SAND DUNES, SOILS AND WATER – IMPACTS OF MINING ON NORTH STRADBROKE ISLAND

Presentation to FAC
Parliamentary Committee
10 March 2016

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This presentation:

- Parabolic sand dunes on Queensland sandmasses
- Sand dunes with podsol soils on North Stradbroke Island
- Mining for heavy minerals – beaches & low dunes, high dunes
- Water on NSI – surface and subsurface
- Impacts of mining on dune integrity and water system
- Off-lease impacts – Amity, swamps, Lake Kounpee
- Impacts of Enterprise mining – 18-Mile Swamp, Ibis system

Parabolic sand dunes on Queensland sandmasses

Series of active, large, elongate parabolic dunes, Cape Flattery, far north Queensland

Satellite image, southern Fraser Island

(standard colour codes)

Sand dunes with podsol soils on North Stradbroke Island

Satellite image NSI 1976

(standard colour codes)

Southern NSI

Relict, large parabolic dunes

1982 B & W aerial photo

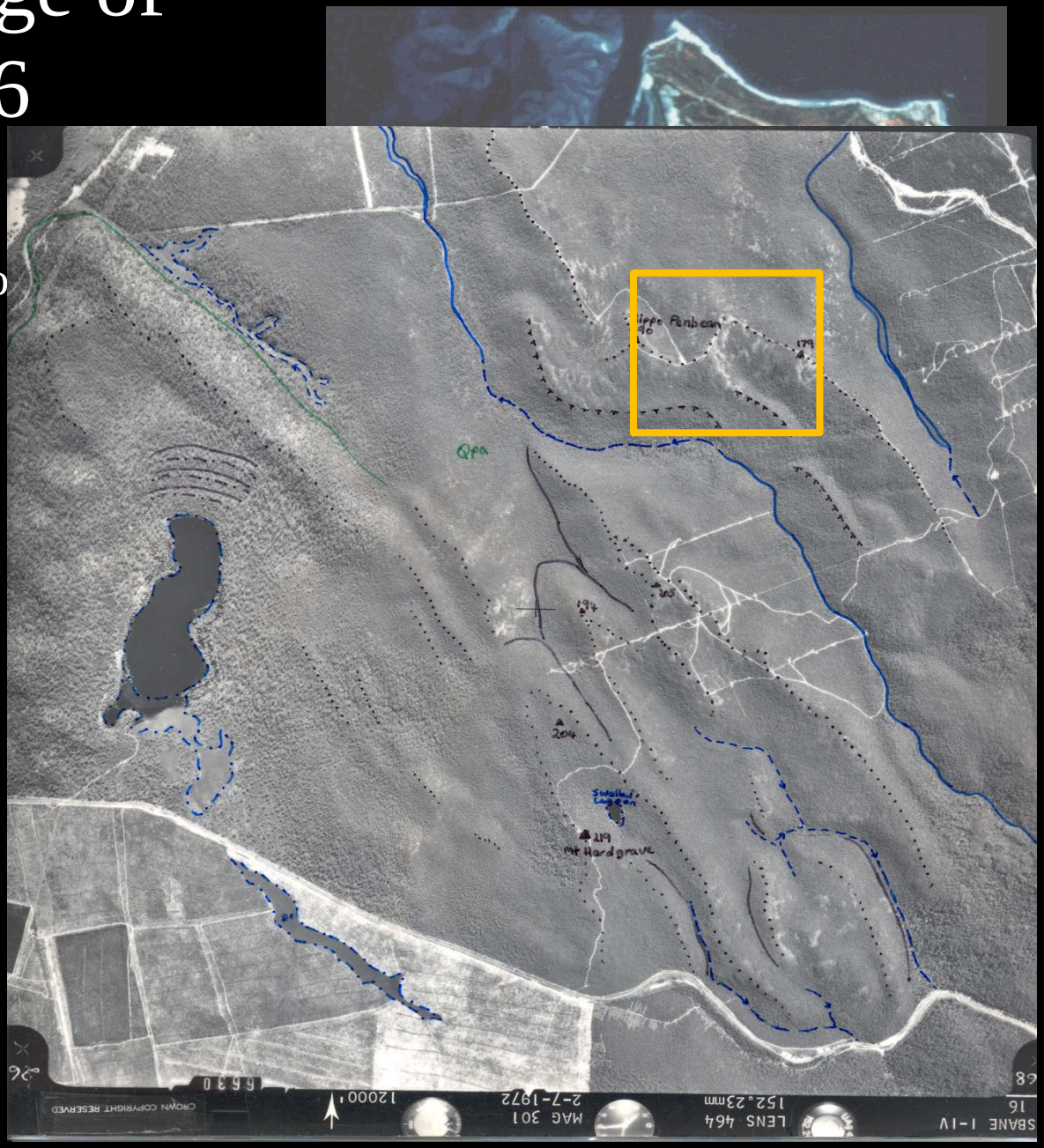
Satellite image of NSI 1976

(standard colour co

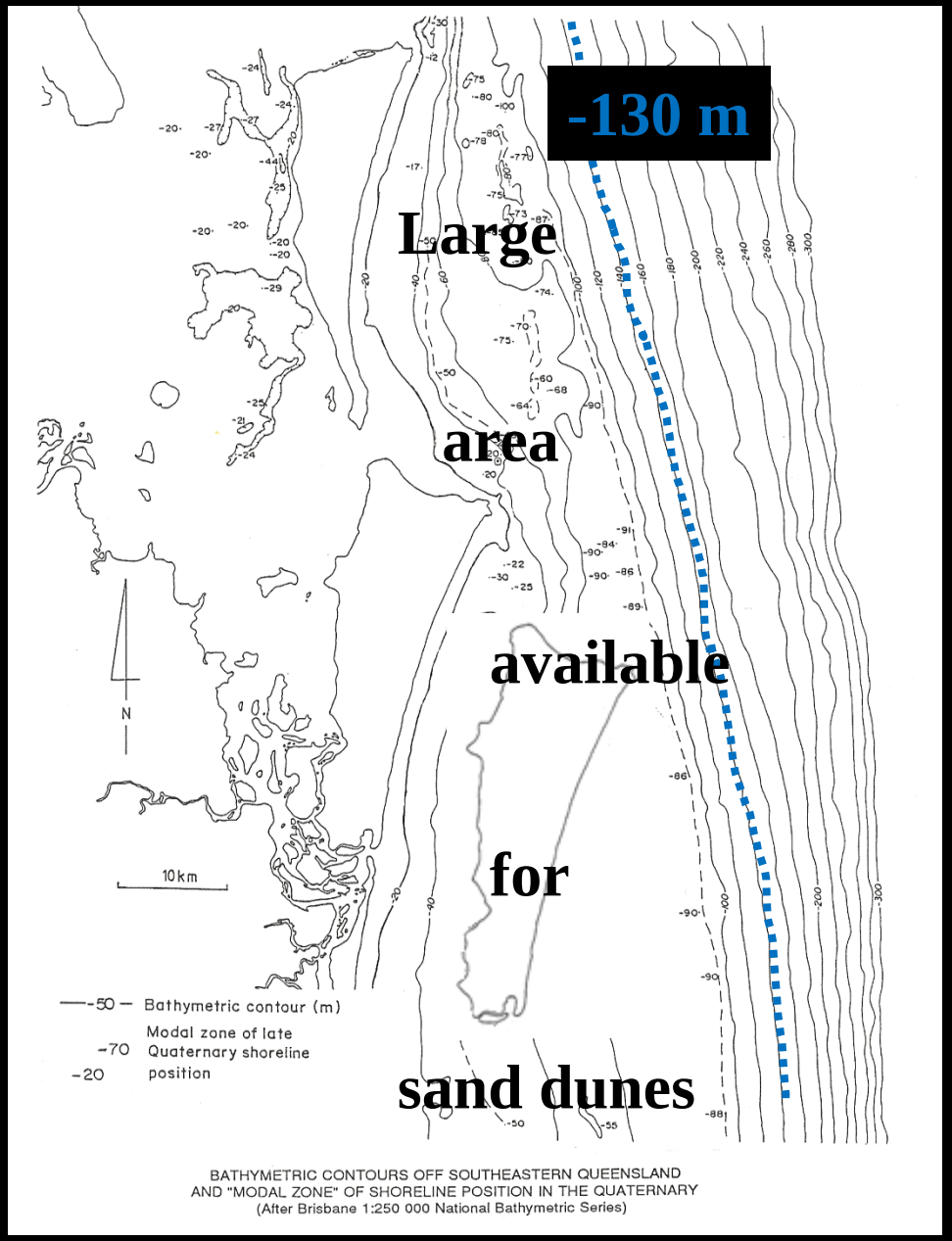
Northern NSI

NW-SE ridges (relict after large parabolic dunes)

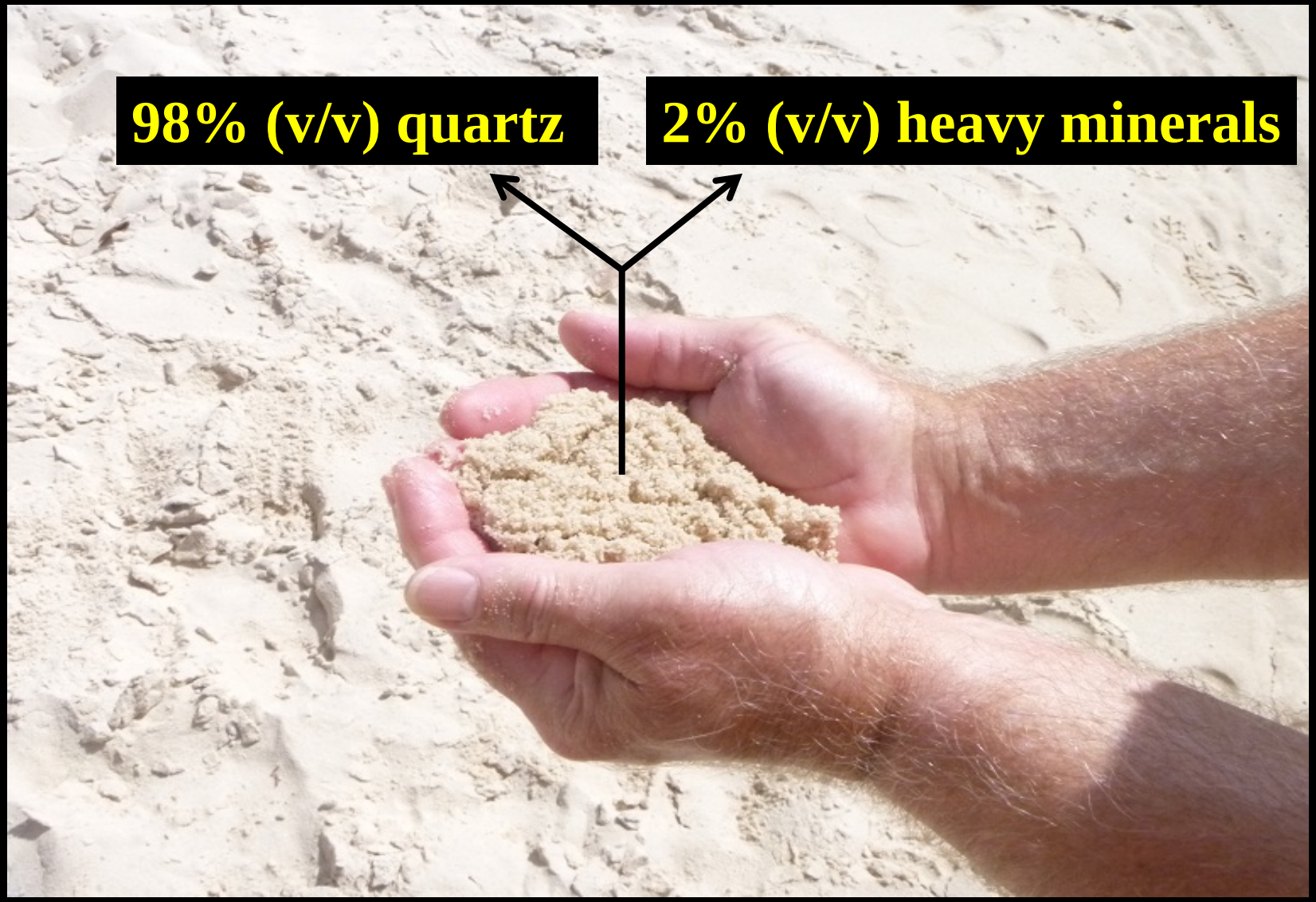
1982 B & W aerial photo



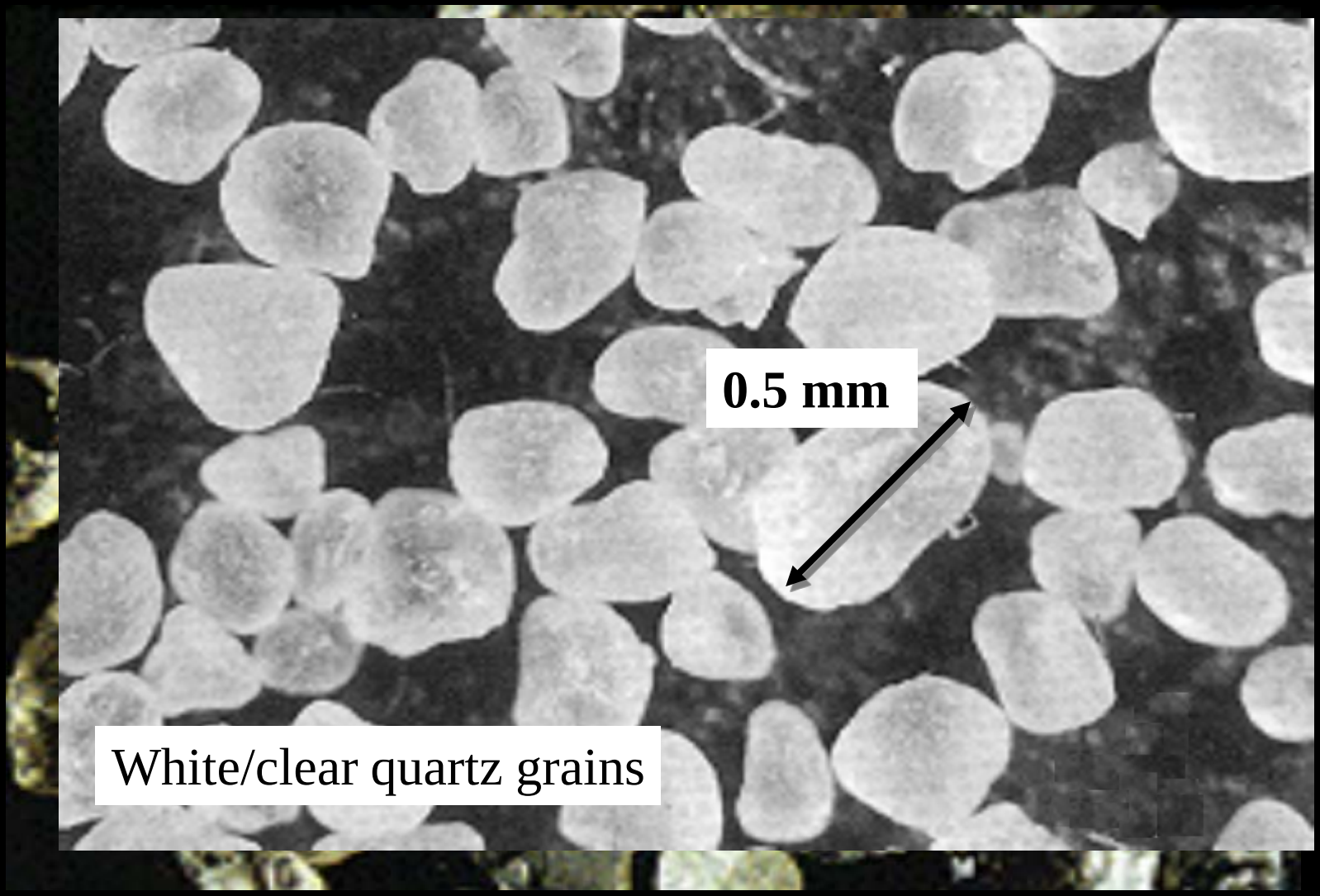
Sand islands and position of coastline about 18,000 years ago



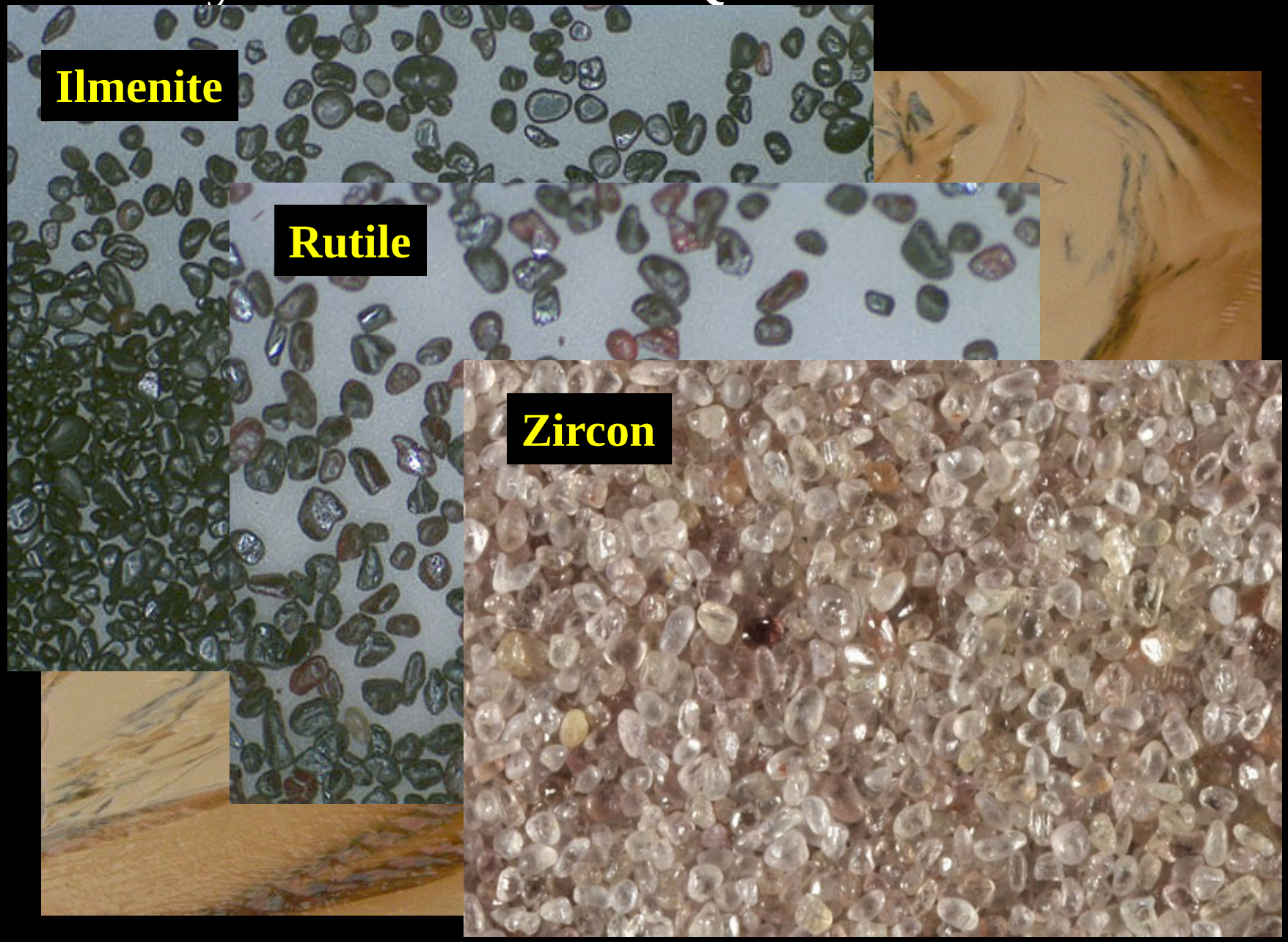
Minerals of SEQ beach and dune sands



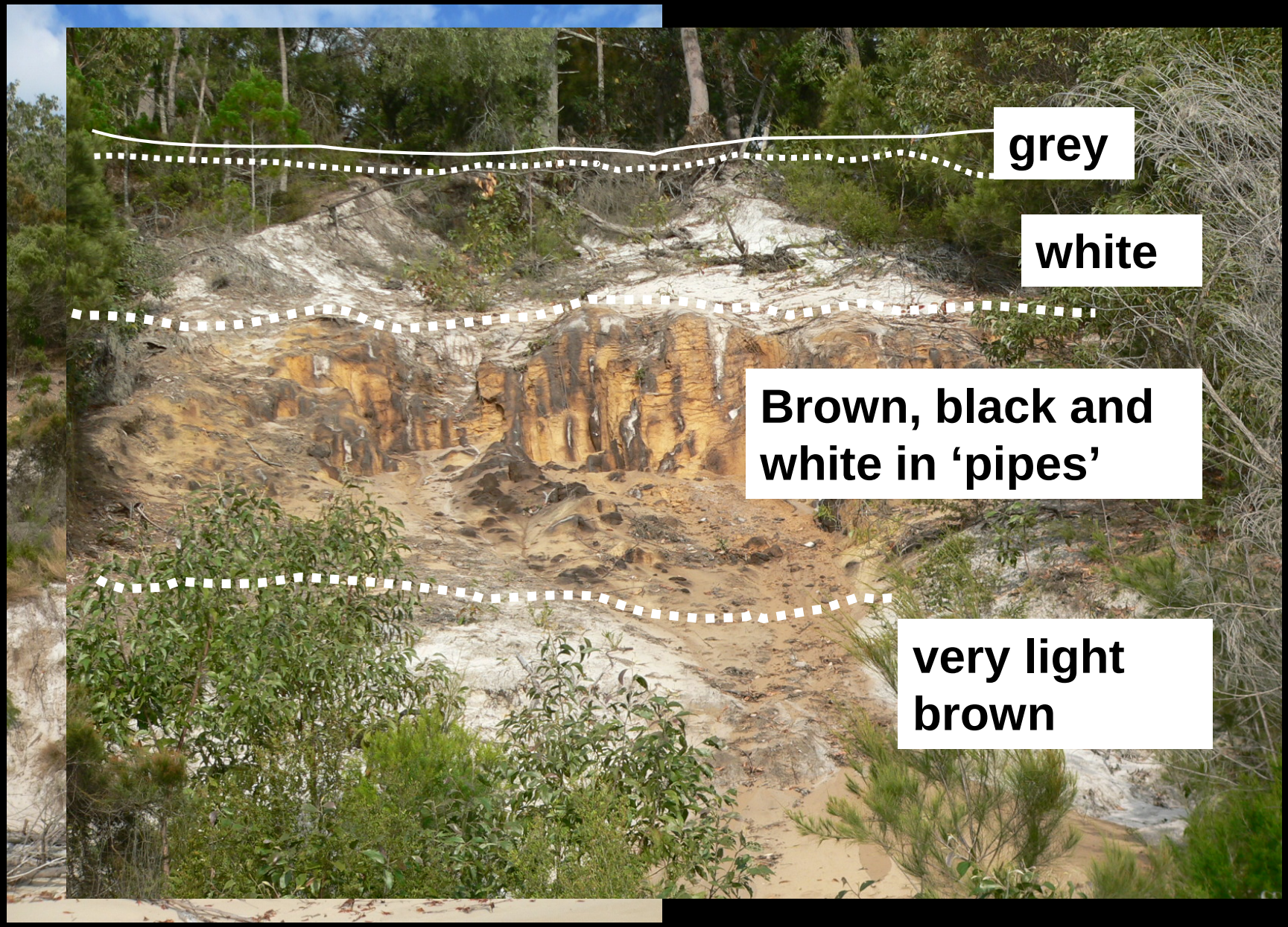
Quartz sand grains under a microscope



Heavy minerals in SEQ beaches and dunes



Deep siliceous podsol soil profile



Examples of humic podsols
(Also called ‘coffee rock’, humicrete)

Mining for heavy minerals – beaches & low dunes, high dunes

Mining of low dunes and beaches

Cudgen Beach, NSW, c.1958

Tomago area, NSW, 1986

Basic mining and rehabilitation sequence at Gordon Mine (view to S)

Image courtesy CRL

Water is involved throughout dredging and pumping sand to concentrator

Floating concentrator generates mixed sands for tailings and separates mineral sand products

Yellow-brown sand tailings built up from many stacking positions

Stripped topsoil stored in stockpiles then reclaimed for spreading over dredge tailings

Reshaped topography with topsoil, but…erosion creates variable base conditions for revegetation outcomes

Revegetation in progress

Water on North Stradbroke Island – surface and subsurface

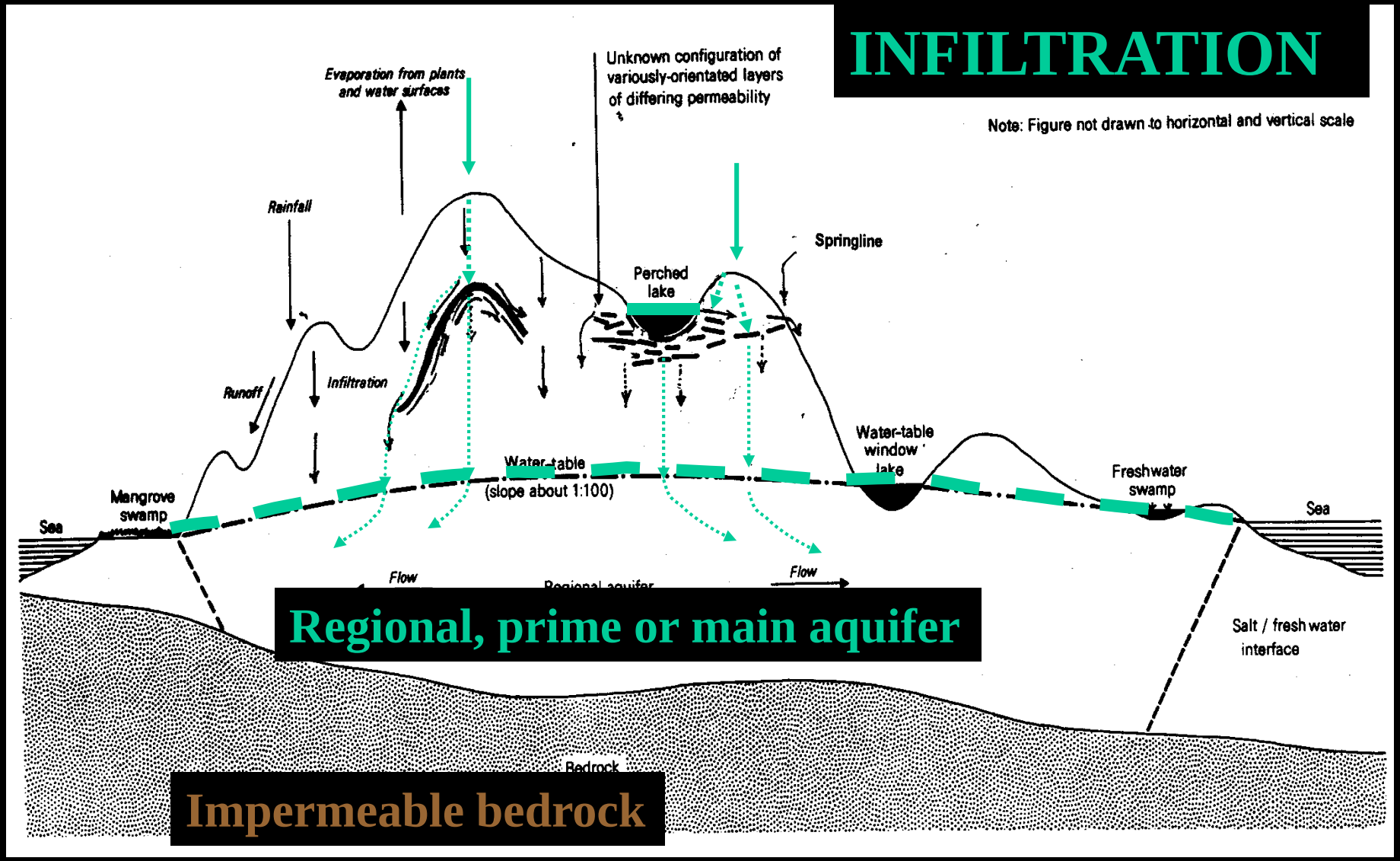
Where can I see the groundwater on North Stradbroke Island?

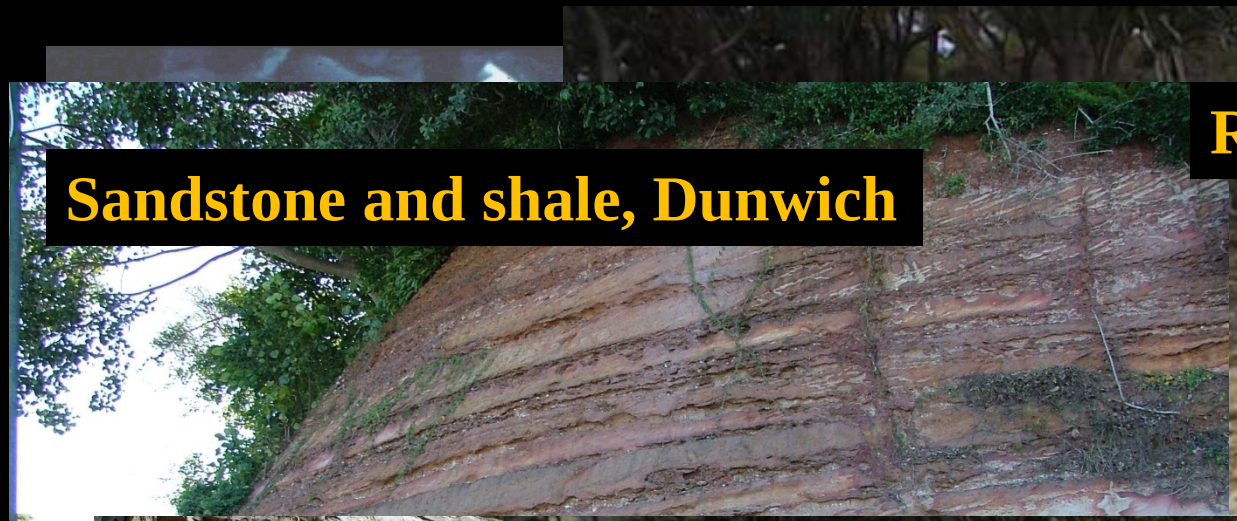
First find a beach…

Then dig a hole.

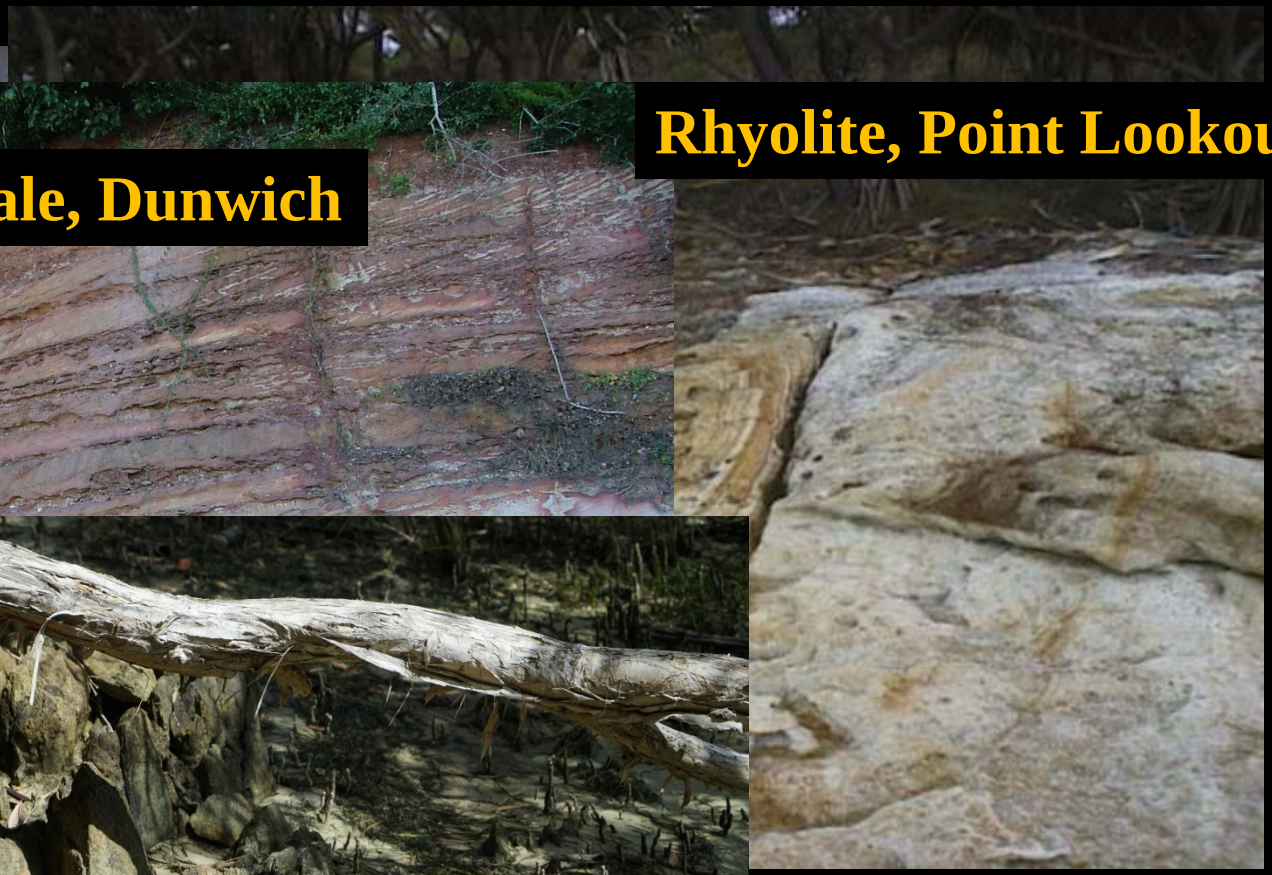
That's the top of the groundwater oozing out from between the sand grains

Diagrammatic cross-section of a typical sand island





Sandstone and shale, Dunwich

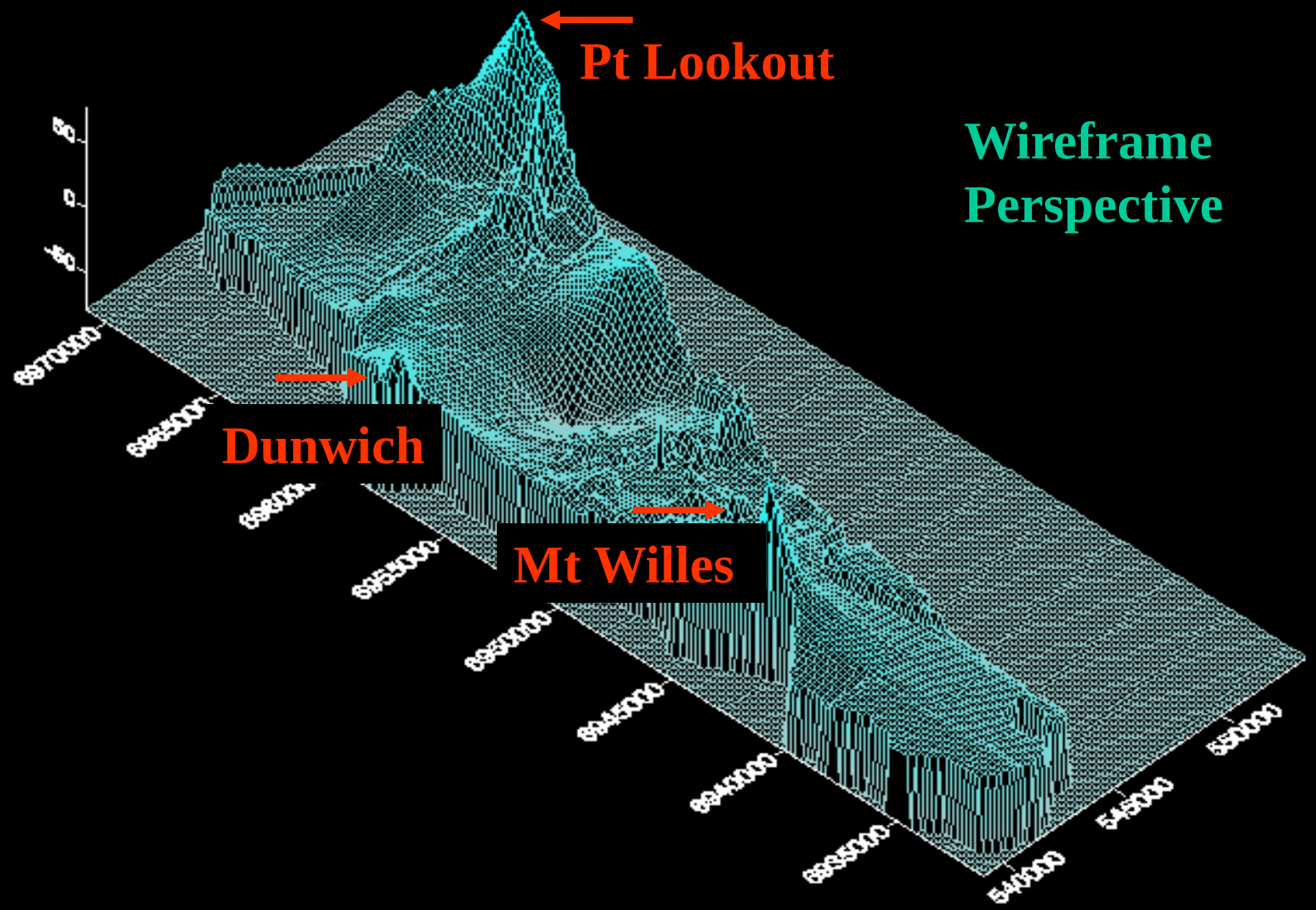


Rhyolite, Point Lookout

Greenstone, Canaipa Passage

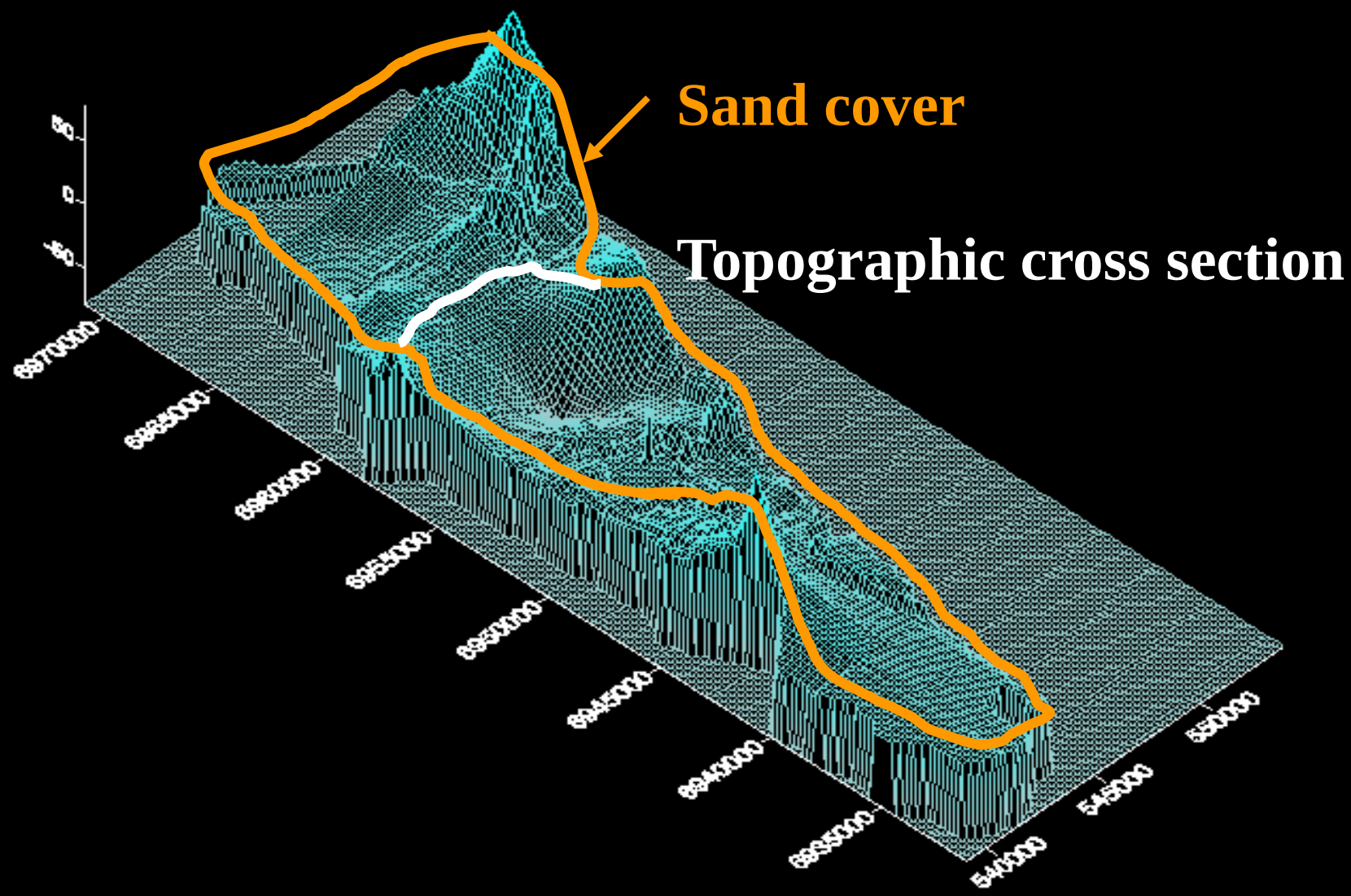
Bedrock topography for North Stradbroke Island

(Reconstructed from intersections in 6680 drill holes)



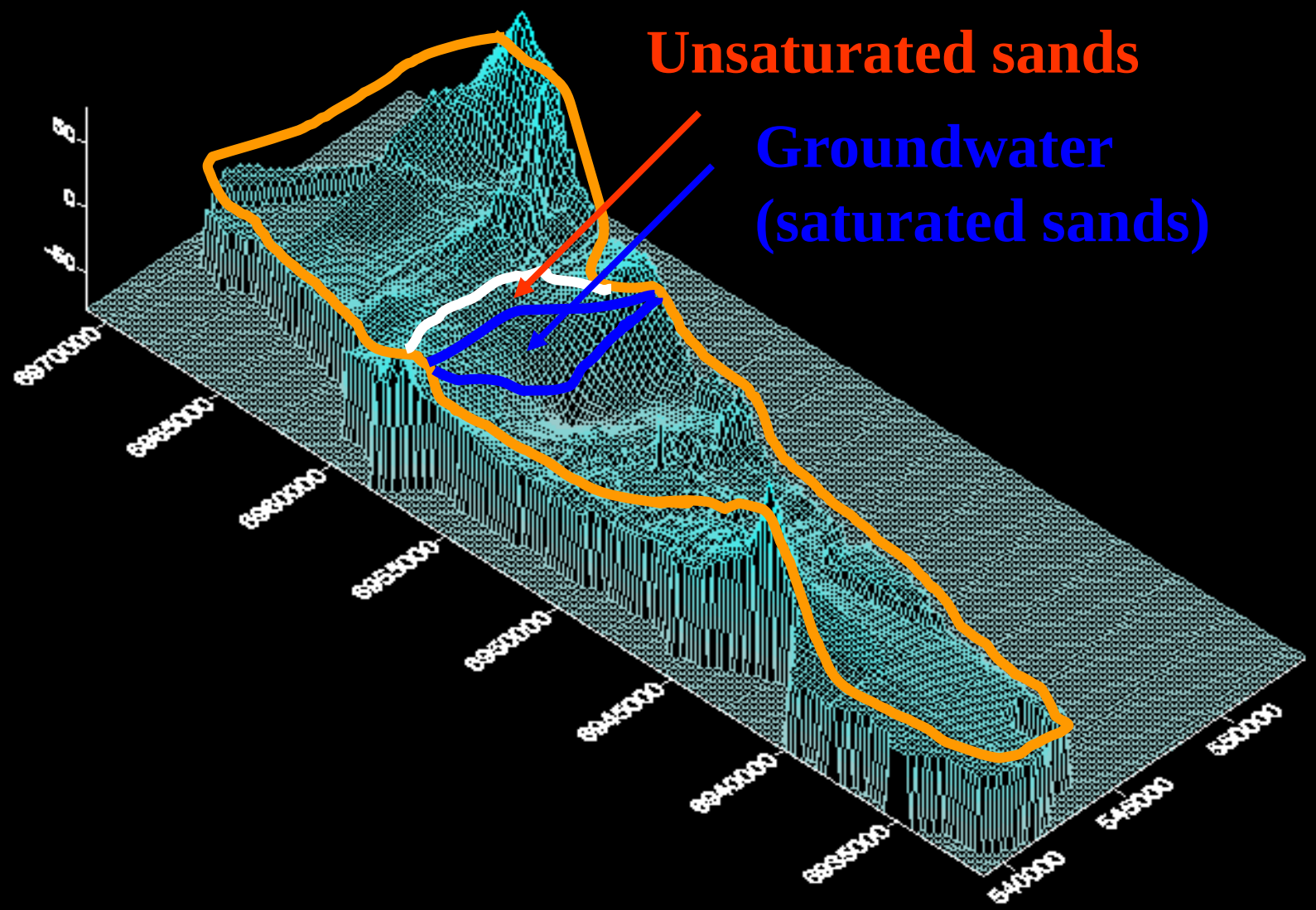
Bedrock topography and sand cover NSI

(Diagrammatic on wireframe perspective)



Saturated and unsaturated sands in one cross -section

(Diagrammatic perspective)



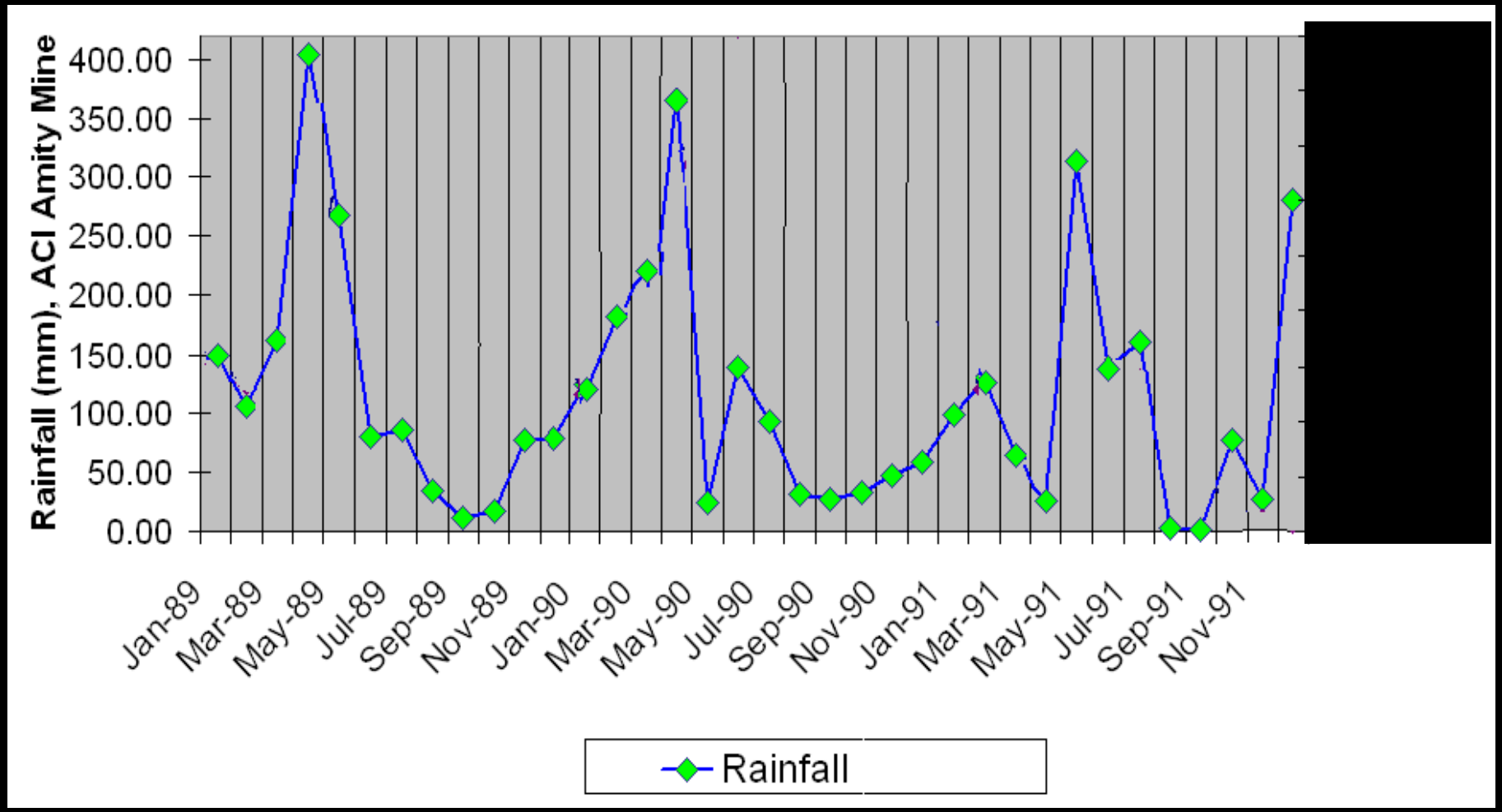
North Stradbroke Island...

two perched waterbodies

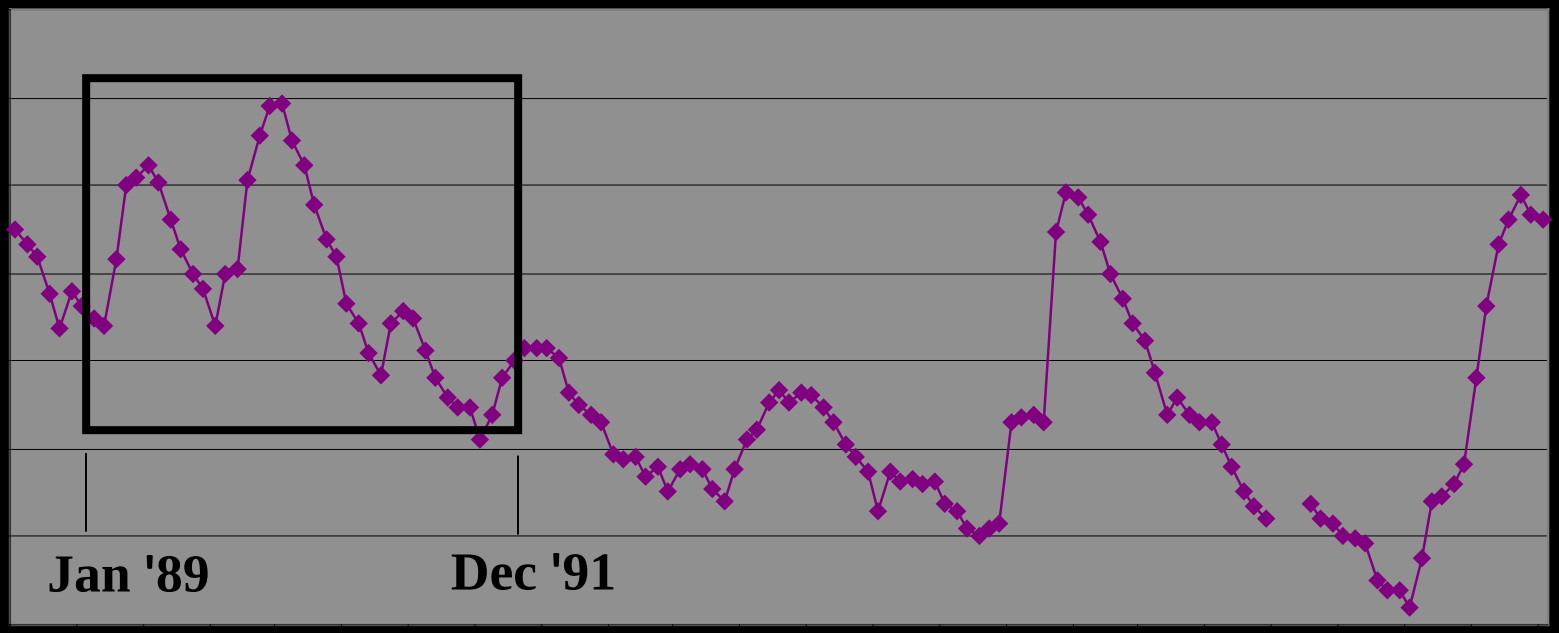
Brown Lake, NSI

Swallow Lagoon, NSI (view NW

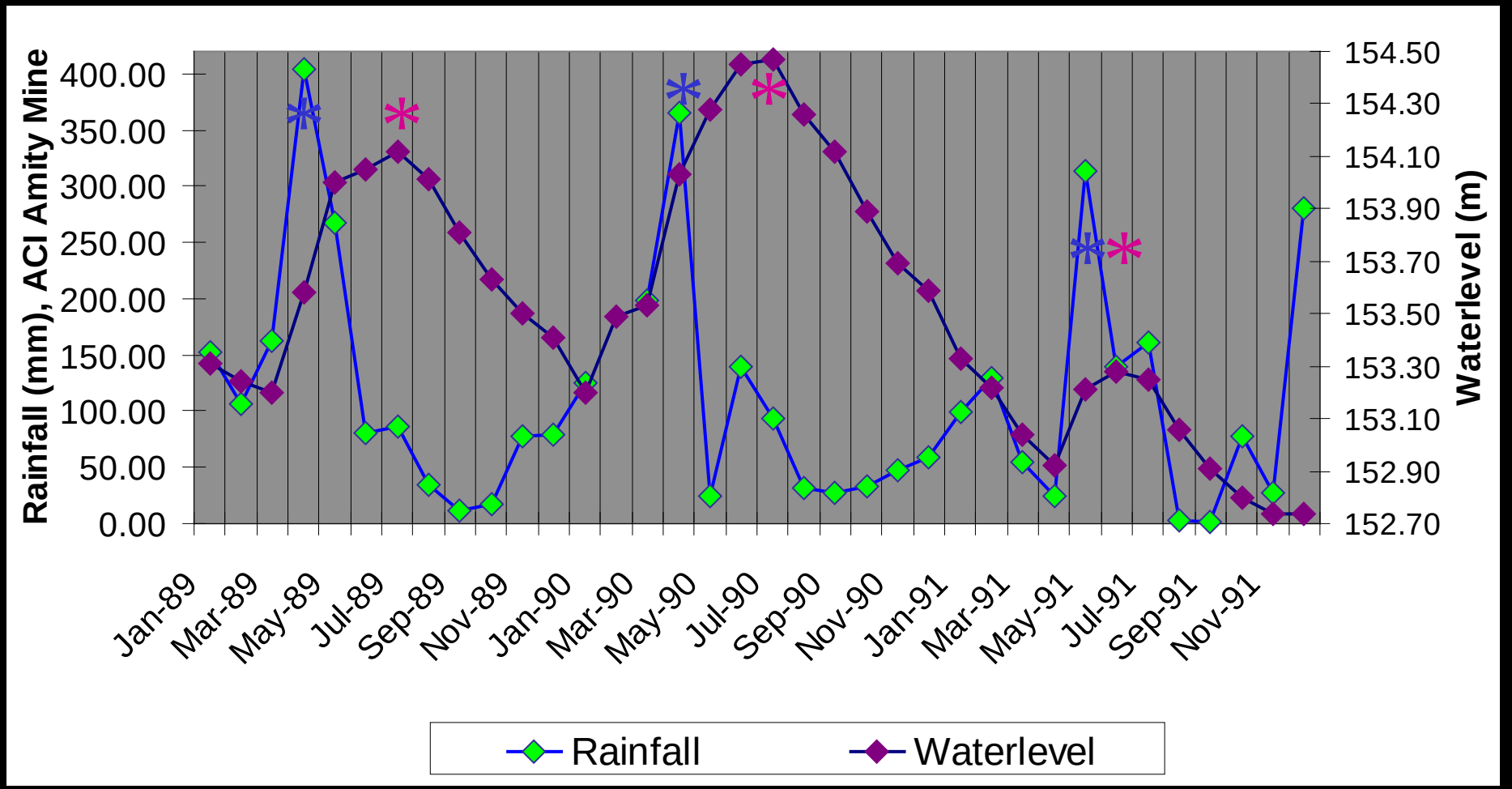
Dynamic water system on NSI…
seasonal, long- and short-term variations



Monthly rainfall near Swallow Lagoon, January 1989 to December 1991



Waterlevel fluctuation in Swallow Lagoon, July 1988 to January 2000

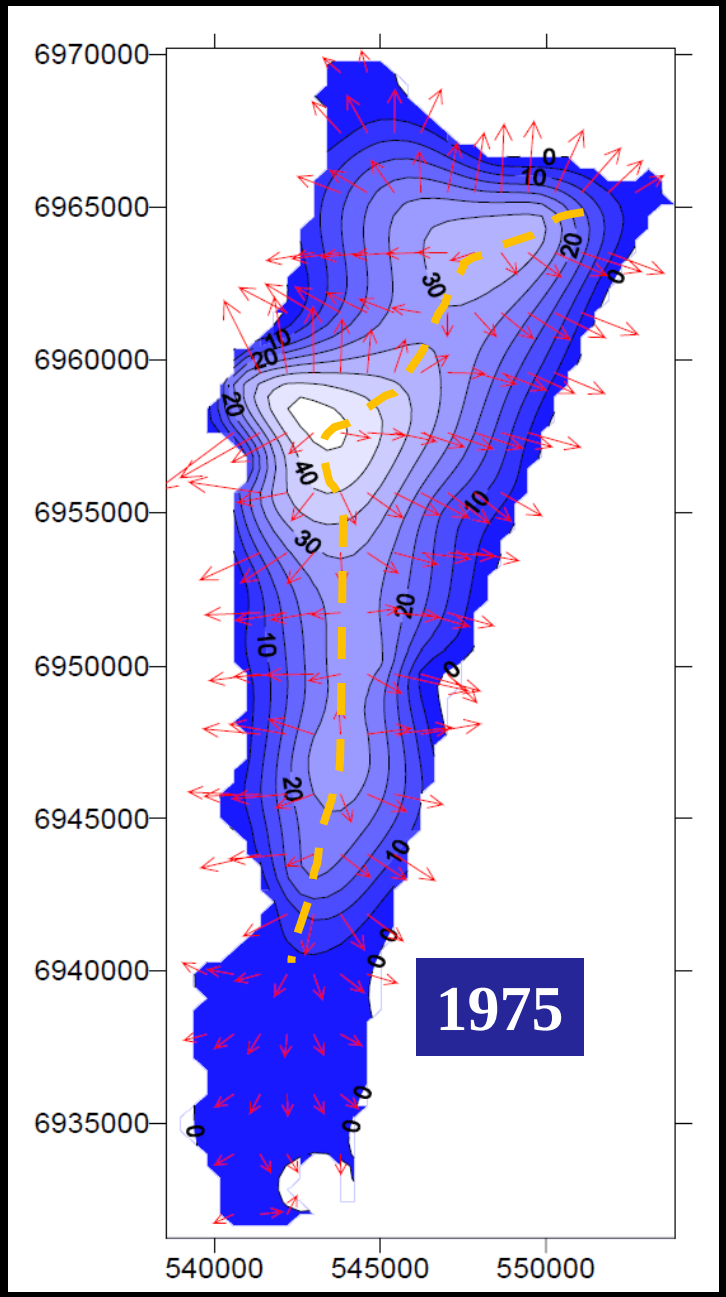


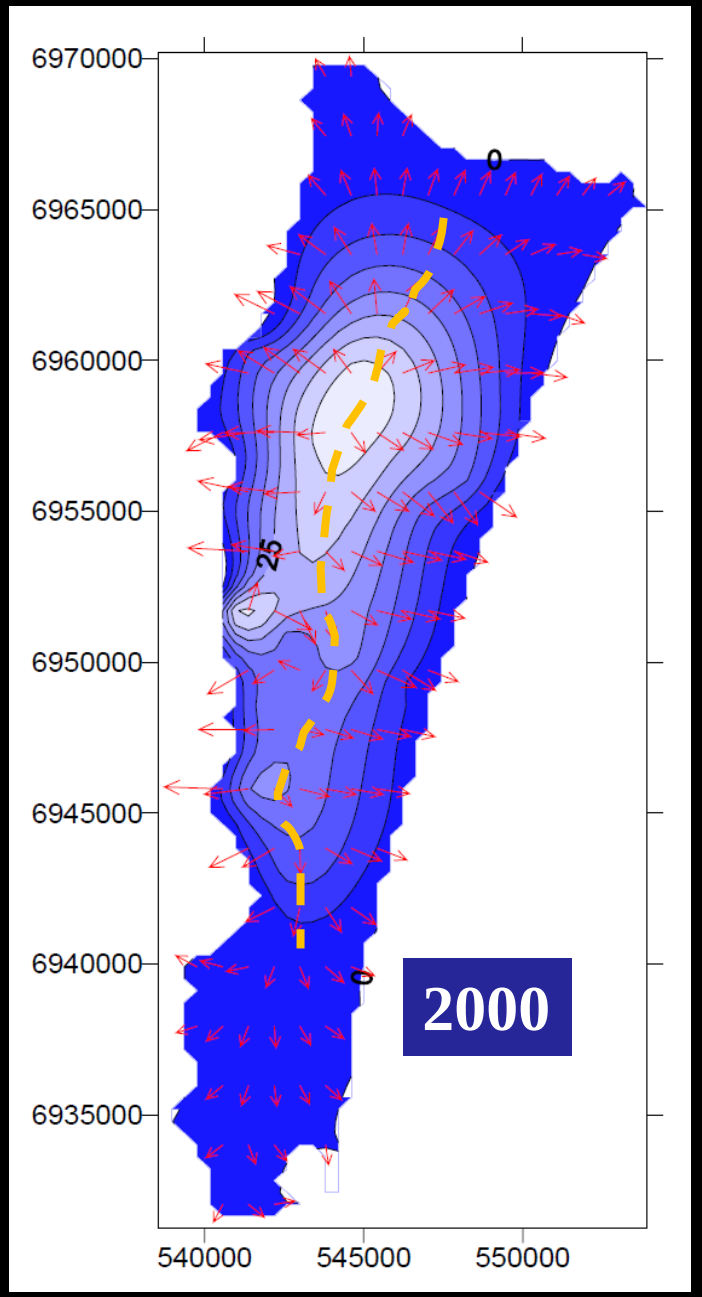
Monthly rainfall and waterlevel in Swallow Lagoon, January 1989 to December 1991

NSI

Ground-water surface elevation changes over time

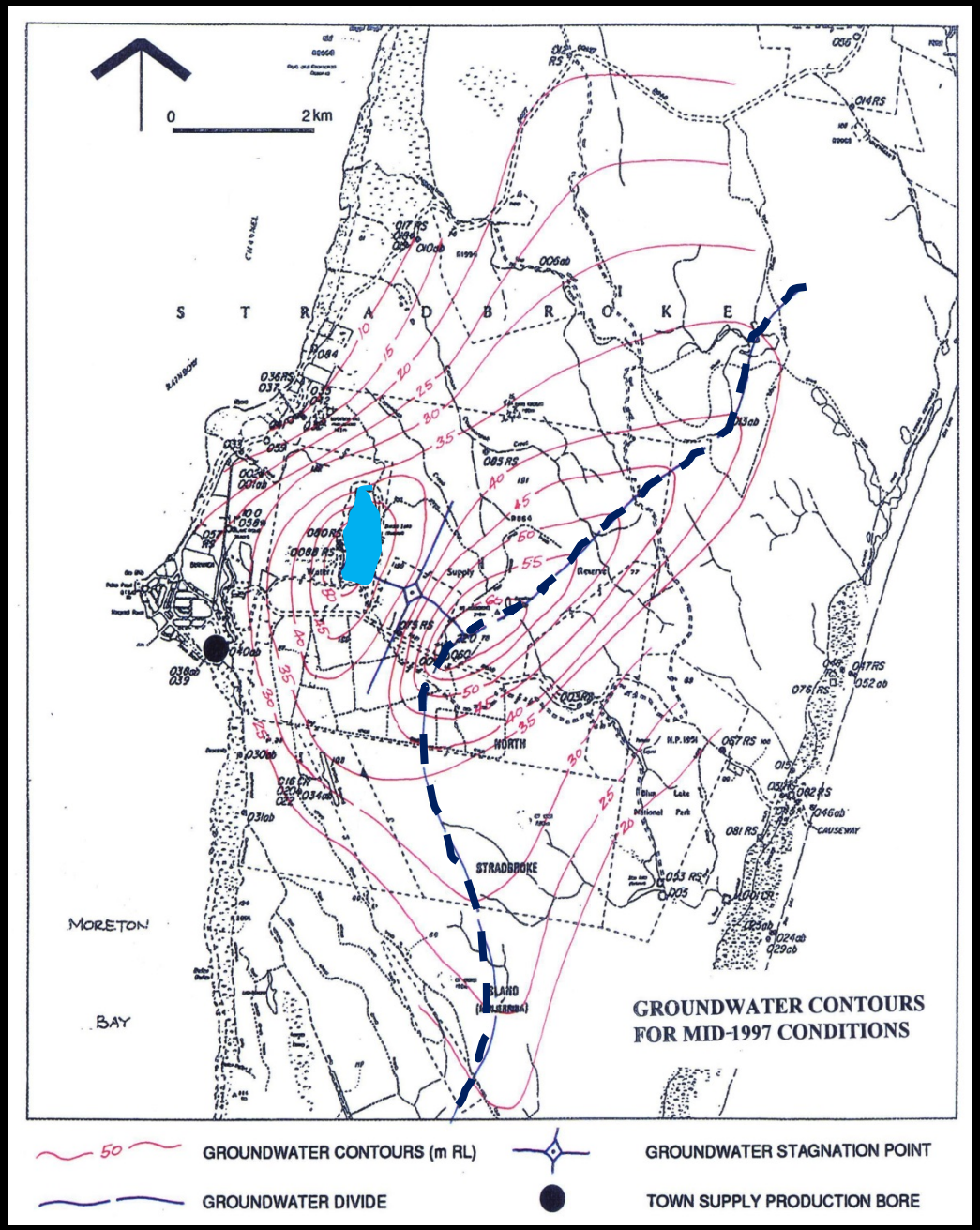
(After Chen, 2001)



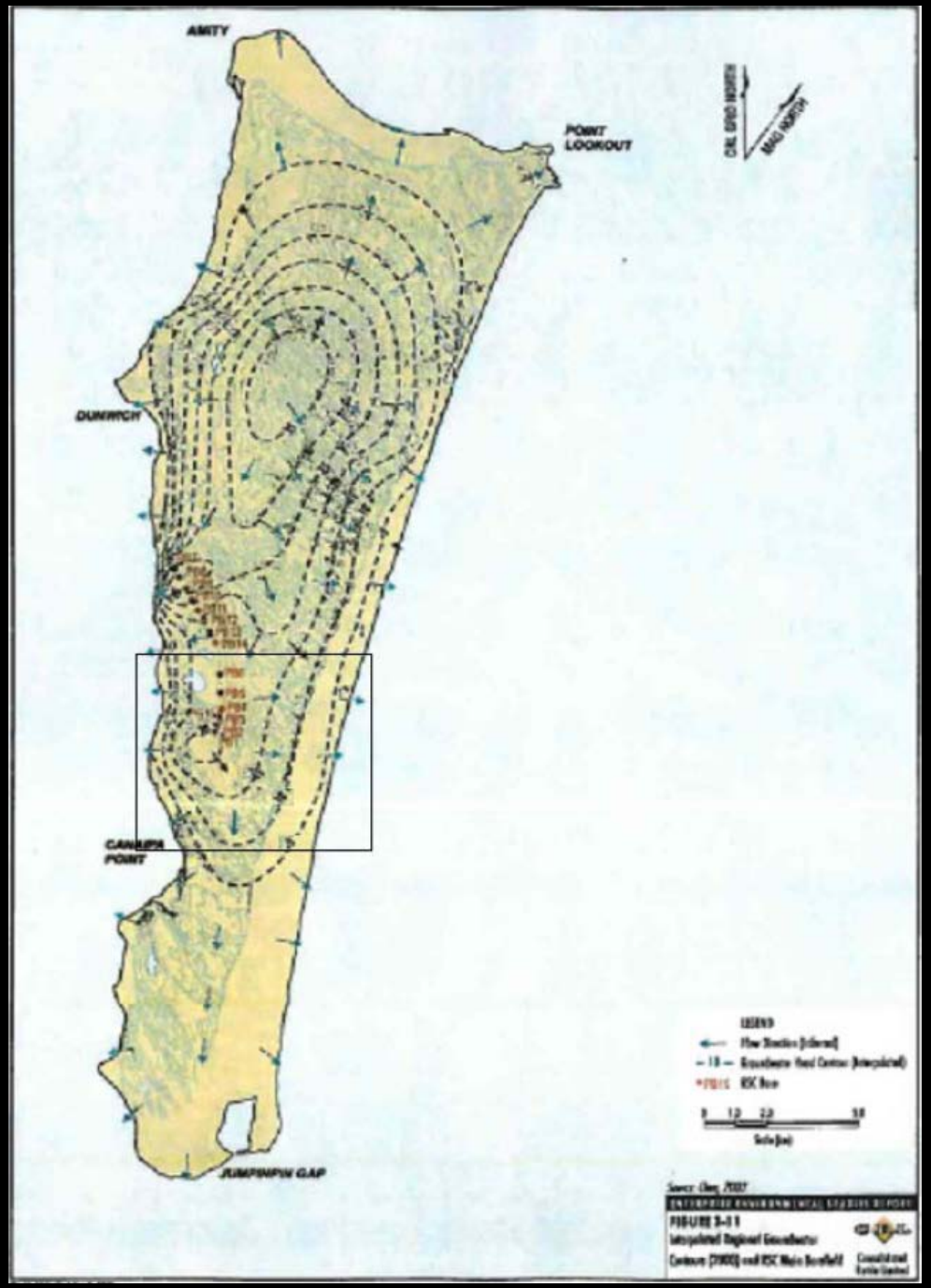


Groundwater contours mid-1997, central NSI

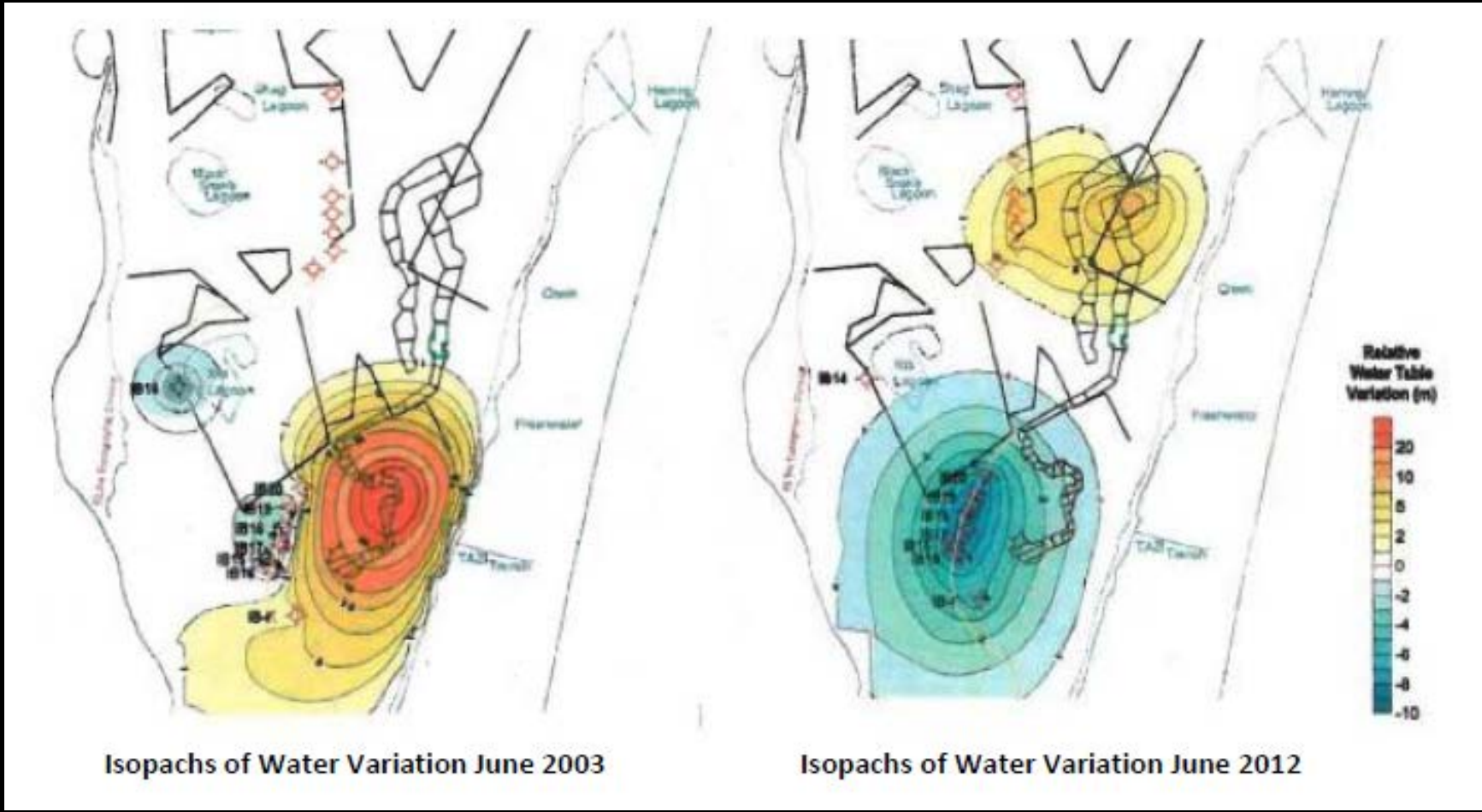
(After GHD, 1999)



Natural groundwater variations affect subsurface movement of water losses from mining



Forecast variations in groundwater linked to operations at Enterprise Mine



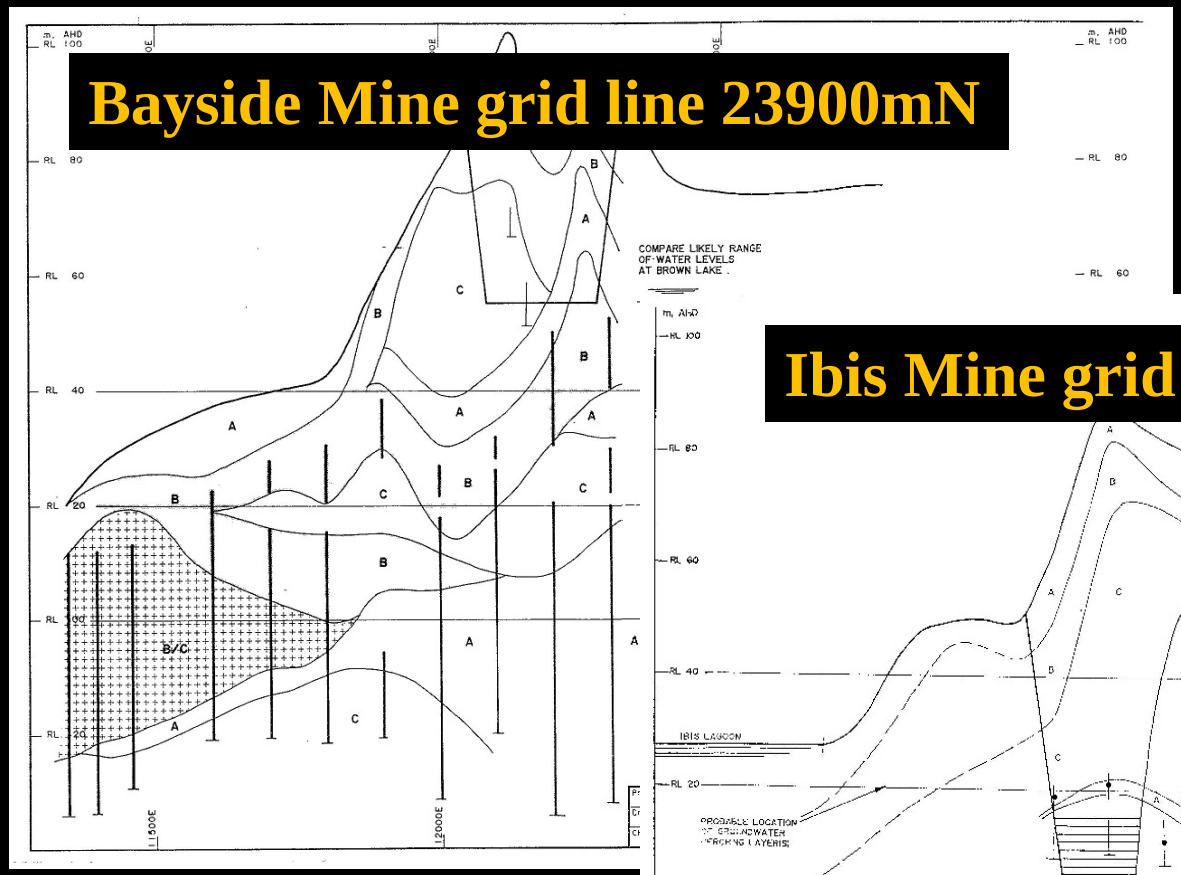
(CRL, 2003, Environmental Studies Report)

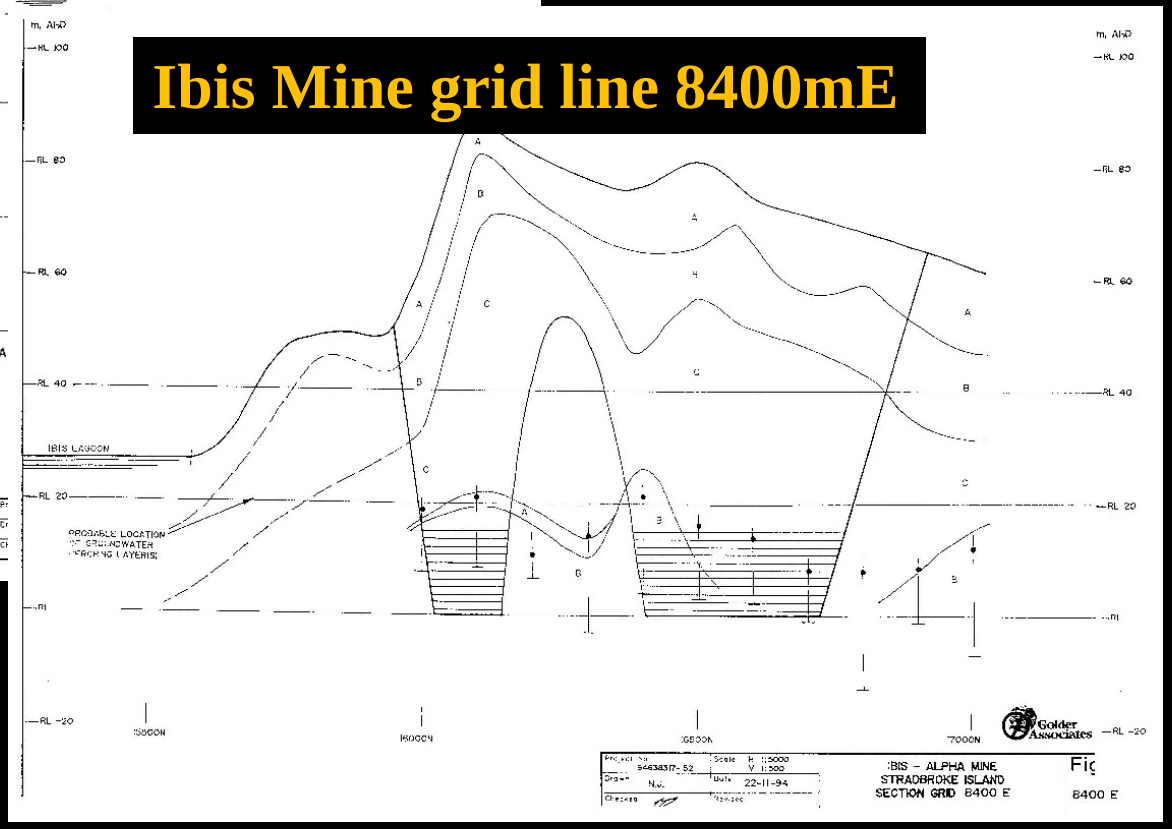
B-horizon of a soil…a type of semi-permeable aquitard slowing groundwater movement

B-horizon in giant podsol exposed by mining

a type of semi-permeable aquitard slowing groundwater movement

Drilling and mining reveals soil profiles formed on different older dunes

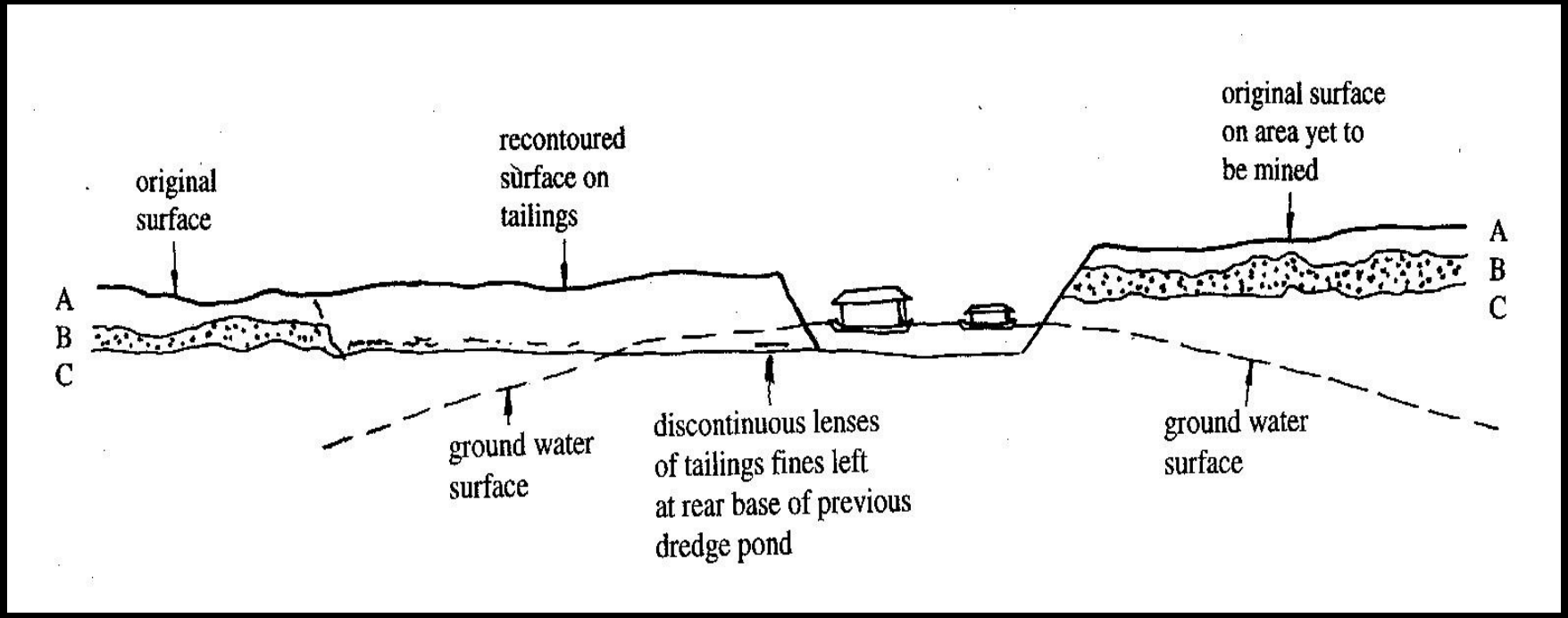




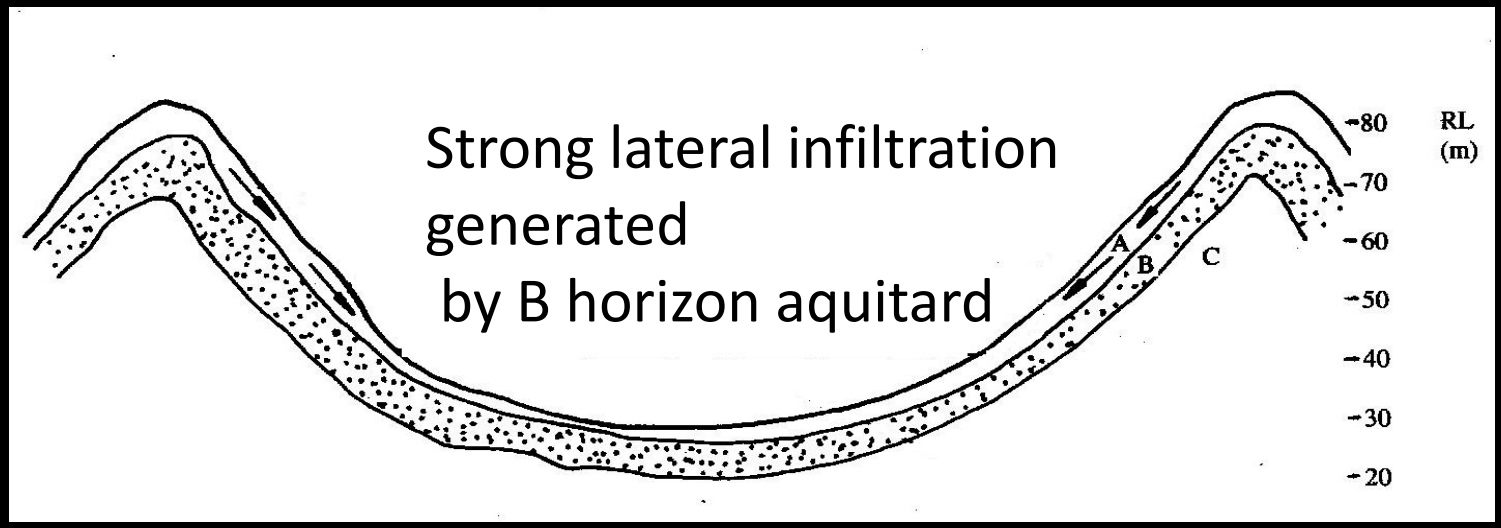
Variable sands exposed in excavation walls

Iron-cemented sands act as aquitard to water movement

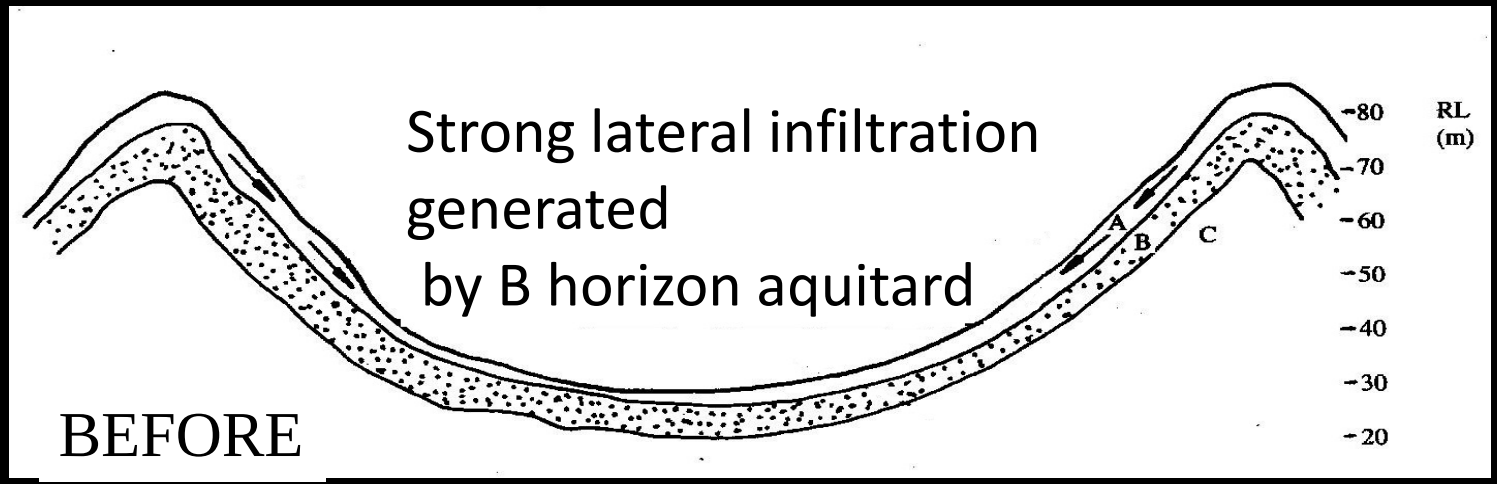
Long section of dredge tailings replacing natural soil profile

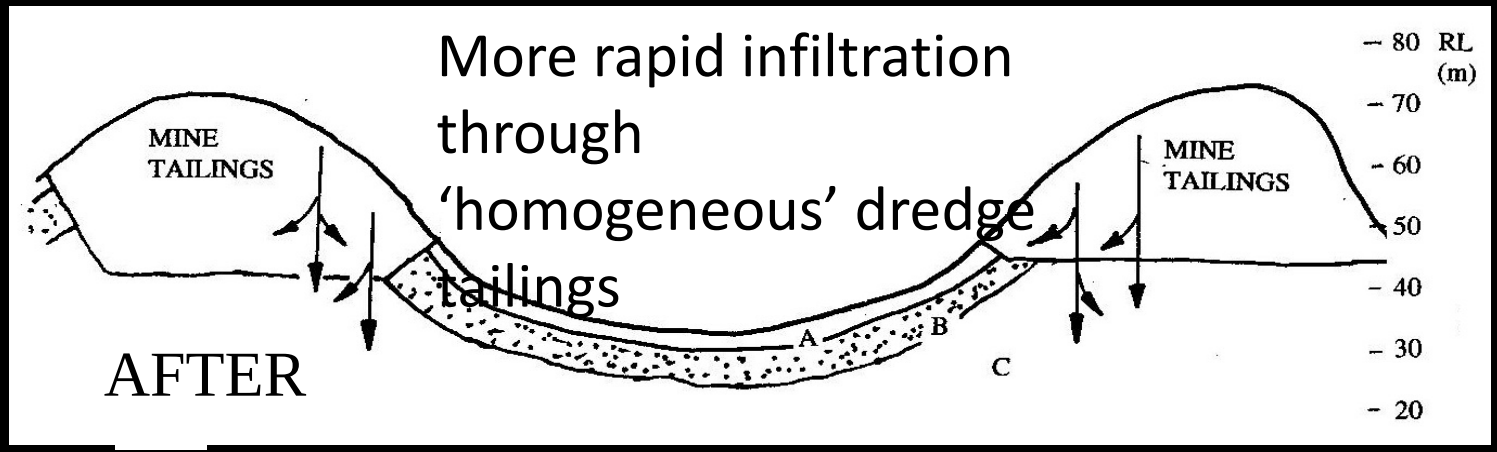


Cross section of natural soil profile



Cross section of natural soil profile replaced by dredge tailings





Off-lease impacts caused by substandard water management

- Amity Mine: multiple impacts 1977→
- Bayside Mine: sand spill into Moreton Bay 1982→
- Ibis Mine: flooding of Ibis Lagoon West 2000-01→
- Enterprise Mine: flooding of Ibis Lagoon system 2010→
- Yarraman Mine: flooding off-leaase 2012-13→

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- Waterbodies drained: Blaksley Lagoon 1981→
  Lake Kounpee 1987→
- Waterbodies flooded: Native Companion Lagoon 1988→
  Ibis Lagoon 1996-97→

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Damage to intertidal, swamp and terrestrial areas, Amity Mine, 1977-80

Amity Mine – as in 1979 aerial view to SW

History of off-lease damage at Amity Mine 1977-80

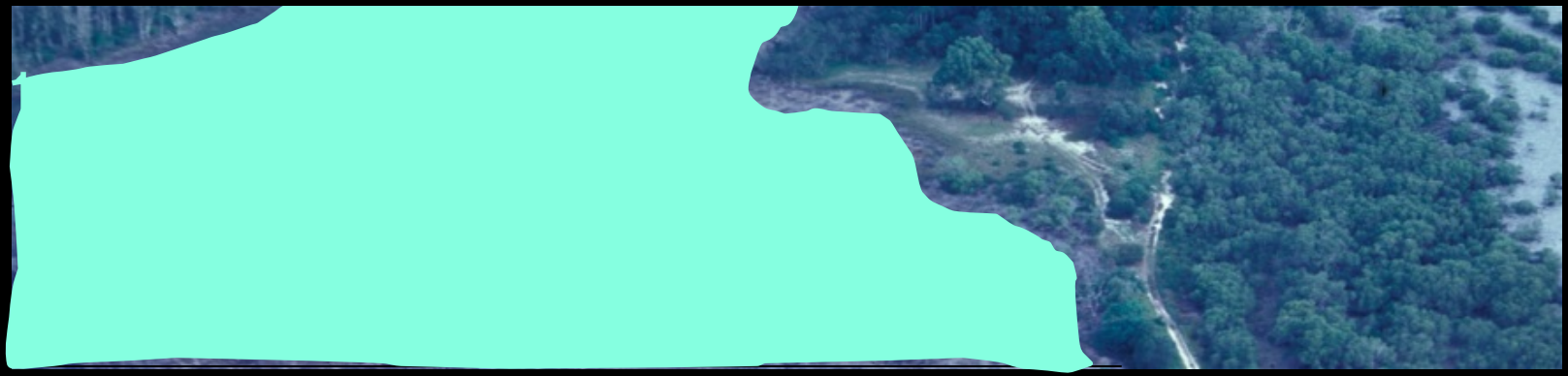
Salt water pumped from Wallum Creek to dredge pond …

… drains to west and kills 2 ha terrestrial vegetation

History of off-lease damage at Amity Mine 1977-80

Bund dam built across Wallum Creek to exclude salt water

Impounded freshwater kills mangroves and intertidal fauna



Channel cut in Amity swamp to supply make-up water to Amity Mine

Sand spill into Moreton Bay from Bayside Mine 1982

Bayside sand slip in 2010 and size comparisons

Disruption to coastal swamp and mangroves at Bayside sand slip 1982

Ibis Mine floods Ibis Lagoon West, 2000

Surface water levels in two Ibis lagoons during part of 2000

Flooding from Yarraman Mine 2012-13

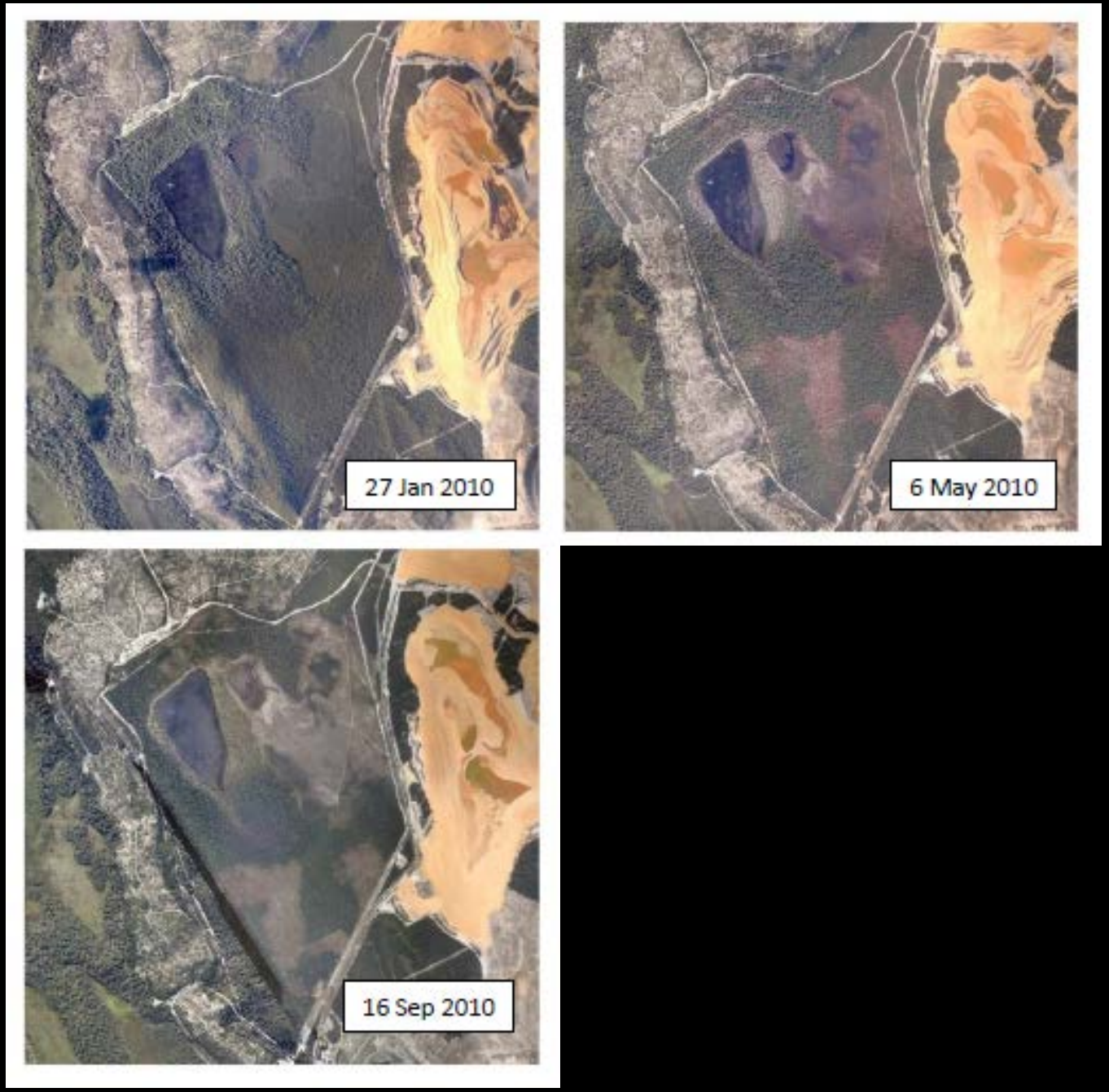
Flooding of Native Title Exclusive Possession Land and Fisherman Track from Yarraman Mine

Water discharge from Yarraman Mine through poor management of tailings water

Probable flooding of Ibis Lagoon system from Enterprise Mine in 2010

Ibis Lagoon system located west of Enterprise Mine 2010

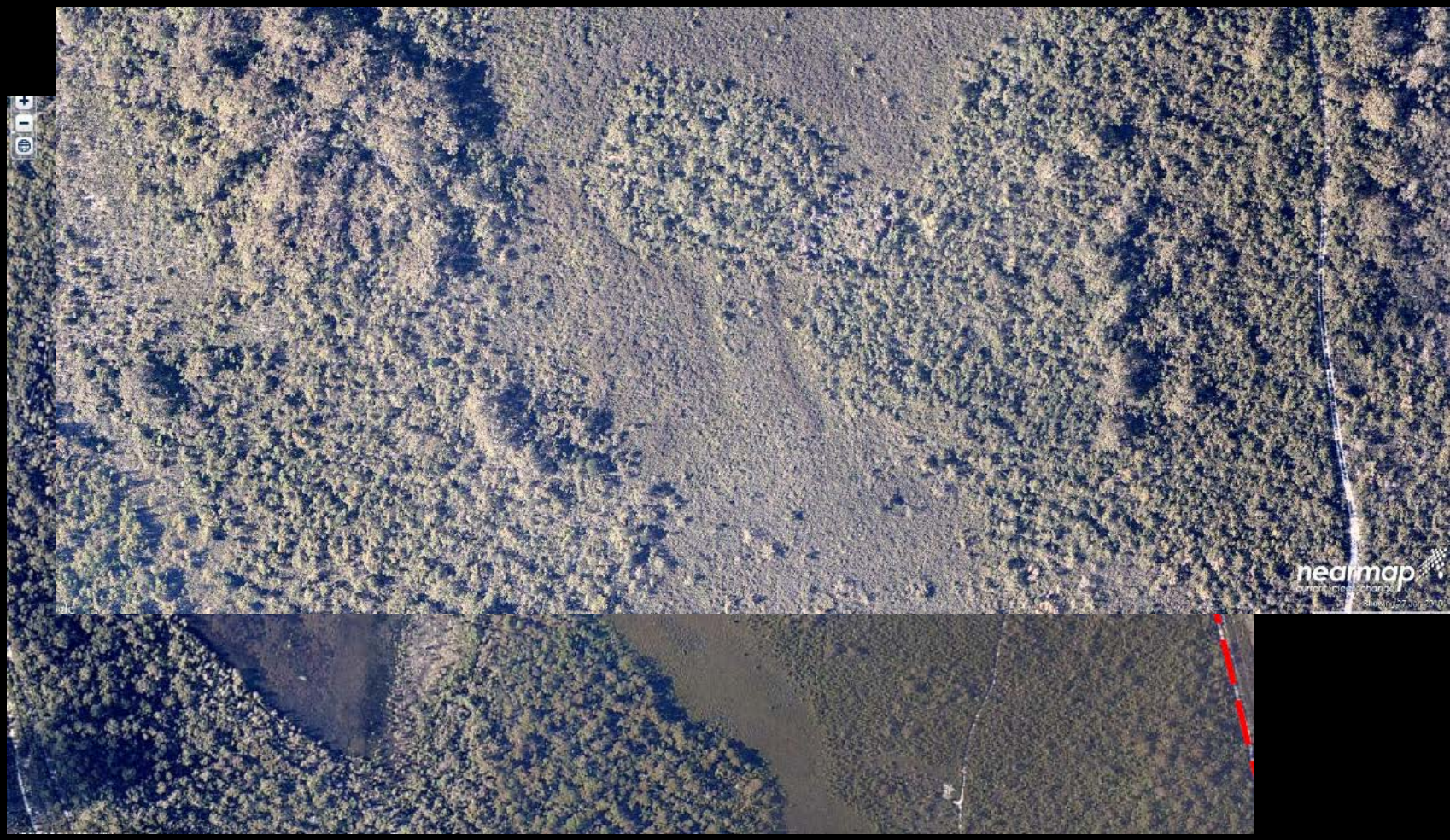
Condition change in Ibis Lagoon system during 2010



(Nearmap Imagery)

Condition change northern area Ibis Lagoon system – 27Jan2010 and 6May2010

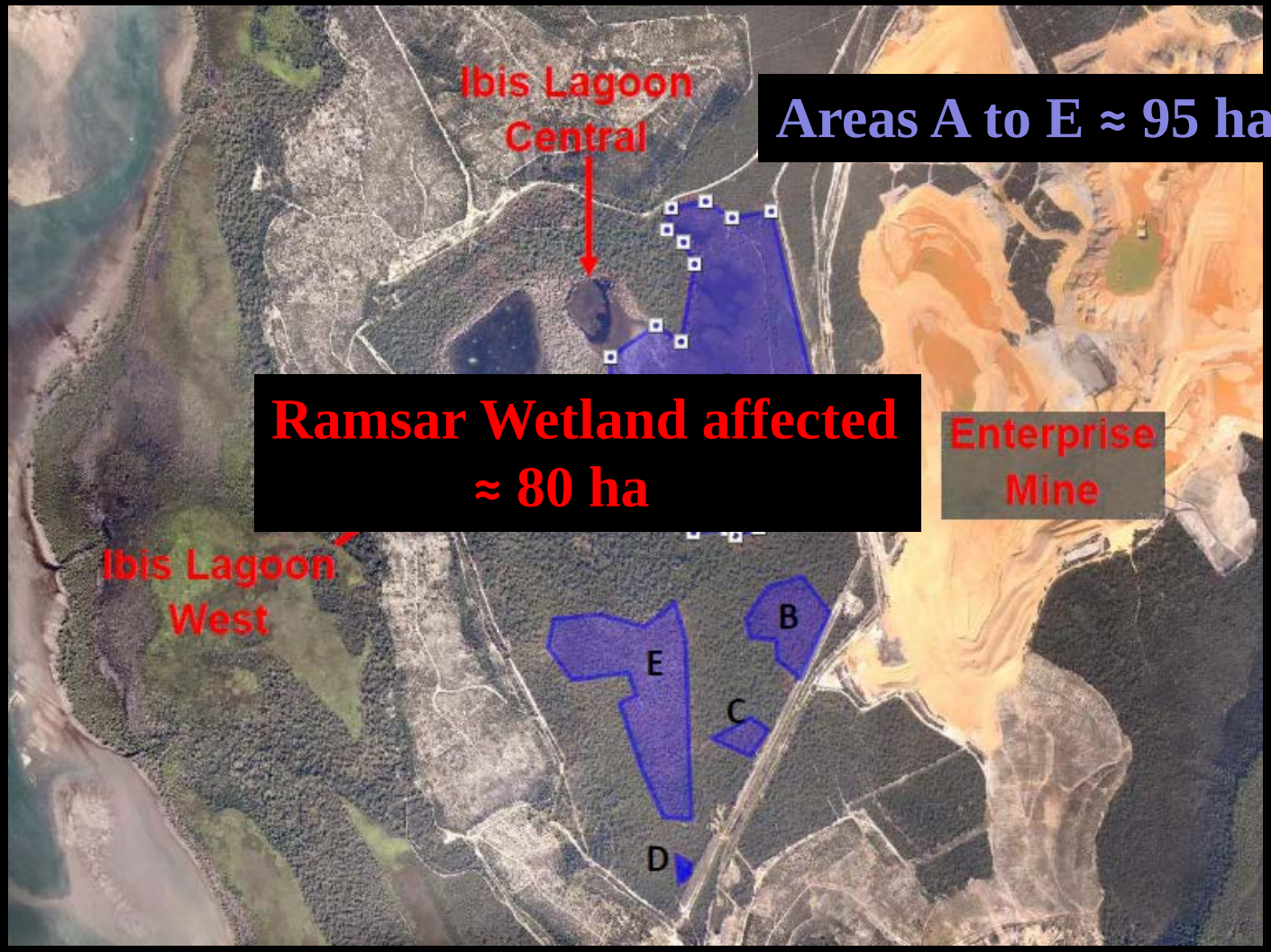
Detail of part of northern area Ibis Lagoon system 27Jan2010



Details of condition change in part of northern area Ibis Lagoon system

Photo-patterns in southern area of Ibis Lagoon system on 6 May 2010

Compilation of flood-damaged areas, Ibis Lagoon system on 6 May 2010



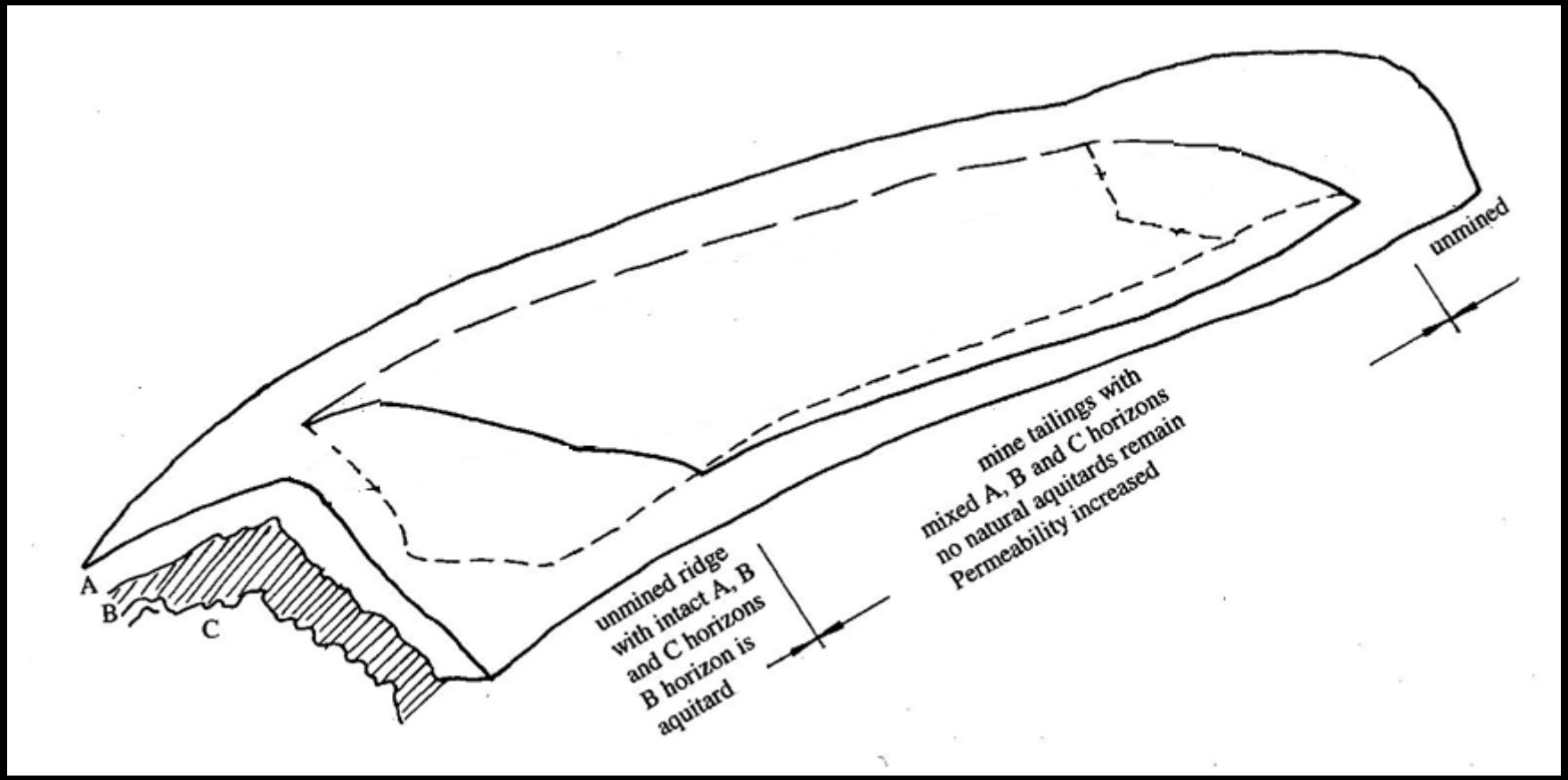
Impacts of mining on North Stradbroke Island

Areas mined on North Stradbroke Island…

…floating dredge and dry mining

…low dune and beach mining

Mining legacy: original soil profiles replaced by wedges of mine tailings



Mining legacy:

- Most natural waterbodies, on and off lease, flooded or drained
- Inter-catchment transfers of waters permanently affected original aquatic ecosystems
- Hydrogeology and groundwater regimes permanently altered