Executive Summary

THE AIM OF THIS STUDY: In this study, the impacts of meteorological hazards and the potential impacts of climate change on the Wellington region are identified. The hazards investigated are intense rainfall and floods, droughts, landslides and erosion, coastal flooding, severe winds, snowfall and frost, excessively high temperature, lightning and hail, ex-tropical cyclones and wildfire. The likely impacts of climate change on these hazards over the next 50 to 100 years have been identified and the potential climate change impact on Wellington Region activities has also been reported.

USE OF SCENARIOS: Climate change predictions given in this report are derived through the use of scenarios, in which a number of greenhouse gas emission pathways are constructed for the future, based on a range of plausible social, economic and technological developments. For each of these scenarios, predictions are then made for greenhouse gas concentrations and the resulting climate changes, based on scientific understanding and incorporating science-based uncertainty ranges. The result is a set of several different climate “projections”, spanning likely future emissions pathways.

FLOODS: These present a significant hazard to the Wellington Region. l-in-100 year flood inundation maps based on historical climate and river data are provided in Figures 2.4 to 2.7 for the Hutt, Otaki and Waikanae Rivers and a l-in-50 year flood map for the Wairarapa Plains is shown as Figure 2.8. Climate change is expected to increase flooding risk,.but science-based quantitative information on this is currently weak, with projected possible changes spanning a wide range. Interim projections are that the intensity of heavy rainfall could increase by up to about 7% by 2050. By 2030 the return period of heavy rainfall events and associated floods could be reduced by up to a factor of 2, and by 2070 by up to a factor of 4, but also the possibility cannot be ruled out that there will be no discernible reduction in return periods.

DROUGHTS: The part of the Wellington region most affected by droughts is the Wairarapa, where there are on average 15 days per year when soil moisture deficits exceed 130 mm. There is substantial year-to-year variability however, with up to 74 days of deficit exceeding this amount in some years. In the Kapiti, Wellington and Hutt Valley areas there are on average 10 days annually with a deficit exceeding 130 mm. Dry growing seasons (October – May) in the Wairarapa are frequently but not always associated with El Niño climate patterns. Projected temperature and rainfall changes suggest there will be a trend of increasing drought occurrence in the Wairarapa through the coming century, but no quantitative predictions are yet available.

LANDSLIDES: The Wellington Regional Council has made a number of attempts to define the landslide hazards in the region, focussing on both rainfall and earthquake induced landslides. Maps of landslides resulting from specific ‘storms are shown as Figures 4.2 and 4.3. However, the current landslide hazard maps are not comprehensive or accurate enough to rely on solely for effective landuse management and planning strategies. A comprehensive landslide inventory would provide information on susceptibility, landslide triggers, and the frequency and magnitude of events.

TIDES: The storm tide height reached in Wellington Harbour during the 1936 Cyclone event of approximately 1.7 m above the Wellington Vertical Datum-1953 is probably a useful benchmark for a 1% Annual Exceedance Probability (or 100-year return period). Also, wave heights of up to 8.1 m (Te Kaukau Pt) are possible around the Wellington Region coast, based on 20-year hindcast modelling.

SEA-LEVEL RISE: "Most likely" estimates for sea-level rise around the Wellington region by 2050 and 2100 are 0.26-0.30 m above WVD-53 and 0.42-0.62 m above WVD-53, respectively. There is a small chance that sea level might rise by up to 1.0 m above WVD-53 in the year 2100. For tides, a level of 0.9 m above WVD-53 which would currently not be exceeded at all in 100 years, would be exceeded by up to 17% of all High Waters given the predicted rise in sea level by 2050.

WIND STORMS: The maximum 3-second gust speed (km/hr) at 10 m above the ground for low lying areas expected to be equaled or exceeded at an average interval of 142 years for most of the Wellington region is about 198 km/hr and at an average interval of 475 years is about 216 km/hr. These return period wind speeds are higher for escarpments, hills and ridges by between 1.04 and 1.54 times (see Table 6.1 for multiplication factors). Under global warming the mean westerly wind component across New Zealand is expected to increase by approximately 10% of its current value by 2050.

SNOW: Snowfalls (periods when snow is reported as falling, even if it melts upon reaching the ground) are quite rare below about 200 metres above sea level, occurring about once in every 2-5 years in the Wellington region. At about 200 metres and above, on average at least one fall of snow is likely each year and at around 600 metres there are an average of 5 snowfalls a year. Above 800 metres, an average of about 22 days of snowfall have been reported at Makahu Saddle and Ngamatea, in the ranges to the north of Wairarapa.

FROST: The lowland areas exhibiting the highest frost risk are the Hutt Valley, particularly Upper Hutt, the area around Palmerston North, and west of the Tararuas between Masterton and Dannevirke which currently experience around 30 – 40 screen frosts each year. This number varies by year to year, ranging from about 15 to 65. High elevation areas (above 500 m) regularly receive more than 100 screen frosts each year. Climate models indicate about 10 fewer screen frost days per year by 2100 in the Wellington region.

EXTREMELY HIGH TEMPERATURE: The mean annual extreme maximum temperatures are typically around 31-32 °C on the Wairarapa Plains in the vicinity of Masterston and Greytown. The east coast typically receives extreme temperatures up to around 30 °C, while west of the Rimutakas and Tararuas maximum temperatures rarely exceed 27 °C. Higher mean temperatures due to climate change will increase the probability of extreme warm days and decrease the probability of extreme cold days. The expected change between 1990 and 2 100 in the number of days per year above 25°C, for the SRES Al mid-sensitivity emission scenario, and for the HadCM2 and CSIRO9 global climate models, for example, is an extra 15 – 30 days for the Wellington region.

HAIL AND LIGHTNING: The frequency of occurrence of both hail and lightning is relatively low in southern Wairarapa (1 – 2 days of hail/year and 0.15 – 0.25 lightning flashes/km^2/year) and correspondingly higher to the north (2 – 3 days of hail/year and 0.5 – 0.7 lightning flashes/km^2/year) and near the Kapiti Coast (3 – 5 days of hail/year and 0.4 – 0.6 lightning flashes/km^2/year). We expect the frequency is higher still over the Tararua ranges, although the data does not show it because of the lack of observing sites. Climate change is likely to change the risks of hail and lightning, most probably increasing the risk of each because of an increase in convective activity. Some researchers suggest an increase of 1°C in average wet-bulb temperature might be accompanied in mid-latitudes by a 40% increase in lightning, but this is still quite uncertain.

EX-TROPICAL CYCLONES: These events pose a risk in that they bring both intense rainfall and wind, however the frequency of events is relatively low. Tropical cyclone track data suggest that central New Zealand, including the Wellington region is affected by cyclones of tropical origin once every three to six years. The most extreme ex-tropical cyclone to impact the Wellington region was the Wahine storm in which the strongest winds reached 110 km/h (gusting to 150) at the entrance to Wellington Harbour where the inter-island ferry Wahine was making its arrival.

STORMINESS: While it appears likely that "storminess" will increase in the Southern Hemisphere this century, we cannot yet say whether this will mean more intense storms, or a higher frequency of passing cold fronts, or some combination of these. Moreover, a general increase over the Southern Hemisphere as a whole does not necessarily imply an increase locally in the small sector of the hemisphere that New Zealand occupies. Regional changes will be sensitive to changes in prevailing wind strength and direction, which vary considerably between models. An analysis of current and predicted future changes in storminess requires processing large quantities of daily data from observations and models, and is a topic identified by NIWA for future research.

WILDFIRE: While the occurrence of four wildfires at the same time (January 2001) was an extremely rare event, the chances of similar fire seasons in the future are more likely due to easier access into forested areas, taller trees (more fuel) and a more blurred rural-urban interface. Wildfire frequency is closely related to drought frequency, as lower than normal rainfall is the main proponent for higher than normal fire outbreaks. It is possible that wildfire risk might increase in the future, based on climate change scenarios, particularly in the drier eastern parts of the Wellington region.

IMPACTS: Potential impacts of climate change on Wellington region activities through changes to meteorological hazards are wide ranging. These include but are not limited to: An increased threat to lifelines and services coming from 'more frequent heavy rainfall events and associated floods; increased drought risk particularly in the east of the Wellington region affecting the suitability for particular crops; sea level rise making groundwater aquifers near the coastline vulnerable to saltwater intrusion; and changes in temperature and rainfall regimes brought about by climate change causing problems for plant and animal pest eradication programmes. Also, climate change has the potential for positive impacts to the Wellington region such as the introduction of sub-tropical or frost-sensitive crop species, and yield increases due to higher carbon dioxide concentrations and extended growing seasons.