requirement to minimize hazards. You should consider policies where each new parcel would have at least the minimum developable area, consistent with the zone district, outside of any high hazard area. A sample policy, such as one from the adopted suggested modifications of the Solana Beach LUP, could be:

- **Revised Findings on City of Solana Beach LCP Land Use Plan,** pg. 29, at: http://documents.coastal.ca.gov/reports/2012/6/Th24a-6-2012.pdf

  Policy 4.10 *Land divisions, including lot line adjustments, shall be prohibited unless all proposed parcels can be demonstrated to be safe from flooding, erosion, fire and geologic hazards and will provide a safe, legal, all-weather access road(s), which can be constructed consistent with all policies of the LCP.*

♦ Siting Development to Avoid Hazards/Setbacks

A critical element of every LCP is the designation of appropriate review and setback criteria for bluff, cliff, and beach level development. Siting criteria help to carry out Coastal Act requirements in Section 30253. You should consider LUP policies that avoid locating new development in hazardous areas where feasible. Where locating development to completely avoid hazardous areas is not feasible, policies should provide siting standards to minimize the exposure of new development to geologic, flood and fire hazards. These policies should include any additional exposure to flooding and erosion due to sea level rise.

Your LCP should require a setback that assures that the structure will be stable for its economic life without the need for shoreline protective devices that alter the natural landform. The Commission in recent actions has generally defined the economic life of a structure as 75 to 100 years. This lifespan could potentially vary, though, if the development included specific provisions for its removal from the hazard zone at the end of the specified economic life or when it became endangered. For development along coastal bluffs or cliffs, both slope stability and erosion should be part of the analysis.

The relative stability of a slope can be calculated quantitatively by a slope stability analysis, in which the forces tending to resist a potential landslide are divided by the forces tending to drive a potential landslide. The industry standard for a "stable" site is that this quotient, called a factor of safety, be at least 1.5 in the static condition, and 1.1 to 1.2 under seismic conditions. The factor of safety generally increases with distance from the bluff edge, so the point at which the factor of safety reaches 1.5 constitutes a minimum setback for existing conditions and without considering erosion.

Most coastal bluffs are steadily retreating due to erosion, impacts from storm waves and effects from sea level rise. In order to assure that the site will still

have a 1.5 factor of safety at the end of its economic life, the amount of bluff retreat expected over its life must be added to the initial setback.

Sea level rise should be incorporated into the erosion rate used in the factor of safety analysis. It is clear that future erosion rates are likely to be higher than historic rates; but, there is no fully accepted approach for estimating future bluff erosion with sea level rise. One approach used in the past has been to use the high range of historic erosion rates to represent future erosion rates. A more process-based method is to correlate future erosion rates with the increased frequency of wave impacts. This approach was used in the Pacific Institute study of sea level rise and is documented as part of their report:

- **The Impacts of Sea-Level Rise on the California Coast**, at: http://www.pacinst.org/reports/sea_level_rise

Your LCP should require a site analysis for bluff-top development to determine the present-day setback needed to minimize hazards. The factor of safety against sliding that is typically used to show that a development is stable is 1.5. To find the total setback needed, add to that figure the predicted bluff retreat for the expected life of the project, such as 100 years of bluff erosion. The Coastal Commission's staff geologist presented a memo on the topic to the Coastal Commission:

- **Establishing development setbacks from coastal bluffs**, at: http://www.coastal.ca.gov/W-11.5-2mm3.pdf.

For examples of LUP policies on bluff setbacks, see the suggested modifications to the City of Solana Beach LUP, the City of Laguna Beach LUP and from the San Luis Obispo County LUP for the Estero Area:

- **Laguna Beach General Plan Land Use Element**, beginning on p. 7-20, at: http://documents.coastal.ca.gov/reports/2012/5/W13a-5-2012-a1.pdf
- **San Luis Obispo County Local Coastal Program Major Amendment No. 2-04 (Part 2) Estero Area Plan**, at: http://documents.coastal.ca.gov/reports/2008/7/Th16a-7-2008.pdf
- **County of San Luis Obispo Estero Area Plan**, Ch. 7 Planning Area Standards, at: http://www.slocounty.ca.gov/Assets/PL/Area+Plans/Estero+Area+Plan.pdf
- **Revised Findings on City of Solana Beach LCP Land Use Plan**, suggested modifications on Hazards beginning on p. 22, at: http://documents.coastal.ca.gov/reports/2012/6/Th24a-6-2012.pdf

The examples from the City of Solana Beach and the City of Laguna Beach include bluff setback policies that address sea level rise. For example this one from the City of Solana Beach:

> ***Policy 4.27****:...The predicted bluff retreat shall be evaluated considering not only historical bluff retreat data, but also*

> *acceleration of bluff retreat made possible by continued and accelerated sea level rise, future increase in storm or El Niño events, the presence of clean sands and their potential effect on the pattern of erosion at the site, and any known site-specific conditions...*

It is also important to include setback policies that distinguish accessory structures, to allow their easy removal or relocation.

Additional guidance specific to evaluating sea level rise may be considered by the Commission in the near future.