Coasts and Infrastructure – DRAFT 11.1.07

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Local rates of sea level rise (SLR) depend on both global and local factors. The expected range of global sea level rise by 2100 is 7- 23 inches (IPCC 2007). Locally, changes in atmospheric circulation patterns and vertical land movements will affect the amount of relative sea level rise. Based on our understanding of these factors to date, sea level rise in the Puget Sound region is expected to closely match the changes in global sea level. Very little relative SLR is expected in the northwest Olympic peninsula due to rates of tectonic uplift that exceed projected rates of SLR. Due to limitations in available data, we cannot characterize the uplift characteristics of the central and southern coasts; however, the few data points available suggest that uplift in this region is lower than that observed to the north. Uncertainties in both the climate system and in human response to climate change will make exact predictions difficult. The future climate will depend upon the future rate of greenhouse gas emissions, which is subject to policy initiatives and economic incentives. Future sea level rise also depends on uncertain rates of ice sheet melting in Greenland and Antarctica. Recently observed higher rates of ice sheet melting make 48 inches of sea level rise by 2100 within the range of possibility.

It is well established that physical impacts of climate change and sea level rise will manifest themselves in a variety of ways, each of which is discussed below. The specifics of all these impacts are driven by sea level rise scenarios, forecasts of increased storm activity, and the dynamics of coastal erosion caused by sea level rise and storms. Our research utilizes existing results from CIG and others, and GIS based mapping technology to identify coastal areas most likely to be significantly affected by climate change and sea level rise.

Inundation. As sea levels rise, the lowest lying areas will be inundated and regularly flooded during the daily tide cycle. Specifically, low lying river deltas, port areas, and ocean beach communities on the Long Beach peninsula of Willapa Bay and the Ocean Shores community near Grays Harbor are known to be at risk.

Episodic Flooding. It is important to realize that coastal impacts of sea level rise will not be limited to simple property inundation as sea levels increase. Changes in sea level will predominately be experienced through increased episodic flooding as current extreme events become less extreme (relative to new extremes) and more frequent. During major storm events, sea level rise will compound the impacts associated with storm surge and could contribute to more extensive coastal flooding. Changes in the seasonal pattern of rainfall could also lead to more frequent and serious flood events during the cool (October-March) season.

Erosion. Although erosion generally reflects a long-term shift in the equilibrium profile of the shoreline, major episodes of erosion often occur during storm events, particularly when storms coincide with high tide. Erosion will likely increase around the globe due to sea level rise. However, prediction of the exact local effects is difficult as coastal systems often show complex, non-linear responses to changing conditions (Nicholls et al. 2007). Long term erosion will commonly be punctuated by episodic events, especially in the case of soft rock cliffs (*ibid*). Therefore, it is both the low-lying areas as well as some bluff backed beaches that are at risk from erosion.

Saltwater Intrusion. As the sea level rises, freshwater aquifers and wetlands will be subject to increased intrusion by salt water. Intrusion could threaten drinking water sources, affect local drainage, and impact coastal estuaries.

Ecological Changes. Increasing ocean temperatures may affect species survival rates and the vitality of invasive species (e.g. spartina in Willapa Bay), though it is difficult to make exact prediction of complex ecological changes at this time. In some regions, near-shore habitat will be squeezed between rising water levels and armored beaches. This could reduce the coastal and intertidal habitat available to migrating shorebirds, forage fish, shellfish, and other species.

Social and Legal Impacts. The vulnerability of coastal areas to increasing sea levels, storms, and other climate change stressors will depend not only on the physical stressors to the environment but also on the ability of those areas to adapt to those changes. The long-term nature of the sea level rise issue affords response opportunities not necessarily available in other arenas. Pro-active policy choices have the potential to decrease the economic costs of responding to the issue and limit future conflicts.

References:

(IPCC) Intergovernmental Panel on Climate Change. 2007. *Climate Change 2007: Climate Change Impacts, Adaptation and Vulnerability: Summary for Policy Makers, Contribution of Working Group 2 to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.*

Nicholls, R.J., P.P. Wong, V.R. Burkett, J.O. Codignotto, J.E. Hay, R.F. McLean, S. Ragoonaden and C.D. Woodroffe, 2007: "Coastal Systems and Low-Lying Areas." *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 315-356.