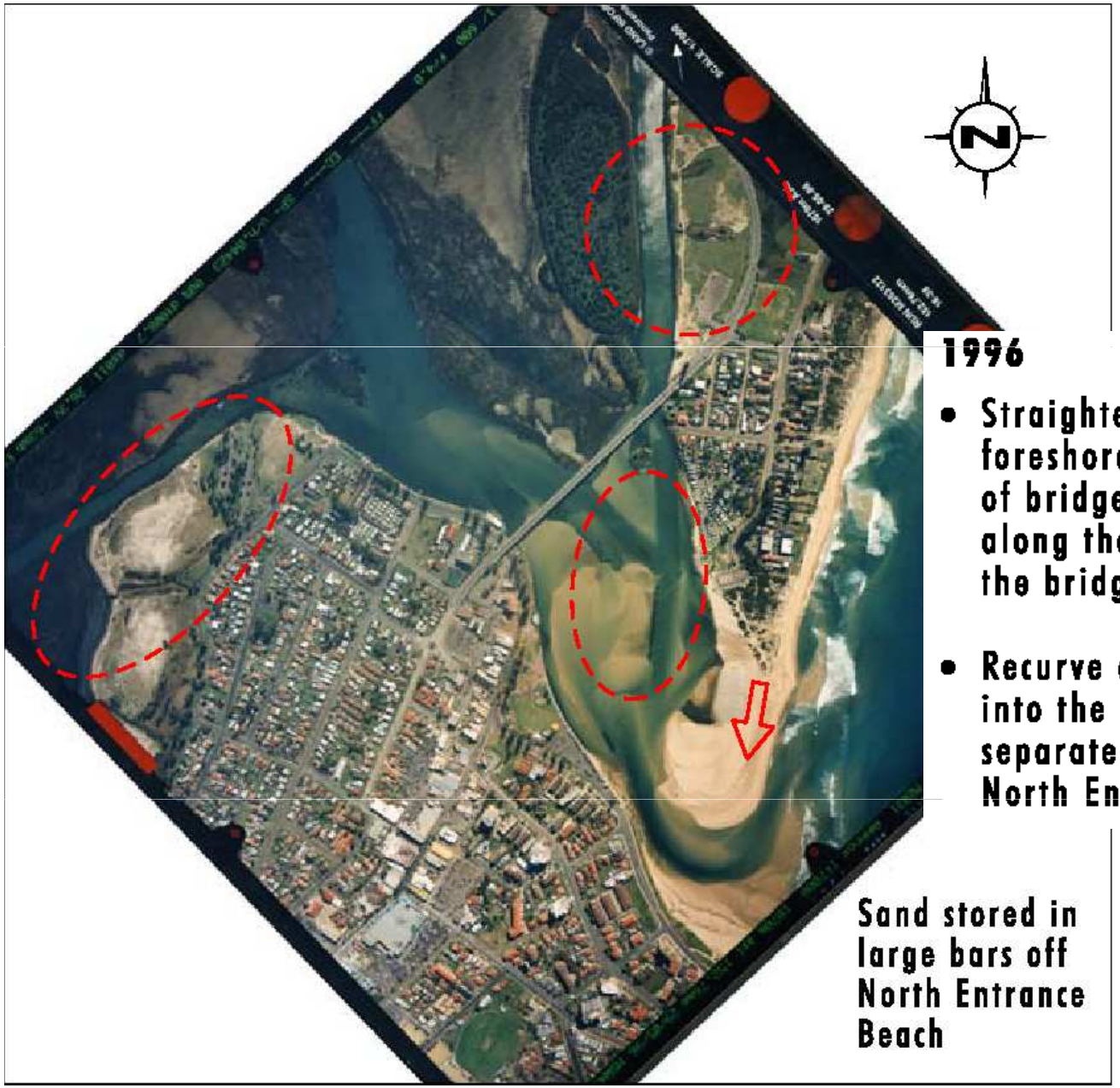
- Multiple dredged channels - outside and inside the bridge
- Accretion on ocean side of the entrance spit. Some recovery of shoaling in the entrance outside of the bridge
- The Entrance Beach in accreted condition



1986

- **Entrance channel broken through on northern side of spit, isolating the southern entrance shore and The Entrance Beach from the main beach**

- **Reclamation and further dredging on western shore, inside the bridge reclamation**



1996

- Straightening and reclamation of lake foreshore and channel dredging to north of bridge, in outer entrance area, and along the western foreshore inside the bridge

- Recurve on spit shows sand moving south and into the entrance. Wide curved entrance channel separates an accreted Entrance Beach from North Entrance

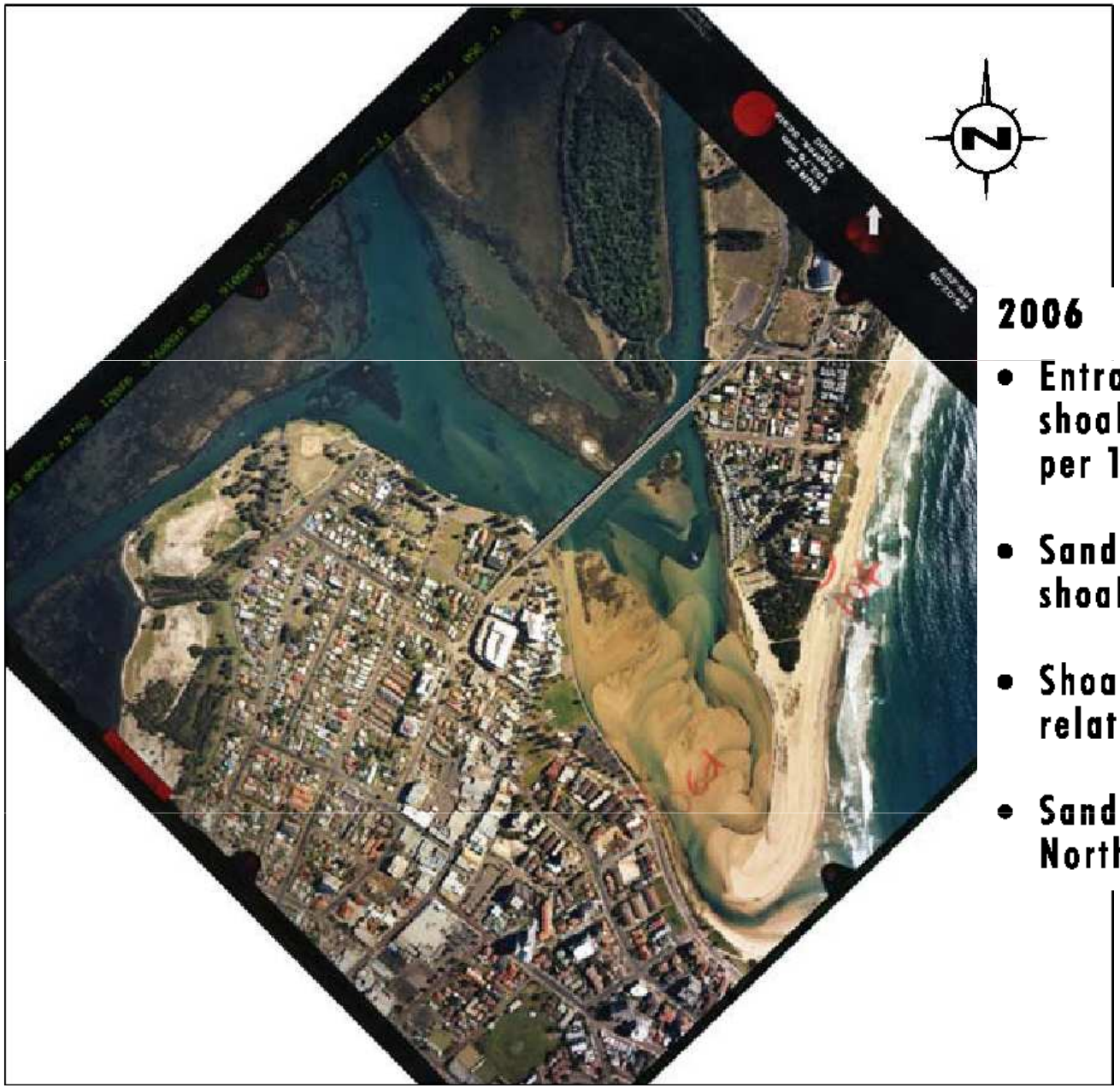
1999

- Entrance almost closed, with straight spit and widespread shoaling in the outer entrance
- Deep channels (dredged) control flows upstream of the bridge
- Reduced sand volumes on The Entrance Beach and North Entrance Bench sand has moved into The Entrance
- Significant volume of sand from the tidal delta are locked into the reclaimed foreshores to the north east and west of the entrance (minimum estimate ~200,000m^3)

2001

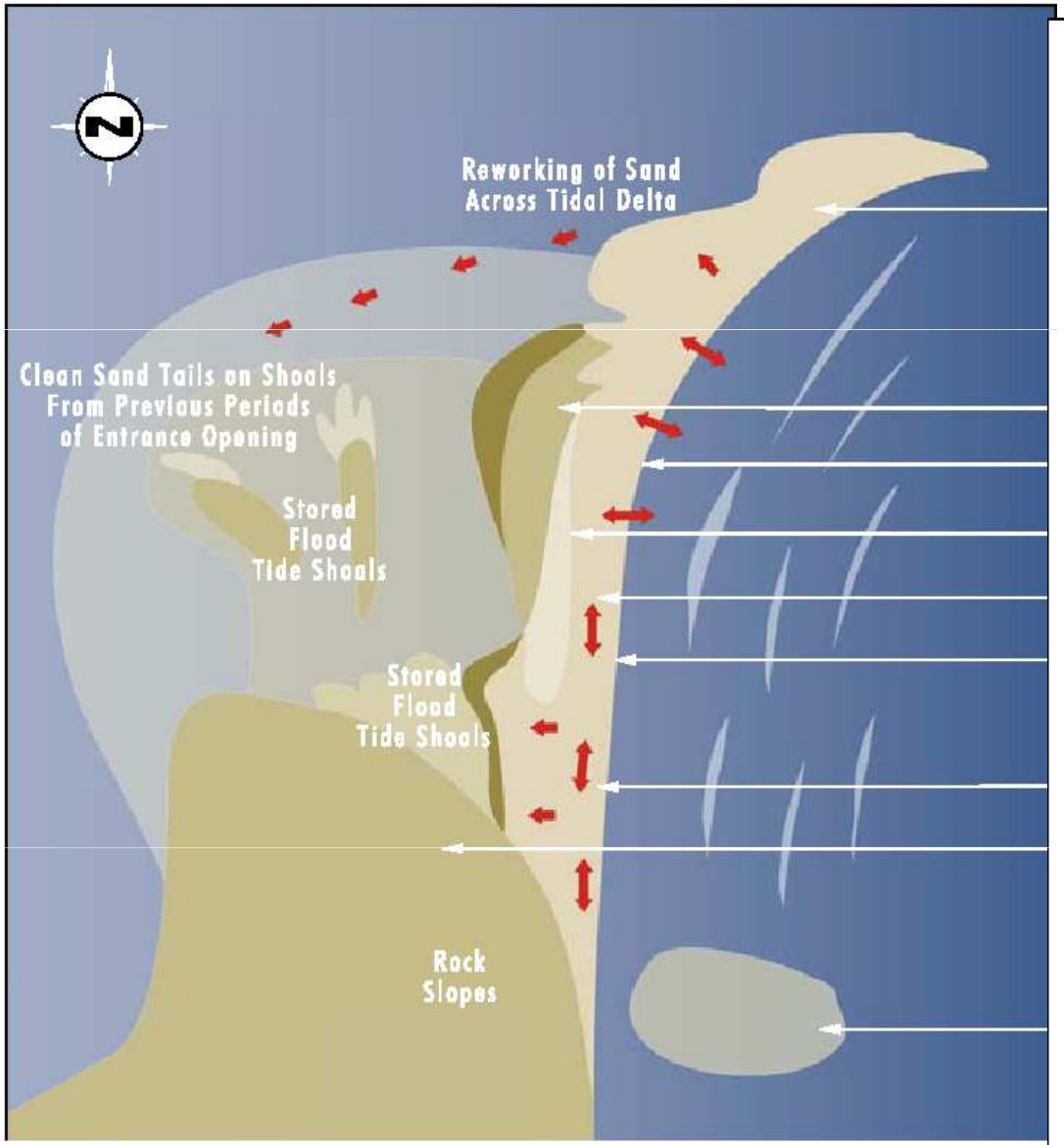
- Dredged channels in outer entrance area have reduced shoaling. North Entrance Beach accreted

- Reclaimed areas and dredged channels control flows and sediment movement inside the bridge



2006

- Entrance almost closed and channels heavily shoaled. North Entrance Beach is narrow (as per 1999)
- Sand volume stored in the spit and entrance shoals
- Shoal areas inside bridge vegetated and relatively stable
- Sand also accumulating in nearshore area of North Entrance Beach



Type 1: Entrance Closed, Active Aeolian Processes

Ongoing Aeolian Losses
From Beach to Lake Shoreline

Back Barrier Flat

Rip Cell Circulation Along All of Beach

Narrow, Single Frontal Dune

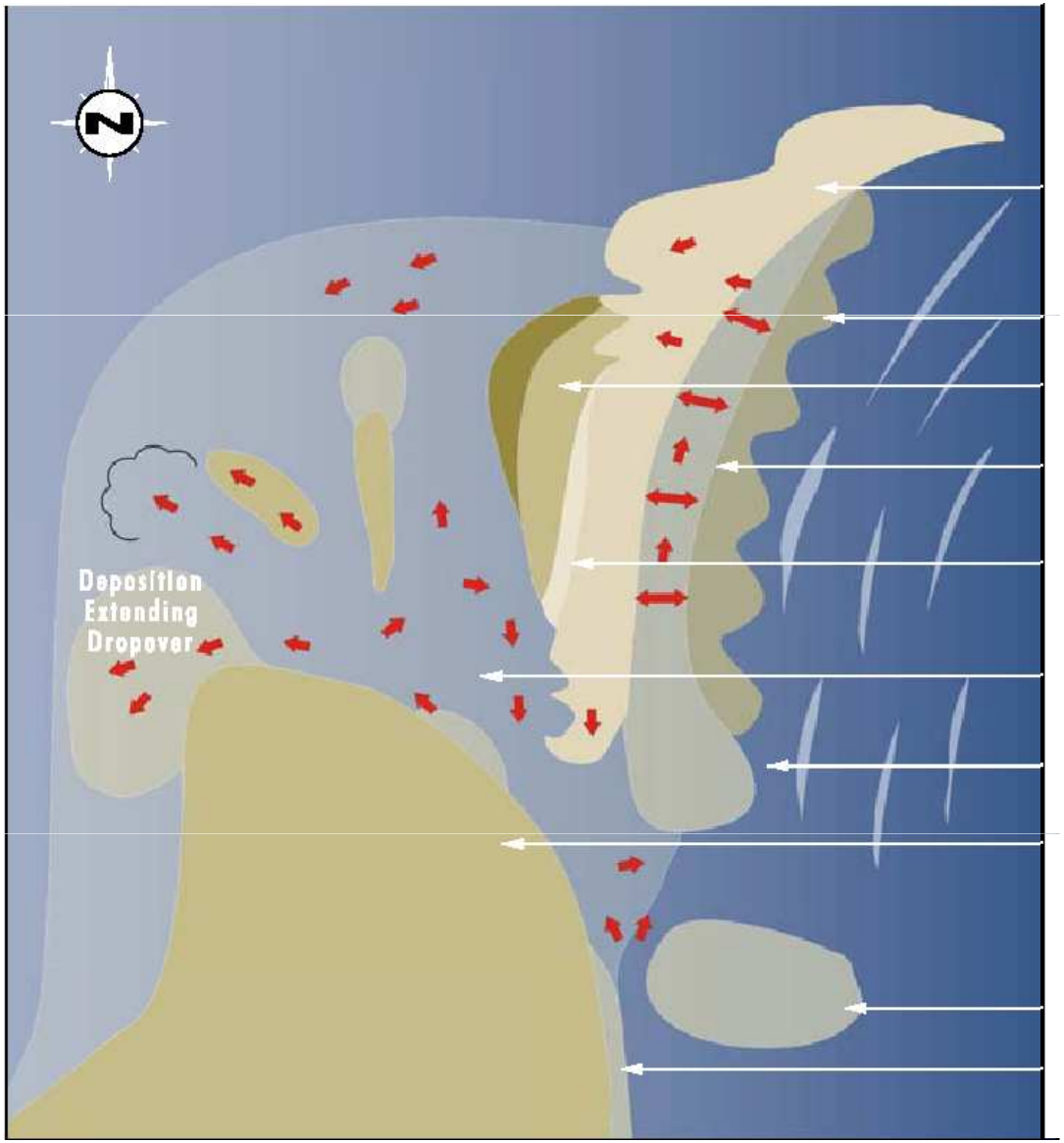
Wide Beach

Shoal Tied to Beach

Closed Entrance:
Potential for sand to move north/south across THe Entrance.
Also some minor windblown sand loss into The Closed Estuary

Bedrock Controlled Shoreline

Rock Reef in Nearshore



Type 2: Entrance Open, Active Aeolian Processes, Predominantly Natural Shoreline Configuration

Ongoing Aeolian Losses
From Beach to Lake Shoreline

Extensive Nearshore Bars

Back Barrier Flat

Rip Cell Circulation Along All of Beach

Narrow, Single Frontal Dune

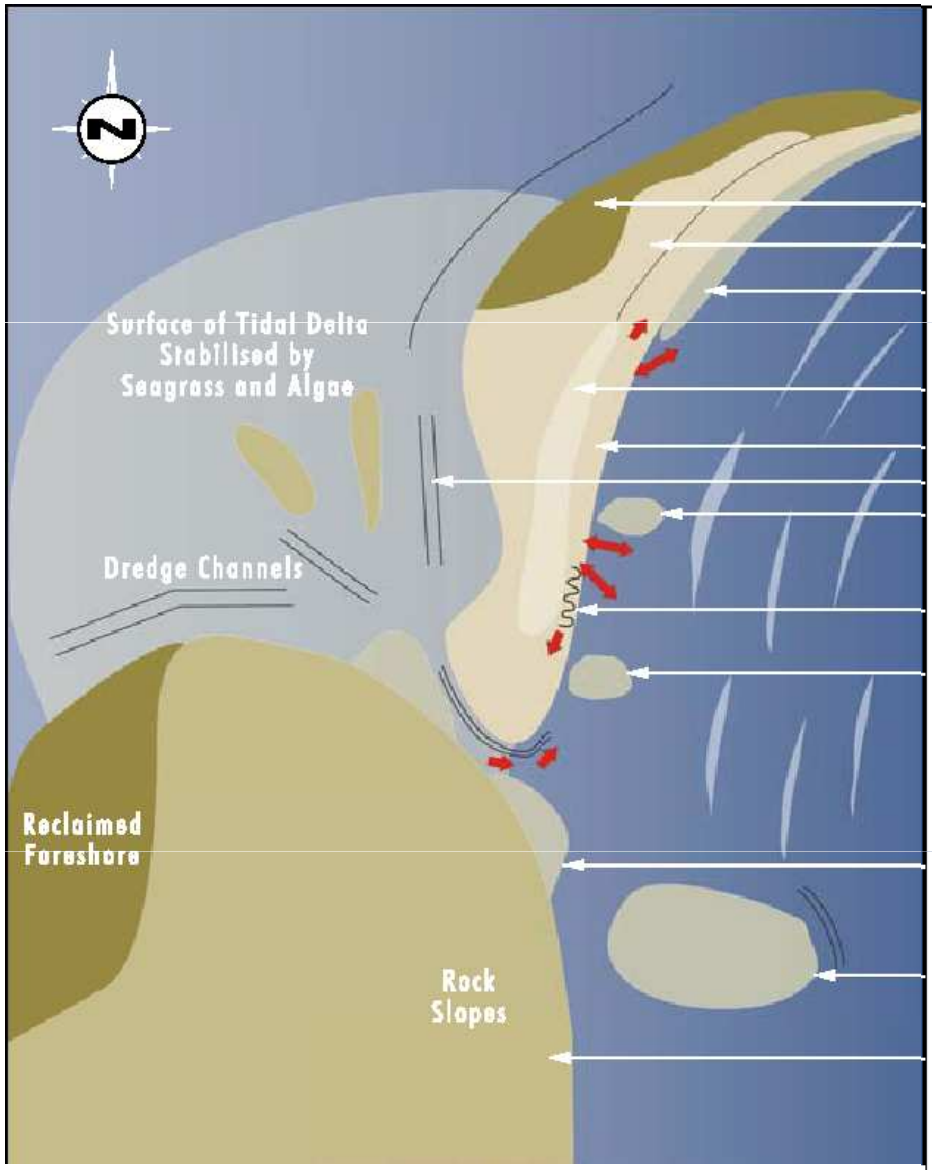
Flood Tide Shoals

Ebb Tide Shoal

Bedrock Controlled Shoreline

Rock Reef in Nearshore

Sand Stripped From The Entrance Beach



Type 3: Entrance Open, Dredged and Scoured. Previous Mobile Sand Areas Now Locked Up

Reclaimed Foreshore

Stabiised Transgressive Dune, Now Developed

Shoal/bar

Single Frontal Dune with Development

Narrow Beach, Depleted Sand Volume

Dredge Channel

Shoal

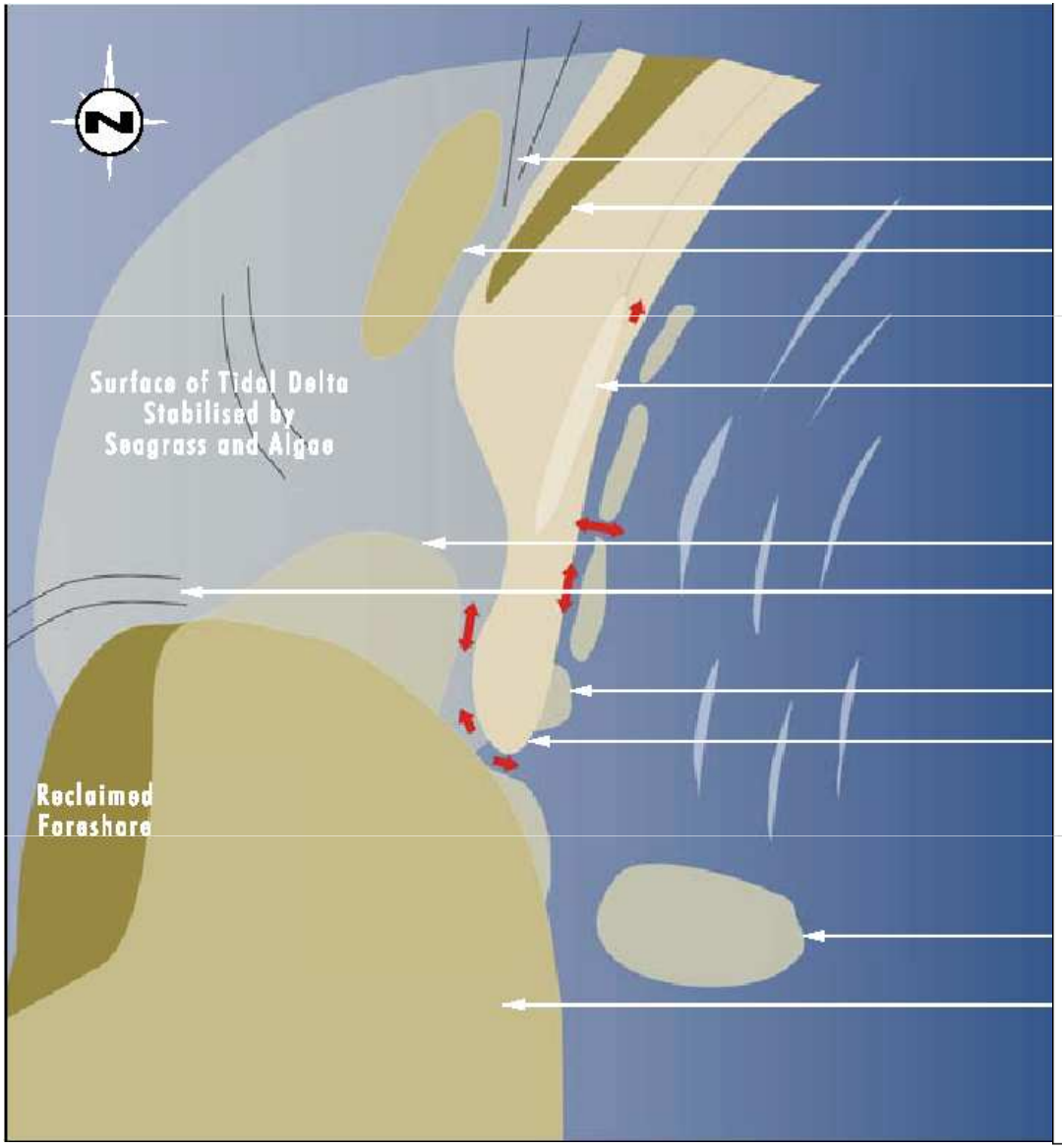
Cusps with Rips and Deeper Water Close to Shore

Ebb Tidal Shoal

Sand on The Entrance Beach

Rock Reef in Nearshore

Bedrock Controlled Shoreline



Type 4: Entrance Closed, Very Restricted Tidal Currents. Narrow Depleted Beach and Bars

Deep Dredge Channel

Reclaimed Foreshore

Island

Narrow Depleted Beach, with Narrow Bars

Shoaled Entrance

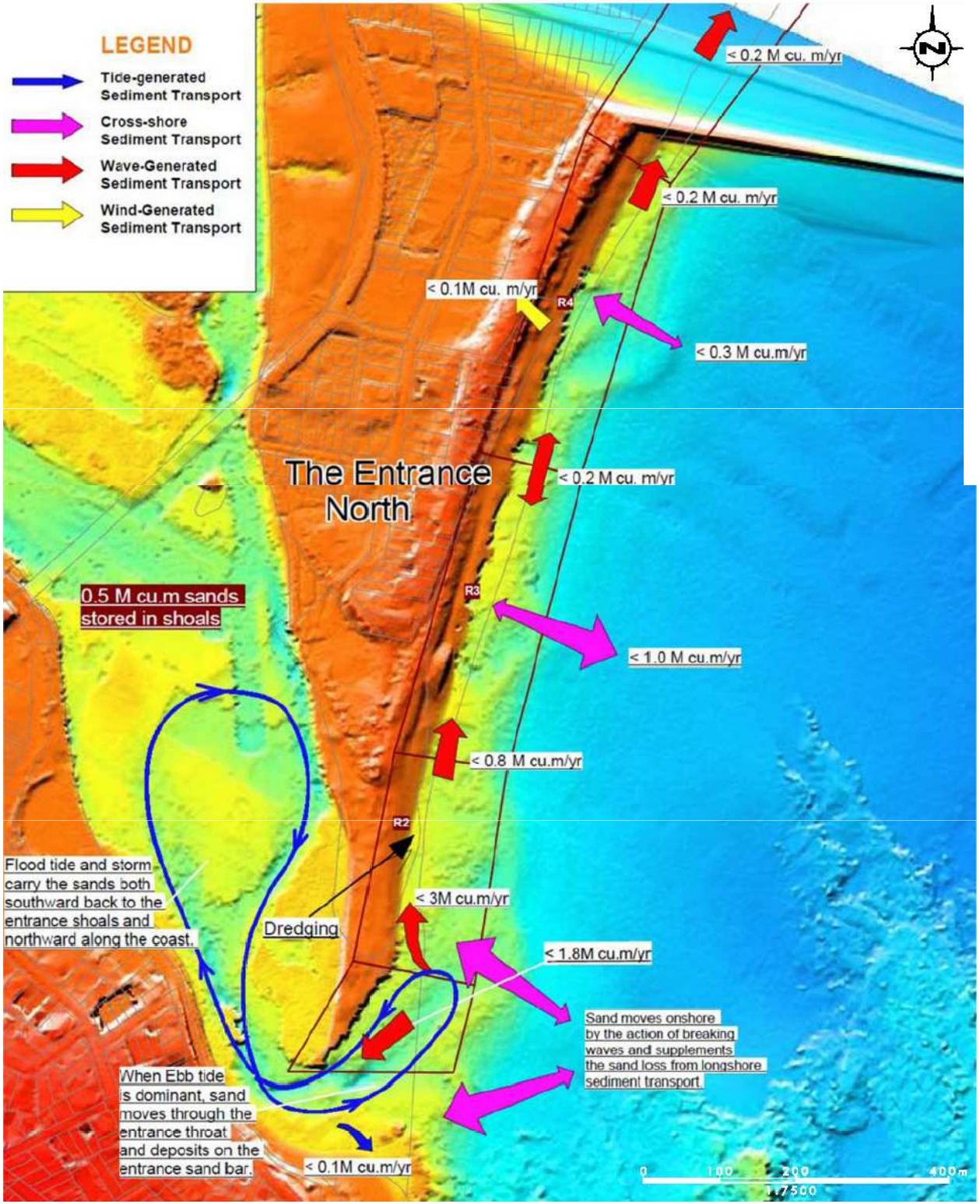
Deep Dredged Channel

Small Ebb Delta

Entrance Closed (except for narrow channel along both sides of the spit)

Rock Reef in Nearshore

Bedrock Controlled Shoreline


LEGEND
Tide-generated Sediment Transport
Cross-shore Sediment Transport
Wave-Generated Sediment Transport
Wind-Generated Sediment Transport
< 0.2 M cu. m/yr
< 0.2 M cu. m/yr
< 0.1M cu. m/yr
R4
< 0.3 M cu.m/yr
The Entrance North
< 0.2 M cu. m/yr
0.5 M cu.m sands stored in shoals
R3
< 1.0 M cu.m/yr
< 0.8 M cu.m/yr
R2
Flood tide and storm carry the sands both southward back to the entrance shoals and northward along the coast.
< 3M cu.m/yr
Dredging
< 1.8M cu.m/yr
Sand moves onshore by the action of breaking waves and supplements the sand loss from longshore sediment transport.
When Ebb tide is dominant, sand moves through the entrance throat and deposits on the entrance sand bar.
< 0.1M cu.m/yr
0
100
200
400m
1:7500