April 14, 2008

Nancy Wieben Stock
Presiding Judge of the Superior Court
700 Civic Center Drive West
Santa Ana, CA 92701

Dear Judge Stock:

On behalf of the City of Laguna Beach, I am responding to the Grand Jury Report entitled "Paradise Lost: If a Tsunami Strikes the Orange County Riviera." I am basing our comments on the April 8 draft version.

First, I have enclosed an excerpt from a report which was recently prepared by a consultant to the City. The consultant determined maximum wave run-up which is part of a project to install lifeguard towers on the beaches. The members of the Grand Jury may be interested in the wording on Page 10 which indicates that the maximum run-up in Laguna Beach is likely to be less than two meters in height. Also, as I mentioned to representatives of the Grand Jury, there are only two relatively small areas within Laguna Beach that would be susceptible to a tsunami. It would be relatively easy for someone to seek safety simply by walking uphill a block where the elevations are such that they would be substantially above the hazard area. Therefore, the threat confronting Laguna Beach is substantially less than those posed for other Orange County beach communities.

Response to F-1 – I am not sure this applies to Laguna Beach.

Response to F-2 – We believe that the signs are sufficient for the threats to our beach area.

Response to F-4 – Public beach visitors come from all over the country and a comprehensive public education program would either be unduly expensive or ineffective. If there is a tsunami – or other high wave action – we have career lifeguards and police officers who would direct the evacuation of our two low lying beach areas.

Response to findings:

R-1 – We have no objection to having the Sheriff's Department take the lead to standardize maps for the entire Orange County coastline.

R-2a. – As indicated before, we believe our signs are adequate.

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R-2b. – We do not agree that these signs are particularly valuable; they will be ignored by everyone given the proliferation of other directional and safety signs, particularly on Coast Highway.

R-4 – As indicated previously, in the event of a hazard warning, our career lifeguards and police officers are available to provide onsite evacuation directions to visitors in the two low lying areas. As indicated previously, it is very easy for people along those two beach areas to walk to higher ground in a very short period of time.

If members of the Grand Jury have any questions, I would be happy to discuss this further at (949) 497-0704. Thank you.

Sincerely,

Kenneth Frank
City Manager

Enclosure
cc: Department Heads
City Council

Waves as high as 20 feet were recorded on January 17, 1988, and 14 to 16 foot high waves with period in excess of 20 seconds, were recorded during the 1982-83 El Niño winter. The design wave used for the wave runup and wave force analysis is provided in the next section.

The National Oceanographic and Atmospheric National Ocean Survey (NOAA, 2000) tidal data station closest to Laguna Beach is located at Newport Beach (Station 9410580). The tidal datum elevations are as follows:

Mean Higher High Water	2.65 feet
Mean High Water	1.90 feet
Mean Sea Level (MSL)	0.00 feet
Mean Low Water	-1.82 feet
Mean Lower Low Water	-2.75 feet

OCEANOGRAPHIC DESIGN PARAMETERS

There are several factors that are important to the design of a structure along the shoreline. Some of the factors are based upon the existing topography/bathymetry and elevations/geometry of the proposed structure at the sites. The offshore slope is relatively steep at 1/35 (vertical/horizontal [V/H]). The back beach areas where the towers are to be located vary in elevation from about +9 feet MSL to +12 feet MSL. Other factors are based upon extreme oceanographic conditions or the coincidence of several extreme conditions. In order to determine design wave characteristics for the runup and force analysis, it is necessary to determine the design water level. The design water level in this analysis is the maximum still water level under typical 100-year recurrence interval conditions. Water level is dependent upon several factors, including the tide, storm surge, wind set up, inverse barometer, and climatic events (El Niño). For this location, the maximum tide is about +4.5 feet MSL. Added to the +4.5 feet MSL elevation are the effects of El Niño, wind/wave setup, inverse barometer, and sea level rise (Titus and Narayanan, 1995). An estimate of the super-elevation due to these additional factors is approximately 1.75 feet. Therefore, the design water elevation is +6.25 feet MSL (4.5 feet + 1.75 feet = 6.25 feet).

Estimation of the maximum scour depth at the toe of the beach enables the engineer to evalaluate the actual water depth at the toe of the beach and wave break point under the design water level conditions. The design scour elevation is estimated based upon the erode-ability of the materials at the toe of the beach. A conservative estimate of the scour elevation at the toe of the beach in 50 years is about +0.0 feet MSL. Using the maximum still water elevation and the maximum scour of +0.0 feet MSL yields a total water depth of

6.25 feet at the beach toe. This represents less than 1% recurrence wave and water level conditions at the proposed lifeguard towers over the next 25 years, and will be used in the design analysis.

As discussed above, waves from distant storms and nearby hurricanes (chubascos) have pounded the coastline of Laguna Beach several times within the last few centuries. However, these extreme waves break further offshore and lose a significant portion of their energy before they reach the shoreline. The relatively steep offshore area allows for energy from large waves to come relatively close to the shoreline. Once a wave reaches a water depth that is about 1.28 times the wave height, the wave breaks and runs up onto the shore. The design wave height at the toe of the bluff is the maximum unbroken wave at the toe of the structure when the beach/bedrock is at the maximum scour condition. The total water depth is 6.25 feet, which would yield a design wave height of 5.0 feet.

WAVE RUNUP AND OVERTOPPING ANALYSIS

As waves approach the shoreline and the proposed lifeguard towers, they break and water rushes up the beach, and sometimes to the structure. Often, wave runup and overtopping, strongly influence the design and the cost of coastal projects. Wave runup is defined as the vertical height above the still water level to which a wave will rise on a structure of infinite height. Overtopping is the flow rate of water over the top of a finite height structure (the floor of the proposed structure) as a result of wave runup.

Wave runup and overtopping at the proposed structure is calculated using the US Army Corps of Engineers Automated Coastal Engineering System, ACES. The methods to calculate runup and overtopping implemented within this ACES application are discussed in greater detail in Chapter 7 of the Shore Protection Manual (1984) and the Coastal Engineering Manual (2004). The overtopping estimates calculated herein are corrected for the effect of onshore winds. Figure 2 from the ACES manual shows some of the variables involved in the runup and overtopping analysis.

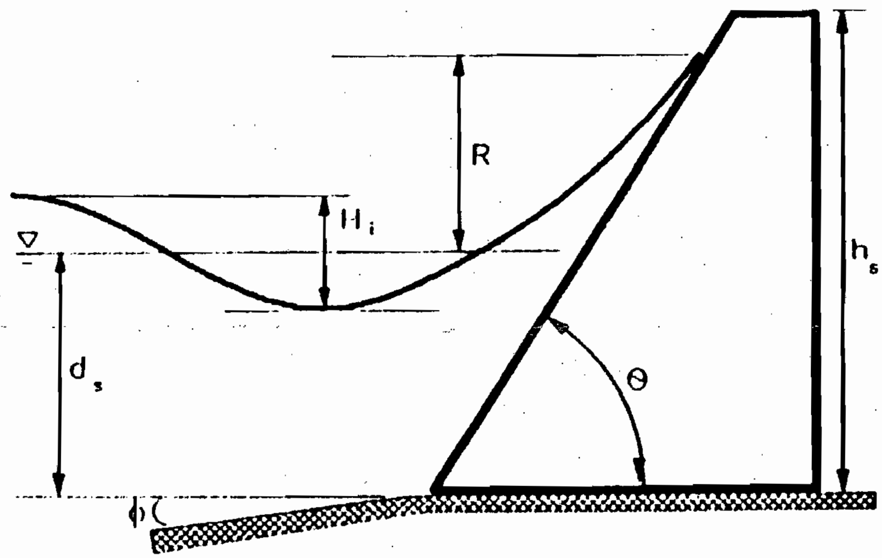

Figure 2. Wave runup terms from ACES analysis.

The runup analysis was performed on the beach and proposed tower assuming a continuous slope, from the toe of the beach to the back beach, of about 1 to 8 (V/H). The design wave period is 18 seconds. The near shore beach slope is 1/35 and the onshore wind is 40 knots. The runup analysis shows that the beach at elevation ~+10 feet MSL, under the design extreme oceanographic conditions, can be overtopped at a rate of about 4.3 ft^3/sec-ft. This overtopping results in a wave runup bore height of less than 2 feet. Thisresult is in reasonable agreement with the runup elevation range, +11.2 feet to +14.7 feet MSL, reported in USACOE (2002), Figure 6-20a. The force of the wave runup at this elevation is moderate and will not damage structural pile foundation elements provided they are built to code standards. It is important to point out that the wave runup modeling is very conservative. In reality, the beach slope will be relatively flat with the foundation of the tower being a concrete pile/caisson. The broken wave will runup the beach face, travel beneath the actual tower, and around the pile to the back beach area. The result of the overtopping analysis is shown in the table below.

TABLE

AUTOMATED COASTAL ENGINEERING SYSTEM ... Version 1.02 9/24/2007 7:55
Project: LAGUNA BEACH LIFEGUARD TOWERS RUNUP ANALYSIS

WAVE RUNUP AND OVERTOPPING ON IMPERMEABLE STRUCTURES

Item		Unit	Value	
Wave Height at Toe	Hi:	ft	5.000	Smooth Slope
Wave Period	T:	sec	18.000	Runup and
COTAN of Nearshore Slope			35.000	Overtopping
Water Depth at Toe	ds:	ft	6.250	
COTAN of Structure Slope			8.000	
Structure Height Above Toe	hs:	ft	9.000	
Deepwater Wave Height	H0:	ft	2.757	
Relative Height	(ds/H0):		2.267	
Wave Steepness	(H0/gT^2):		0.265E-03	
Wave Runup	R:	ft	16.775	
Onshore Wind Velocity	U:	ft/sec	67.512	
Overtopping Coefficient	Alpha:		0.700E-01	
Overtopping Coefficient	Qstar0:		0.700E-01	
Overtopping Rate	Q:	ft^3/s-ft	4.273	

Tsunami are waves generated by submarine earthquakes, landslides, or volcanic action. Lander, et. al. (1993) discusses the frequency and magnitude of recorded or observed tsunami in the southern California area. James Houston (1980) predicts a tsunami of less than 5 feet for a 500 year recurrence interval for this area. Legg, et. al. (2002) examined the potential tsunami wave runup in southern California. While this study is not specific to the Laguna Beach, it provides a first order analysis for the area. Figure 3 shows the tsunami runup in the southern California bight. The maximum tsunami runup in the Laguna Beach coastal area is less than 2 meters in height. Any wave, including a tsunami, that approaches the site will be refracted, modified, and possibly reduced in height. The Legg, et. al. (2002) report determined a maximum open ocean tsunami height of less than 2 meters. The wave runup analysis above, performed for the surface gravity wave, can be used to calculated the expected runup due to a tsunami about 2 meters in height. The runup due to a tsunami will be similar to the extreme wave runup discussed above.

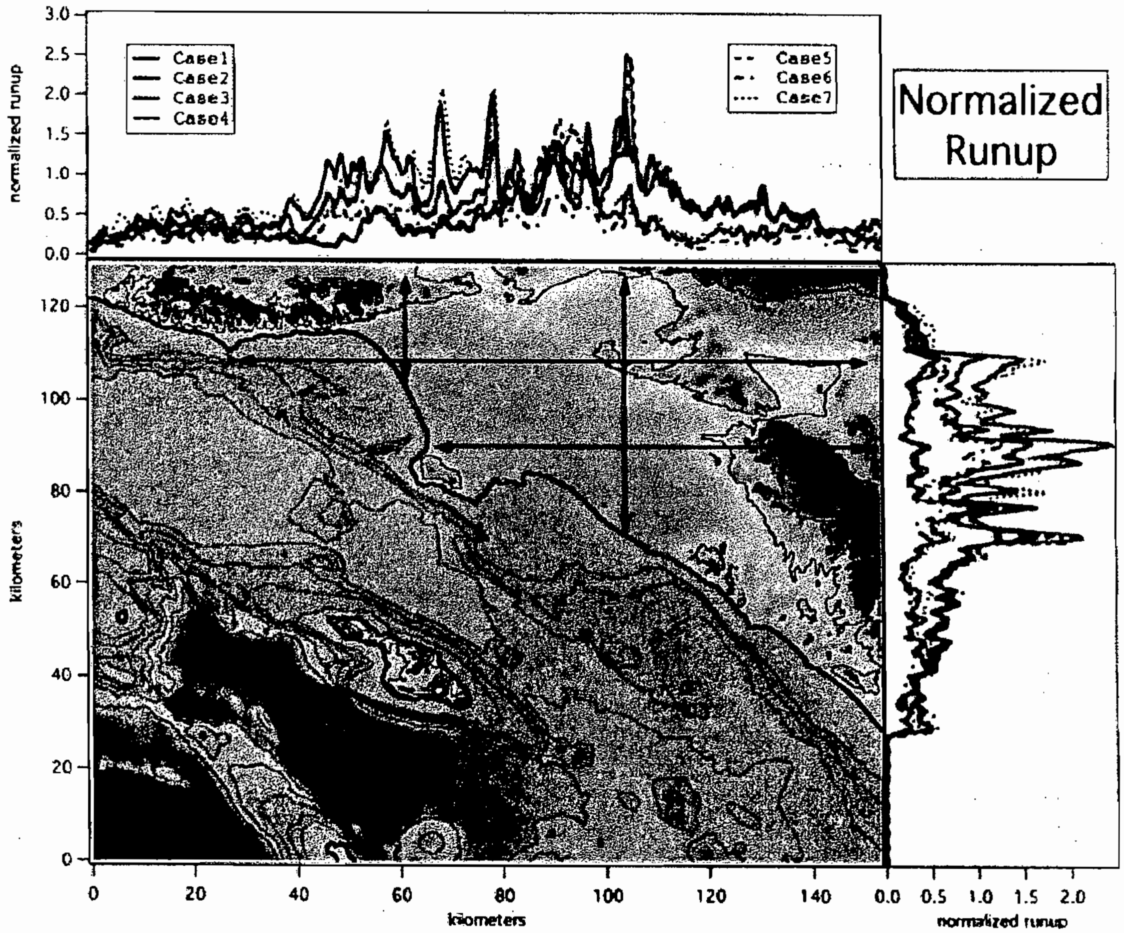

Figure 10. Map showing maximum runup normalized to the maximum seafloor/island uplift for each of the seven Catalina Fault tsunamigenic earthquake scenarios modeled in this study (fault parameters in Table 4).

Figure 3. Tsunami runup in Southern California, taken from Legg, et al. (2002).

WATER DEPTH AND WAVE FORCES

The wave overtopping analysis yielded a maximum overtopping rate of about 4.3 ft^3/s-ft. This rate can be used to calculate the water depth and velocity using the Manning Equation. The ocean frontage of the Divers Cove and Main Beach serves as a wide channel for the overtopping waters to flow from the berm crest through to Pacific Coast Highway. Using the overtopping rates per length of beach along the ocean front of the property, yields a water depth of about 1.75 feet.