Thesis Proposal

Running Order:

Hi, I’m Emily, and my current working title of my research project for my honours year is the Earthquake Fault Mechanics in Sydney Basin: An Analysis and three-dimensional map of the Luna Park Fault Zone.

**Introduce the Problem**

Sydney Basin is actually a part of a relatively seismically active area, experiencing magnitude 5.5 earthquakes and greater. When the Lucas Heights Nuclear Power Station began the development of a new reactor site, it was discovered that the site sits on top of ancient fault zones. The fracturing of rock due to stress can trigger earthquakes, and these fault zones once activated have the potential to be reactive as they define a zone of structural weaknesses. In order to understand and quantify these risks, it is required that we better understand the risks that these faults pose to us. As the host-rock is predominantly sandstone, and we have limited understanding of the behaviour of faults in sandstone, this is a particularly important study. With a focus on the Luna Park Fault Zone that runs across Sydney Harbour, I will aim to characterise this sandstone fault zone to understand how its features interact with one another, using this to understand how they behave and hopefully this will allow us to understand the hazard involved. Additionally, I am hoping to use the data we gain through analytical work to construct a three-dimensional map of the fault to aid in further understanding it. Not only is it important to understand the risk, but this fault zone runs through important infrastructure and urban areas making it a very valuable endeavour.\*Fix end

**Background Information**

**Introducing the Greater Area**

The Sydney Basin is a smaller component of the Sydney-Gunnedah basin, sitting in its southern region of a geological structure that dominates New South Wales and extends into Queensland. The Sydney Basin region sits on a passive continental margin, however despite this tectonic stability there is still seismic risk posed to the region, with earthquakes with a magnitude of 5.5 Richter Scale earthquake predicted as occurring every 40 years within this area due to the release of stress through the fracturing of rocks that has built up underground overtime.While the frequency and magnitude of damaging earthquakes in Australia, Sydney Basin in particular, is lower than areas that sit on an active margin or near plate boundaries, they are still significant and have the capacity to cause destruction to infrastructure and environment. An example of a large earthquake experienced in the basin is the 5.6 magnitude earthquake that hit Newcastle in 1989.

Geologically, this basin is classified as a foreland sedimentary basin, meaning that it has developed adjacent to a mountain belt. The age of the basin ranges from Early Permian ( Ma) to Mid Triassic ( Ma), and it is predominantly composed of sedimentary rock with some igneous intrusions and Late Permian ( Ma) coal seams. The rock formations that dominate the particular study area looked at are the Narrabeen Group, Hawkesbury Sandstone and the Wianamatta Group. After these sediments were deposited, during the Late Triassic ( Ma) a tectonically active period meant that there was minor deformation that occurred on the stratified rock, forming faults and joints as well as igneous dykes. The deformed areas highlight structural weak zones, and as such they experienced erosion which formed valleys that with sea-level rise were filled with sediment. As sea level fluctuated, the erosional-sediment-infilling cycle repeated

Zones of rock deformation are points of weakness that can be reactivated and more displacement and deformation can occur. Old fault zones are able to be reactivated, which is a big reason why the development of the new Lucas Heights Nuclear Power Reactor was a cause for concern.

While the site was in operation from 1958, in the early 2000s they began the development of a new reactor, and in geological surveys of the land it was discovered that the site was on top of ancient fault lines. And people referring to them as ancient, we know after they dated the fault zone, that the faults were between 150 and 100 Ma old. This raised concern over the stability of the area, as the presence of an active fault zone may mean more movement and risk of earthquakes which threaten infrastructure and human safety. It is reported that three independent bodies were commissioned to investigate the fault lines, and they allegedly were unable to find the exact age or agree on the cause. Work was given the green light to go ahead, suggesting that they found the area to be inactive.

**Importance and potential impact**

**Methods to Address Research Questions**

**Results**