ADDENDUM TO

ADVERSE TSUNAMI IMPACTS RELATED TO THE DEIR/DEIS'S PROPOSED MODIFICATIONS OF THE BALLONA WETLANDS ECOLOGICAL RESERVE

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For the Sierra Club

TSUNAMI RISKS FOR THE BALLONA VALLEY RELATED TO THE

CASCADIA SUBDUCTION ZONE

"The Cascadia subduction zone remained hidden from us for so long because we could not see deep enough into the past. It poses a danger to us today because we have not thought deeply enough about the future. That is no longer a problem of information; we now understand very well what the Cascadia fault line will someday do. Nor is it a problem of imagination. If you are so inclined, you can watch an earthquake destroy much of the West Coast this summer in Brad Peyton's "San Andreas" …But such apocalyptic visions are a form of escapism, not a moral summons, and still less a plan of action. Where we stumble is in conjuring up grim futures in a way that helps to avert them." Kathryn Schulz, *The New Yorker*, July 20, 2015

The Ballona DEIR/DEIS (for brevity, "DEIR") authors acknowledge that "Southern California is threatened by both near and farfield tsunamis," (DEIR, F7-104) then proceed to minimize these threats. They assure us that a tsunami from Japan, the closest possible farfield threat they mention, would take 10-15 hours to arrive, allowing plenty of time for evacuation. (DEIR, F7-104) Then, after listing what they characterize as nearfield tsunami risk zones--they mention only the Santa Cruz-Santa Catalina Ridge, Palos Verdes Slide, and San Pedro Basin faults--they clearly imply that these much closer fault zones would bring fairly harmless wave run-up to Ballona (F7-104).

Remarkably missing from the DEIR's list of nearfield fault zones is the immensely dangerous Cascadia Subduction Zone ("Cascadia"). The southern end of the Cascadia Subduction Zone reaches as far south as California's Cape Mendocino, approximately 580 miles north of Ballona. The DEIR informs us that tsunamis, for example, the aforementioned tsunami waves from Japan, travel at 350-500 km (221-315 miles) per hour (DEIR F7-104). This means that the arrival time for a Cascadia subduction zone generated tsunami could be less than two hours and no more than three hours. Such a tsunamic arrival could occur when evacuation times would be increased, for example, in the middle of the night or during peak traffic intensities along Culver

and Lincoln Boulevards.

The Cascadia subduction zone is a tectonic plate convergence zone where the Juan de Fuca, Explorer and Gorda tectonic plates move from the west toward the east beneath the North American Plate. This subduction zone lies approximately 80 miles off the West Coast extending from near Vancouver to south of Cape Mendocino. The Cascadia subduction zone contains approximately 30 times the potential energy of the San Andreas Fault according to Oregon State University's Professor Paul Goldfinger.[1] It is the same type and length of tectonic plate convergence that generated the Sumatra, Indonesia, tsunami of 2004, the tsunami that killed 230,000 people.[2] Furthermore, the coming earthquake "could approach the intensity of the Tohoku quake that devastated Japan in March of 2011, according to Goldfinger's research team.[3]

This massive underwater fault, according to Goldfinger, has created "major earthquakes" (magnitude 8.5+) 43 times in the past 10,000 years; it last ruptured in the year 1700.[4] Professor Goldfinger further warns:

> It's been known for some time, and still believed to be accurate, that the southern portions of the subduction zone south of Newport, Oregon, tend to rupture more frequently—an average of about every. . .220-240 years from Coos Bay to Eureka, California.[5]

In other words, the next Cascadia generated tsunami is statistically overdue by over half a century.

The next major Cascadian rupture will adversely impact Ballona in various cumulative ways not analyzed, much less disclosed, by the DEIR. To begin, when Cascadia ruptures, the resulting sea-rise will add to the 5 feet of global-warming related sea-level rise predicted by the DEIR's NSF source for the Ballona area over the next 100 years. In this regard, the DEIR's own NSF source warned in 2012:

> The biggest game changer for future sea-level rise along the U.S. west coast would be a great earthquake (magnitude greater than 8) along the Cascadia Subduction Zone. …During a great earthquake, some land areas would immediately subside and relative sea level would suddenly rise, perhaps by 1 meter or more. This earthquake-induced rise in sea level would be added to the projected rise in relative sea level (about 60 cm by 2100).[6]

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[1] http://activetectonics.coas.oregonstate.edu/cascadia_turbs.htm and https://www.cnn.com/2016/02/11/us/cascadia-subduction-zone-earthquakes/index.html

[2] http://www.cbc.ca/doczone/features/factsheet-cascadia-subduction-zone1 (Accessed 2/5/2018)

[3] https://pubs.usgs.gov/pp/pp1661f/ (Accessed 2/5/2018)

[4] http://oregonstate.edu/ua/ncs/archives/2016/aug/subduction-zone-earthquakes-oregon-washington-more-frequent-previous-estimates (Accessed 2/4/2018) Also published in *Marine Geology*, week of 8/05/2106

[5] Ibid

[6] https://www.nap.edu/read/13389/chapter/7#108, (Accessed 2/4/2018)

The wave height that such an event could generate is of further concern: Rick Wilson of the California Geological Survey warns as follows in *Scientific American*:

> Waves from a large event, such as a high-magnitude Cascadian earthquake, could affect up to 350,000 people along the California coast—not including the people who may be visiting the state's beaches on a warm summer day… Waves could typically reach 45 feet at Crescent City, in the northernmost part of the state, and 10 to 12 feet in Southern California…. [7]

It's important to note here that this 10-12-foot Cascadian wave height expected along Southern California coasts is a baseline from which actual predicted inundation levels are calculated upward. As we saw in the main body of this document and above, the following seven factors frequently or always will **increase** inundation levels: 1) pre-existing storm-induced high-water set-up; 2) pre-existing super-imposed storm-waves, 3) tides higher than mean sea level (adding as much as 6 feet water rise above mean sea level), 4) sea-level rise caused by global warming (increasing 5 feet by 2118), 5) just referenced coastal subsidence (which will bring an immediate 3+ feet sea-level rise during the predicted Cascadia rupture), 6) immediate off-shore shoaling caused by the tsunami hitting the continental shelf [8] and 7) land based obstacles, including buildings and levees, encountered as the tsunami inundates.

It is obvious from these numbers that there are many scenarios, and not only worst-case scenarios, under which inundation levels at Ballona following a nearfield Cascadia subduction zone rupture would exceed 20 feet. The resulting devastation of a 20+ foot tsunami hitting the DEIR's proposed levee system, as we saw in the main body of this document, would be tremendous. The tidal wave would arrive in as little as two hours compounding the risk significantly.

Summary and Conclusion

The entire DEIR/DEIS makes only one passing reference to the Cascadia subduction zone (F7-105) but is completely silent on the massive overdue tsunami that the next major Cascadian rupture will generate. As a result, the DEIR utterly fails to analyze, much less disclose, the added serious danger inhabitants of the Ballona Valley's west end would face when the Cascadia tsunami arrives if the levee system proposed by the DEIR/DEIS's Alternatives 1 and 2 were built.

Postscript

More generally, the DEIR/DEIS's analysis of tsunami risk at Ballona is methodologically negligent because it uses only outdated source materials and inundation maps. One of the DEIR/DEIS's own sources, Rick Wilson, head of the California Geological Survey's tsunami

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[7] https://www.scientificamerican.com/article/new-maps-reveal-tsunami-california/ (Accessed 2/4/2009)

[8] The DEIR itself makes this point for us when it explains that "viewed at sea, a tsunami is barely noticeable; however, as the waves reach the coast, they shoal on the continental shelf with water piling up as the sea floor becomes shallower, and the height of the wave increases dramatically." (DEIR, F7-104)

program, tells us that "before (the 2010 Chilean tsunami and the 2011 Japanese tsunami) ". . .we really didn't have any detailed information about tsunamis along our coast. But because those two events occurred, we were able to have staff go out and collect the data -- it was priceless, really." [9] Yet every DEIR assertion examined in this addendum and in the 18-page main body of this report rely on sources that are at least seven years old. (DEIR 2009 inundation maps at F7-110 and F112, and DEIR References at F7-110 and 3.9:87-90).

[9] http://www.latimes.com/local/lanow/la-me-ln-california-officials-drawing-tsunami-flood-maps-to-aid-future-construction-20140321-story.html (Accessed 2/5/2018)