BUNBURY, OUR HOME FROM A GEOLOGIST'S VIEWPOINT

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WHO AMONGST YOU HAVE SEEN A LOCAL VOLCANO?

DO YOU FEEL THE HEAT???? The heat from under your feet or chairs?

Not a joke – we are living here in Bunbury through the heritage of old volcanoes

(But that's only part of the story)

Mt Mayon, 2019

- video Iceland erupting - Google Search

IN THIS TALK

- Were in the world is Bunbury
- How did the site get here - Plate Tectonic background
- Underneath us – 11km of Perth Basin sediments
- Rivers of basalt and volcanoes
- Landforms – modern and older coastal dunes
  - History of sea levels
  - Evolution of our surroundings
  - Where we like to live
- Questions

We are lonely:

7500KM TO THE WEST = AFRICA

-

5000KM TO THE NORTH = ASIA (ACROSS LOTS OF ISLANDS)

–

THIS IS JUST A GLIMPSE NOW

-

BUT NOT ALWAYS THE CASE

BEFORE ~200 MILLION YEARS AGO (Ma) ***PANGEA*** WAS THE ONLY CONTINENT

200Ma, is only 4% of the time since the Earth and our whole ***Solar System*** were formed 4.5 billion years ago

After ~200Ma we had supercontinent *Gondwana*

CONTINENTAL BREAKUP STEPS

- **Gondwana** and **Laurasia** split apart
- Then ***South America*** and ***Africa*** departed leaving **East Gondwana**
- At 132Ma ***India*** splits off
- Between 120 and 95 Ma ***Antarctica*** and ***Australia*** separate, starting by unzipping from west to east

Note Perth Basin

A BIT MORE ON INDIA

- At 132 Ma, India splits from ***East Gondwana***
- Heads northerly, opening Indian Ocean
- Hits Asia at 25 Ma
- Forms ***Himalayas*** and pushes up ***Tibetan*** plateau
- Causing global climate change

GULF EXISTED BETWEEN the then AUSTRALIA & INDIA

- *In **EAST GONDWANA***
- Tethys Ocean to the north, Antarctica to the south.
- Rivers washing sediment off southern WA and Antarctica
- The sediment was carried into the gulf and dropped on the sea floor or in lakes or swamps
- The rocks underneath the gulf slowly sank, but it was kept topped up by the sediment washed in
- Under ***Bunbury*** is 11 kilometres of sediment
- But over 200 million years this thickness of sediment built up by 1 millimetre each decade!

PERTH BASIN

- At about 140Ma there was a major north-flowing river that cut down into the ***Yarragadee Formation*** running from the south coast northward, past Nannup and Bunbury
- When forces started India splitting from WA – crustal tension in the earth's crust formed fractures from the bottom of the crust
- The fractures allow basalt lava to be erupted from volcanoes and flow along the existing river valley northward with eruptions over 10 million years
- Between 137 Ma and 133 Ma, lava from volcanoes flowed north along a first valley – ***Bunbury Paleoflow***
- Later, a second valley formed and more lava flowed along that valley - ***Donnybrook Paleovalley*** (we are still trying to date this)
- At 130 Ma more lava came up at Black Point – but did not form a valley-flow
- We now call all the volcanic rock from all the vents the ***Bunbury Basalt***

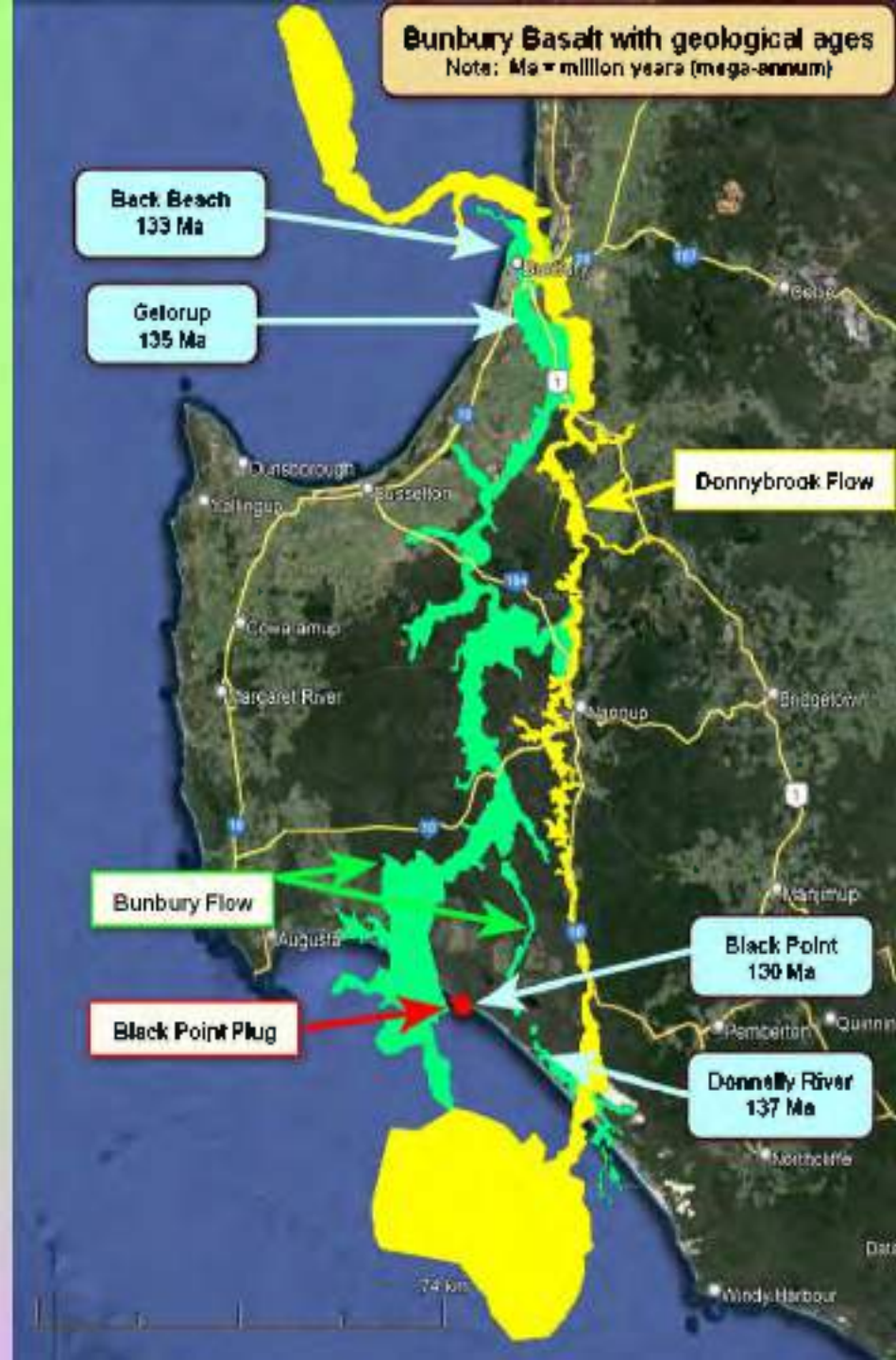
TWO VALLEY FLOWS

or paleoflows

Bunbury Paleoflow is green from 137 to 133Ma
Donnybrook Paleoflow is yellow. Note it cuts the Bunbury Paleoflow and hence is younger

Question: where were the volcanic vents?

- We have not found them - yet
- How far will a river of lava flow? Not 200km
- Side "valleys" imply there were multiple volcanoes adding lava into the main valley
- After the volcanoes stopped, sediment continued being added onto the basalt – the **Leederville Formation**
- Since that time, the Perth Basin sediments were folded and faulted



WHERE IS BASALT UNDER BUNBURY

- Older ***Bunbury Paleoflow*** is green
- Younger ***Donnybrook Paleoflow*** is yellow
- There are three outcrops (red)

Perth Basin rocks were folded and faulted in the 100Ma since sediments stopped being deposited – so the rocks have been broken and bent

- Sea level - height at Back Beach
- 8 metres at Brittain Rd
- 20 metres at Gelorup quarries

At Gelorup the basalt folds down to the east and to the north

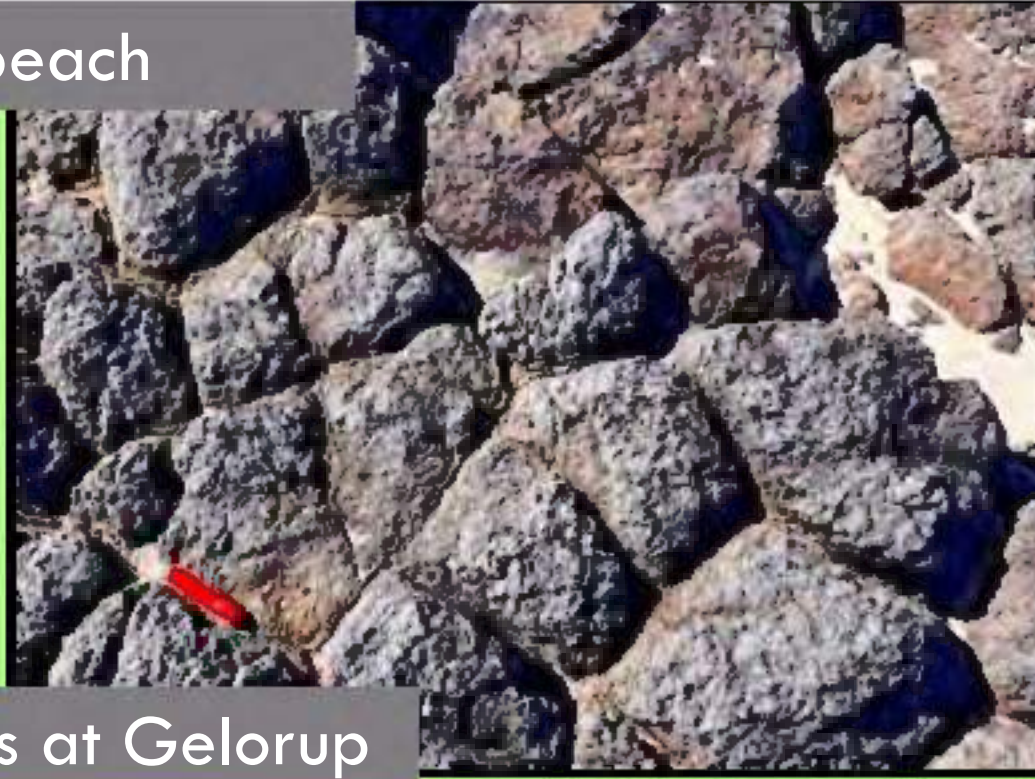
On the beaches

At Back Beach the basalt occurs for 1.4 km along the beach

Look at the outcrop and you will see columns that are typical of basalt lavas that have cooled in the air

The rock. Dark with rectangular, white, felspar crystals

On the beach



In the quarries at Gelorup

WHAT ELSE IS BELOW BUNBURY?

- To the side of and under the Bunbury Basalt is: ***Yarragadee Formation*** – up to 4 kilometres of porous sandstone and siltstone and layers of nonporous clay. Or the ***Leederville Formation***

OUR WATER SUPPLY

- 800mm rain falls on the **Blackwood Plateau**
- Yearly 3 cubic kilometres: much will seep down to the water table. Where does it go?
- Water flows downhill from the Plateau and out under Flinders Bay and Geographe Bay
- Yarragadee holds estimated 1100cubic kilometres of water
- Bunbury and Busselton water supply.
- So, do you call it rainwater, or spring water, or bore water?

WHAT IS ON THE LAND? - SAND, SAND AND MORE SAND

- Do we, like most places, have mountains inland of us? Mountainous? No.
- You drive up the Darling Scarp to our east what to we have?
- The land is pretty flat for **600 kilometres** between 200 and 400 metres altitude
- **It is *FLAT-FLAT-FLAT!***
- The lack of hills and mountains means rivers carry almost no sediment – Major systems are (1) Moore, (2) Avon, (3) Serpentine-Dandalup-Murray, (4) Brunswick-Collie-Ferguson-Preston, (5) Capel-Ludlow, (6) Blackwood (7) Warren-Donnelly
- So where does the sediment in our shores come from – specially our beach sand?
- ***SEASHELLS*** – that are broken and pulverised by the waves on the beaches – mostly with a little quartz sand from older sediments

COASTAL SAND & DUNES

So, our sand dunes are mostly broken seashells

Beach sands blow up into coastal dunes

Back Beach
FRONTAL DUNE
Quindalup Dune

FROM COAST TO HILLS

Quindalup dunes

Our modern dune is still alive!

Sand blowing inland to form new dune at Preston Beach

Looking along the coastal dunes from the Maidens

Looking North to Bunbury (Google Earth image)

South around Geographe Bay to Busselton

THE COAST IS ALIVE

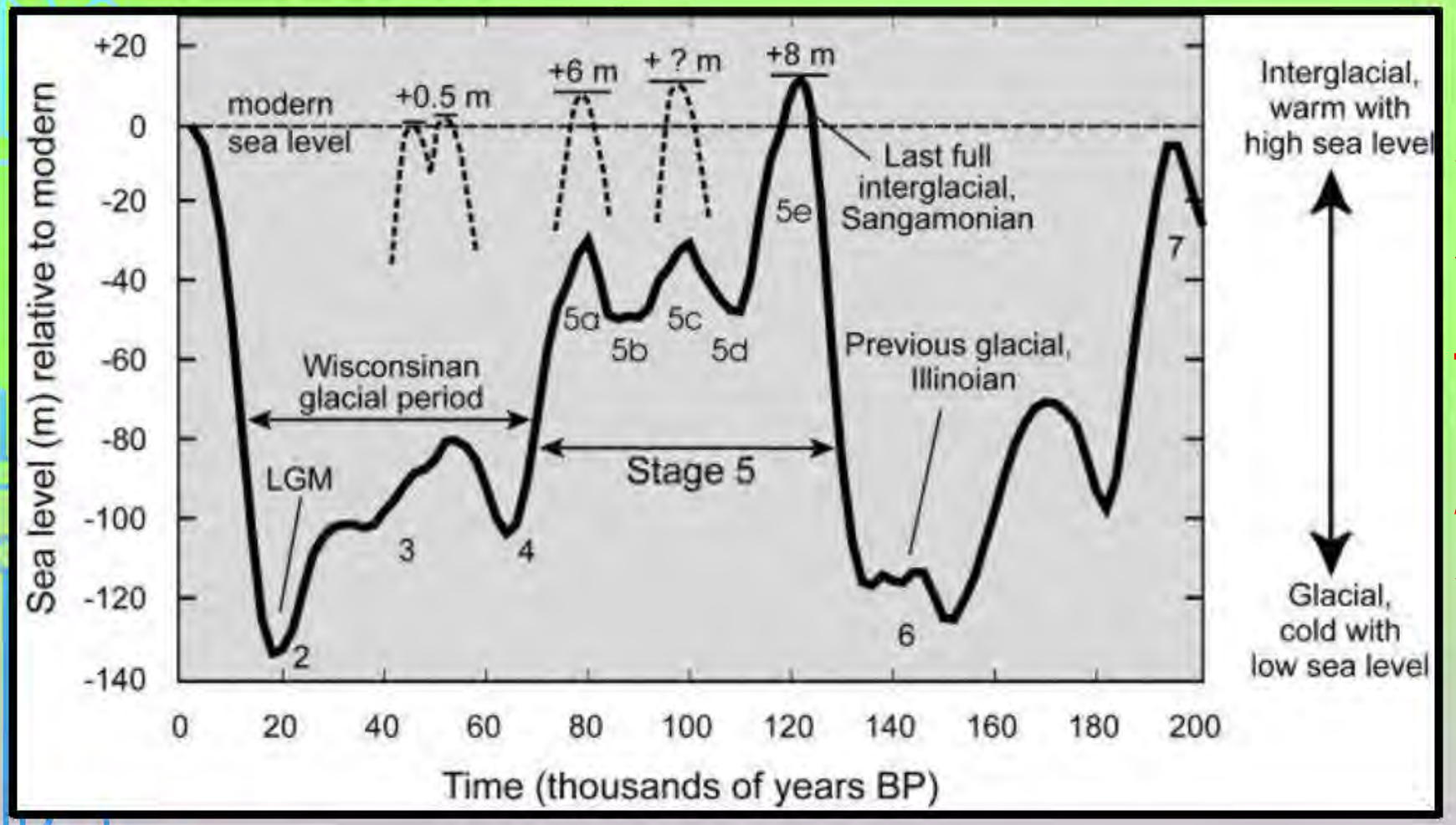
Winter storm-waves erode beach and frontal dune – scary to many near the beach

Summer swells wash sand onto the beach

BEFORE August 2022

AFTER 7 MONTHS - March 2023

SEA LEVEL IS CONSTANTLY CHANGING



At the last sea level maximum, 120,000 years ago, the coast was 8 metres above the present beach.

Minimum at 20,000 years ago,
130 metres below present SL

Thanks to Penn State Uni

WHAT DOES THE 130 METRES DROP IN SEA-LEVEL MEAN?

Bunbury was 80km inland
Sea levels started rising about 12,000 years ago and reached the present about 7,000 years ago

Seas rose 2.5 cm per year in that 5,000-year time span
That was a natural rise

SPEARWOOD DUNE SYSTEM 120,000 YEARS AGO IN THE PREVIOUS INTERGLACIAL, SL AT +8M

- Dune runs from Capel to Geraldton
- Commonly 50m high, up to 80m
- The limesand has been cemented through rainfall effects to limestone

QUINDALUP AND SPEARWOOD DUNE SYSTEMS ARE NOT CONTINUOUS

- The dunes are broken
- Brunswick, Collie, Henty, Ferguson, Preston rivers have continued flowing towards the sea

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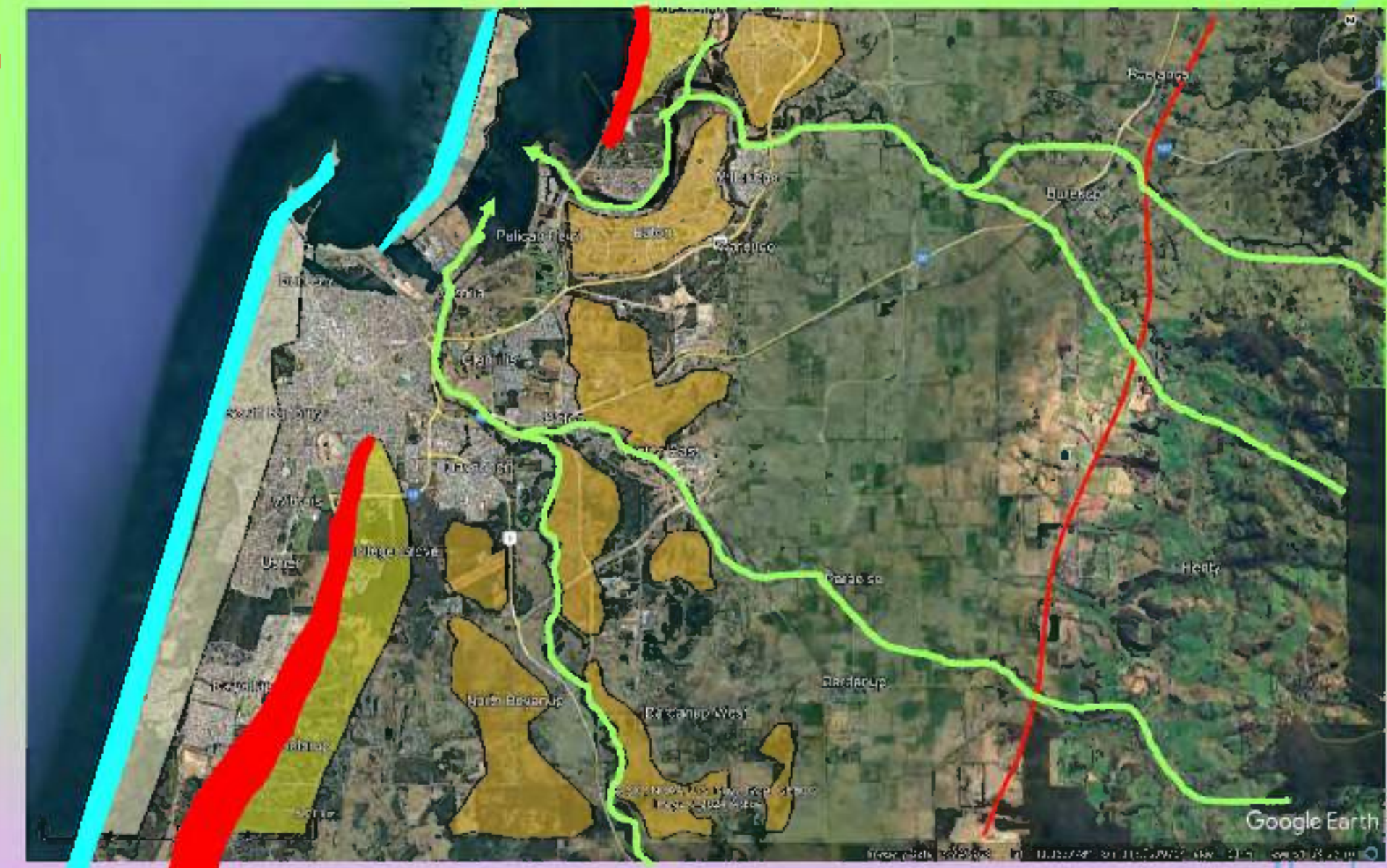
- River flows strong enough to stop the dunes from forming

- Note the dune offsets

WHY?



BEACHES EXISTED ALONG THE BASE OF THE SPEARWOOD DUNE

What is between Quindalup and Spearwood Dune Systems?

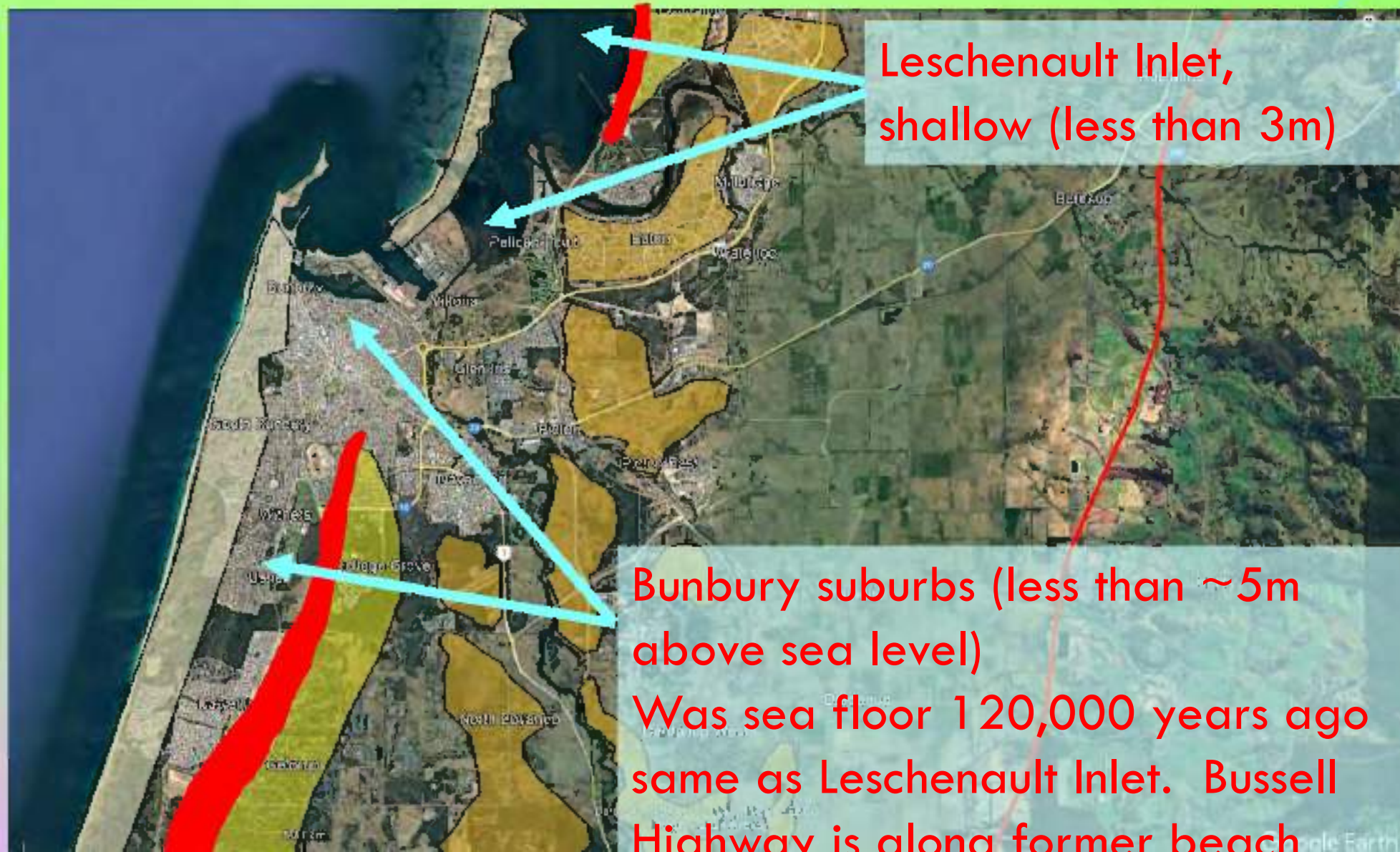
Suburbs of:

- East Bunbury
- Withers
- Usher
- Carey Park

On what was previously the sea floor

AND

Leschenault Inlet



Pinjarra Plain is to the east

Mostly a flat plain sloping from Darling Scarp towards the coast

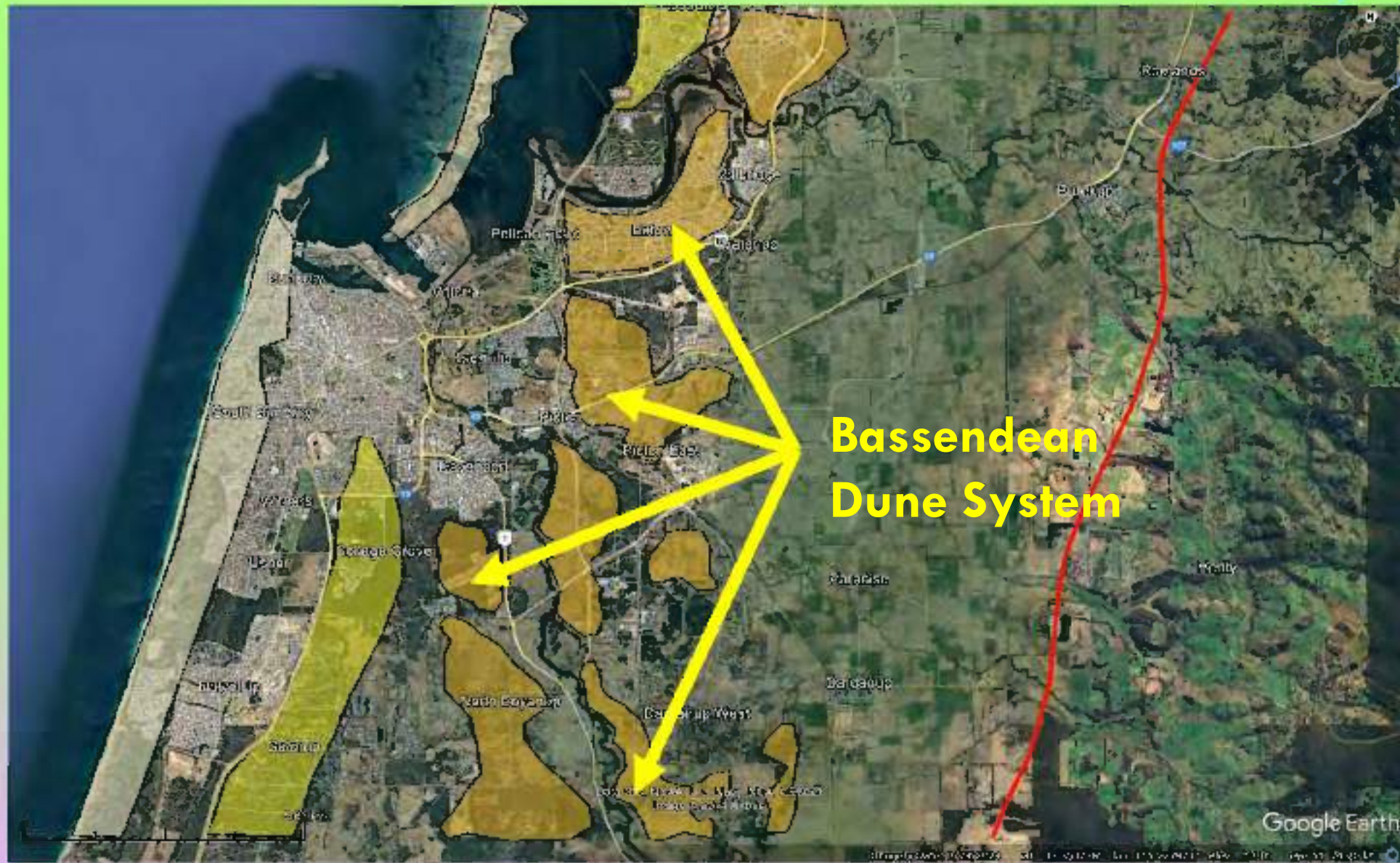
Distinctive in that the soils are clayey and hence a better growing medium

DURING PREVIOUS INTERGLACIAL SEA LEVEL 240,000 TO 390,000 YEARS AGO

- Pinjarra Plain now ranges between 10 and 30 metres above the present sea level
- Inland of the Spearwood Dunes
- The precise sea level is still being debated.

BASSENDEAN SAND DUNES FORMED

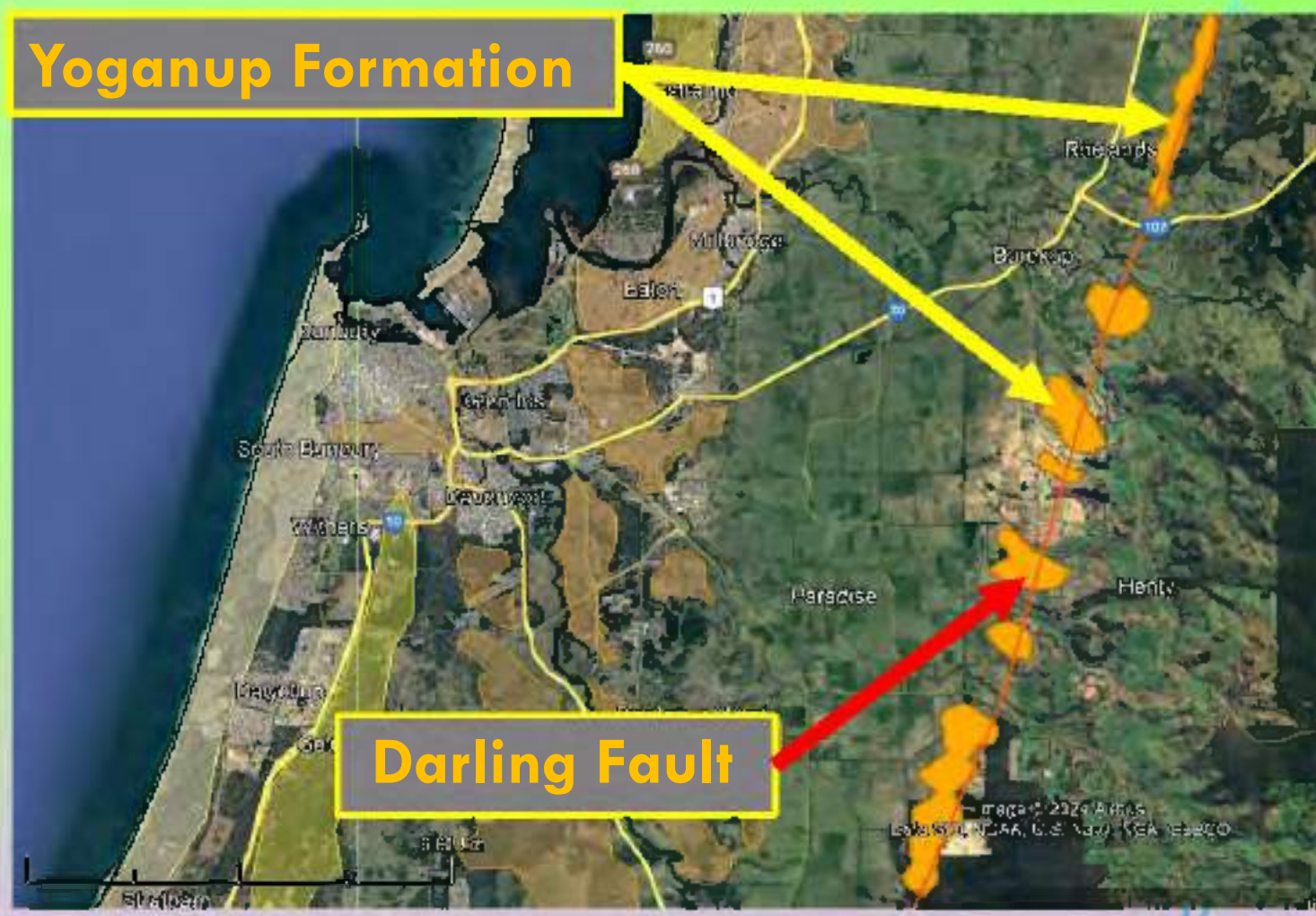
- Low, rounded landforms
- Lime content leached out by rainfall, leaving quartz-rich sand
- Look for farmhouses built on rises as you drive along highways



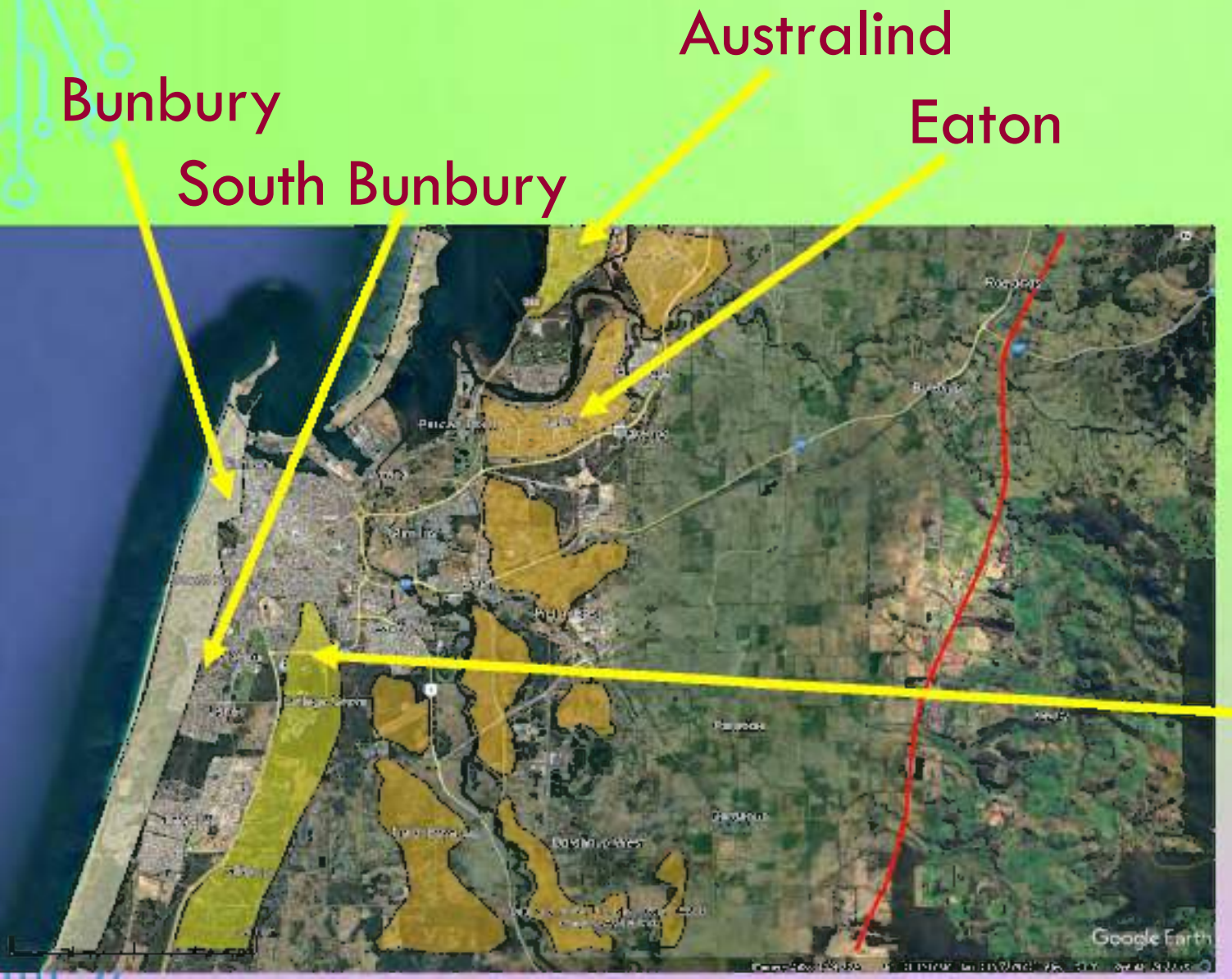
Yoganup Formation

BEFORE MODERN ICE AGE SEA WAS 70M HIGHER THAN NOW - 3Ma

- Coast was at the base of the Darling Scarp
- We find beach deposits – Yoganup Formation
- Subdued landform
- Held rich mineral sand deposits but many depleted (now in the paint around your home)



WHERE DO MANY PEOPLE LIKE TO LIVE?



- Like elevated sites with:
  - Views
  - Variety of shapes
  - Safe from flooding
  - But may have more wind

DUNES PLEASE!

HOW MANY HAVE BEEN THINKING WHY THE COASTAL DUNES ARE BOTH OFFSET TO THE EAST?

ANOTHER QUESTION –" *WHY IS KOOMBANA BAY THE ONLY STEP IN AN OTHERWISE SMOOTH COASTLINE FROM BUSSELTON TO THE PEEL INLET?*

Basalt headland now

Basalt headland

120,000 years ago

MODERN STEPS TO TOWN

- Koombana Bay identified in 1803 as potential safe anchorage by Boudin and French
- Alexander Collie and William Preston explored southwest in 1829 and recognised the Bay and the two rivers of Collie and Preston
- On arrival they found many Aboriginal camps and signs of occupation; our Aboriginal predecessors appreciated the attributes of where these rivers met the sea
- Identified by Governor Stirling as appropriate setting for a new community and port-town

SO, AS WE CONCLUDE

- You now have your bright-eyed pet to take home – keep him warm in this cold weather
- Don't worry about his aging – he is only still a youngster (rock age, that is) and is about 133,000,000 years old
- Sorry but we cannot tell you his birthday

I thank Judy Giacci for the breeding of your pet – she arranged all visitors to the opening of the former Giacci basalt quarry to have a Show Bag in which each had a pet rock

ACKNOWLEDGEMENTS
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Other colleagues
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