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MEMORANDUM

To:	Ray Hiemstra and Mandy Sackett
From:	David Revell, PhD
Date:	4/27/2021
Subject:	Response to Poseidon's comment letter from 2/4/2019
Project No.:	C3010

The purpose of this memo is twofold. First, to respond to comments provided by Poseidon on February 4, 2019 (the "Letter") in response to the Huntington Beach Desalination Review of Sea Level Rise Hazards by Revell Coastal[1] completed on November 18, 2018 (the "Report"). Second, is to introduce additional concerns about the proposed Poseidon Huntington Beach Desalination Plant based on recent scientific and policy work into the regulatory review process.

RESPONSE TO POSEIDON COMMENTS

In the Letter, Poseidon took issue with several findings of the 2018 Report with responses below. These issues included:

1. Critical facility designation and need to apply the H++ scenario;
2. Exposure of the site to tsunami and other coastal hazards based on the state of the science in 2018;
3. FEMA 500 year fluvial flood event;
4. Closed Barrier Beach flooding.

[1] Revell Coastal and all of its staff are now merged with Integral Consulting, (www.integral-corp.com) as the Coastal Resilience practice.

Use of H++ scenarios

State sea level rise guidance requires consideration of the extreme H++ sea level rise scenario of ~9.9 feet by 2100 for all critical assets that have a lifespan beyond 2050 and would result in significant consequences if damaged. State guidance also recommends using the H++ scenario for any projects that have a low tolerance for risk, such as large power plants, major airports and roads, wastewater treatment plants, and hazardous waste and toxic storage sites. These types of "critical assets" or "critical infrastructure" can vary widely from community to community. The California Coastal Commission (CCC) typically defers to local jurisdictions to determine criticality based on the relative importance of its assets for the delivery of vital services and other functions, as well as the social, environmental, and economic risks associated with loss of or damage to such assets. As noted above, wastewater treatment plants and other major public serving infrastructure are used as examples of critical assets that should be assessed under the H++ extreme risk aversion scenario.[2] The Report evaluated a variety of future sea level rise projections and assumed that water supply was a critical facility and thus should address the H++ scenario. Poseidon rebutted this claim, stating that this assumption was based on an erroneous Coastal Commission staff report.

> *"Dr. Revell's only source of evidence for this statement is a November 2013 California Coastal Commission staff report that erroneously stated that Project's storage tank will be "turned over" to the City for use as a reservoir in the City's water system and thus the tank constitutes a "critical facility." Coastal Commission staff's designation of the storage tank as "critical" was based on the fact that the City of Huntington Beach had designated its other reservoirs as critical facilities in its 2012 Hazard Mitigation Plan. This rationale misses the point by ignoring that the City of Huntington Beach's Hazard Mitigation Plan expressly states that "critical facilities" are limited to "City-owned properties." (2017 City of Huntington Beach Hazard Mitigation Plan at p. 79.). As documented in numerous places, including the Coastal Commission's administrative record and Orange County Water District's Water Purchase Agreement Term Sheet with Poseidon, Poseidon will not "turn over" the storage tank to the City; rather, the tank will remain a component of the Project and will be owned and operated by Poseidon to store potable water prior to release to the product water transmission pipelines.*

This argument is largely a legal one and beyond the expertise of Integral, but it should be noted that the City of Huntington Beach goes on to state that "*although not identified as critical facilities* ***because*** *they are not City-owned, a number of other sites in Huntington Beach*

[2] https://documents.coastal.ca.gov/assets/slr/guidance/2018/0_Full_2018AdoptedSLRGuidanceUpdate.pdf

provide important services to the community.[3]" Poseidon's argument is misleading and implies that only City-owned facilities can be "critical facilities" subject to the H++ sea level rise projection. However, this is misguided. The Ocean Protection Council (OPC) 2018 guidance states that projects such as the Poseidon Plant with a design life beyond 2050, that would result in serious consequences if damaged (e.g., be expensive to repair or rebuild), or have little adaptive capacity once developed (e.g., cannot be easily raised or relocated) should take into account the H++ scenario[4]. The CCC has explained that projects like wastewater treatment facilities, which are "large and ha[ve] expensive infrastructure so [they] cannot be elevated, and relocation is costly and difficult" have very low adaptive capacity.[5] Given that the Poseidon plant will have low tolerance to risk, very low adaptive capacity, be highly vulnerable to sea level rise, and present great economic risk if lost or damaged, as well as the fact the facility will provide local drinking water supply, Integral maintains that application of the H++ scenario is warranted.

Furthermore, if Poseidon's desalination plant is elected as one of the region's future water supplies, it may discourage funding and development of other future water supplies, such as those identified in the Municipal Water District of Orange County's Urban Water Management Plan. There is a clear expectation in the City of Huntington Beach's 2010 environmental impact report that Poseidon's project provide water during emergencies:

- The City's 2010 EIR for the project required Poseidon to develop measures to "ensure continuous facility operations and water delivery under earthquake emergency conditions."[6]
- The City's 2010 approval of Poseidon's CDP recognized the critical nature of the proposed facility, with the CDP findings stating that Poseidon was expected to provide a water supply during declared emergencies.[7]

Critical infrastructure is also defined in the Orange County's Local Hazard Mitigation Plan:

- Orange County Local Hazards Mitigation Plan ("OCLHMP") identifies "critical facilities and infrastructure" as being public or private, and as being "facilities critical to government response and recovery activities (i.e., life safety and property and environmental protection) include 911 centers, emergency operations centers,

[3] Draft Local Hazard Mitigation Plan, City of Huntington Beach. Pg. 80
[4] https://www.opc.ca.gov/updating-californias-sea-level-rise-guidance/
[5] https://documents.coastal.ca.gov/assets/slr/guidance/2018/0_Full_2018AdoptedSLRGuidanceUpdate.pdf, pg. 89
[6] See EIR, Section 4.2 – Geology, Soils, and Seismicity, page 4.2-11.
[7] See City's 2010 approval of CUP 02-04 and CDP 02-06, which include findings for a Water Purchase Agreement through which the City would receive certain volumes of emergency water supply.

police and fire stations, public works facilities, communications centers, sewer and **water facilities**…" [emphasis added].[8]

- The Municipal Water District of Orange County's LHMP ("MWDOC") describes critical facilities as "public infrastructure used to provide potable water to the public and maintain wastewater services, necessary to maintain public health and safety."[9] The MWDOC Plan incorporates the facilities owned by OCWD, including its pump stations, reservoirs, water storage tanks, water treatment plants, and potable water pipelines, all of which are considered "critical facilities." With OCWD's involvement in the Poseidon project, including reliance on its water supply and proposed ownership/management of Poseidon's water distribution pipeline, at least part, if not all of Poseidon's project would presumably be considered a "critical facility."

Given that the agreement must eventually be signed by both Poseidon and the City/ County, public works and other governmental departments must be invested in this development. The California Coastal Act Section 30114(a) defines "public works" as including: "All production, storage, transmission, and recovery facilities for water, sewerage, telephone, and other similar utilities owned or operated by any public agency or by any utility subject to the jurisdiction of the Public Utilities Commission, except for energy facilities." The Commission's regulations, at 14 CCR Section 13012(a) define "major public works" as those facilities that cost more than $100,000, adjusted yearly based on the Construction Cost Index. As of 2019, a public works project must cost approximately $275,000 to be considered a "major public works." This was pulled directly from a recent CCC staff report[10] that denied a coastal development permit on a similar basis, for coastal zone infrastructure in support of a desalination plant. Poseidon's desalination facility in Carlsbad – which, like its proposed Huntington Beach project, is a private facility providing water to public water districts –considered a "critical" facility by the San Diego County Water Authority,[11] by the County of San Diego,[12] and is described as such by Poseidon.[13] Since the completion of the Report and the Letter, state regulatory agencies have continued to incorporate climate change planning into policy guidance and regulatory requirements.

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[8] See County of Orange and Orange County Fire Authority, Local Hazard Mitigation Plan, November 2015.
[9] See MWDOC, Orange County Regional Water and Wastewater Hazard Mitigation Plan.
[10] https://documents.coastal.ca.gov/reports/2019/11/Th8a_9a/Th8a_9a-11-2019%20staff%20report.pdf
[11] The SDCWA's 2019-2023 Business Plan and Fact Sheet – Overview [n.d.]. identifies the facility as a critical local water resource.
[12] See, for example, the 2017 San Diego County Multi-Jurisdictional Hazard Mitigation Plan, and as defined in the County's April 2013 Integrated Floodplain Management Planning, which defines a "critical facility" as including both public and private potable water facilities.
[13] See Poseidon's March 18, 2020 press release titled "Carlsbad Desalination Plant Staff Take Extraordinary Step to Shelter in Place to Ensure Operational Continuity at Critical Facility," in which the facility manager describes it as a "critical regional facility."

The OPC Strategic Plan in Objective 1.1: Build Resiliency to Sea Level Rise, Coastal Storms, Erosion and Flooding, identified that Sea Level Rise planning should ensure that the coast would be resilient to at least 3.5 feet of sea level rise by 2050[14]. This Strategic Plan objective has been discussed amongst all of the coastal focused regulatory agencies and as the standard for evaluation. Using this updated guidance, the elevations of the suite of coastal hazards that may affect the site by 2050 are shown in Table 1.

Table 1. Revised potential hazard elevations synthesis adapted from the Report with the updated state guidance of considering 3.5 feet of sea level rise by 2050.

Potential Hazards						
	H++				Updated State Guidance	
Years	Existing	2050	2070	2100	Existing	2050
Base Level of Rise (Mean Sea Level)	*0*	*2.6*	*5*	*9.9*	*0*	*3.5*
Base Level of Rise (Mean High Water)	*4.5*	*7.1*	*9.5*	*10.4*	*4.5*	*8*
King Tide (+7.0 NAVD)	*7*	*9.6*	*12*	*16.9*	*7*	*10.5*
Coastal Erosion						
Coastal Wave Flooding						
Groundwater Daylighting	*5.3*	*7.9*	*10.3*	*14.3*	*5.3*	*8.8*
Fluvial Flooding 500-yr						
Coastal Confluence Flooding 100-yr #1	*9.6*	*11.2*	*12.2*	*15.1*	*9.6*	*12.1*
Coastal Confluence Flooding 100-yr #2	*9.5*	*11.7*	*13.6*	*16.7*	*9.5*	*12.6*
Barrier Beach Flooding	*13*	*15.6*	*18*	*22.9*	*13*	*16.5*

Key

Green: No documented increase in risk of specific hazard impacts at the site.
Yellow: Site access likely to be affected.
Orange: Partial flooding of low-lying areas of the site.
Red: Flooding of highest proposed site grade, causing proposed structures to be flooded.
Dark Red: Flooding of all proposed structures on site.
Numbers: Where available report the flood elevations for each hazard type, not all hazards have an elevation available

[14] https://www.opc.ca.gov/webmaster/ftp/pdf/2020-2025-strategic-plan/OPC-2020-2025-Strategic-Plan-FINAL-20200228.pdf

Tsunami Exposure

Poseidon attempts to rebut the use of the 2009 California Geological Survey maps that mapped worst case inundation extents for a range of local nearfield and distant farfield tsunami sources in preparing the maps for emergency planning purposes. Poseidon instead references 200 years of tsunami observations focused primarily on the largest observed tsunami waves of 2 to 3 feet near the site that were associated with the 1960 Chili earthquake and 1964 Alaskan earthquakes.

This rebuttal is flawed for several reasons, first, tsunami events are episodic events with long recurrence intervals often associated with geologic events, much longer than the only 200 years of observations. Their reference does not consider the potential for local earthquake or submarine landslide sources for tsunamis. In addition, the risk associated with tsunamis is not necessarily the wave height as Poseidon points out. Rather the tsunami risk is largely due to the long wave periods and the substantial differences in wave energy between normally observed wind generated waves and a tsunami wave. Wave energy is a function of the square of the wave period. A 4 foot tsunami wave moving inland for several minutes for example has a lot more wave energy and displaced water volume than a typically observed wind generated wave with a period of seconds. In addition, the deepwater wave speed is very different with a tsunami moving around 500 mph while a 14- second period wave only has a deepwater wave speed of 50 mph. This wave speed means that a tsunami can arrive very quickly from a local source with little to no time to prepare. The 2009 CGS maps project the maximum inundation extents from a wide range of local and distant sources that allows analysis of the elevation that a worst case tsunami could reach.

FEMA flooding

Since the 2018 Report and the 2019 response, FEMA finalized the Preliminary FIRM maps. FEMA FIRM (Panel #06059C0263K) became effective on 3/21/2019. The effective FIRM map for a 1% annual chance storm event (100 year) still identifies the site as in a “X” Zone, an Area with Reduced Flood Risk due to the presence of the existing certified flood control levee. The proposed site remains inside the 0.2% annual chance (or 500 year) storm event. One small portion of the site, outside the containment berm and hydraulically connected to the restored Huntington Beach wetlands is mapped as an AE zone and shows existing flood elevations of 9 feet.

The Poseidon rebuttal to this item was that there are no published flows or elevations for a 500 year flood. The rebuttal then states that their expert consulting team has devoted substantial efforts to understanding the existing and future hazards at the site. The

expertise of the Poseidon consulting team is not being called into question, and Integral respects all involved consulting firms.

The Poseidon rebuttal however, fails to acknowledge that the site is dependent on the existing flood control levee that is managed and maintained by the Orange County Flood Control District. As documented in the 2018 Report future sea level rise effects on existing hazards will likely require changes to the existing flood control channel. Thus the protection of the site is not within the control of Poseidon and depending on future management and adaptation decisions by the County of Orange, the site may become vulnerable without the ability to protect the facility.

Additionally, there were other constraints on flood conveyance in the Talbert flood control channel not previously considered in the Report. As part of the Talbert Marsh Restoration, water levels in the flood control channel were collected and a model of storm water conveyance was developed, calibrated with the monitoring data. These model results identified that during peak flow events the Brookhurst Bridge soffit (bottom of the bridge) downstream of the proposed project site is already 0.5 feet lower than peak flow elevations (Moffat and Nichol 2004). Thus, this bridge becomes an obstacle to flood conveyance and may have a backwatering effect on upstream water elevations increasing the flood risk at the proposed site during high fluvial flows.

Barrier Beach Flooding

Barrier beach flooding is caused seasonally on naturally functioning bar built estuaries when beach sands close the channel. This closure results in bathtub like flooding up to the elevation of the barrier beach berm crest. As documented in the 2018 Report, this berm crest elevation varies alongshore between 12’ and 15’ NAVD near the Talbert Channel Outlet. The Report assumed an elevation of 13’ NAVD for its analysis. Currently, Orange County Public Works maintains the Talbert Outlet channel in an open configuration to avoid this type of flooding. Semi-annual maintenance at the Talbert Outlet includes excavation of approximately 15,000 cubic yards of accumulated sediment within the outlet from a 3.51-acre area within Corps jurisdiction. The discharge of excavated sediment and related earthwork associated with each maintenance event would occur on the beach adjacent to the outlet in an approximately 3.12-acre area above the high tide line. As required for California least tern and western snowy plover habitat management, minor maintenance activities may be conducted during summer months to remove any shoal blocking tidal flow into Talbert Marsh. This requires monitoring and reporting of activities.

The continued management to maintain an open flood control channel outlet across Huntington State Beach requires a host of permits. Currently it is authorized by an Army

Corp Regional General Permit (#46) on a 5-year permit cycle[15], a Coastal Development Permit[16], and an Endangered Species Act Section 10 permit. There is no current consideration of sea level rise and changes that will be required to avoid barrier beach flooding in the future.

Poseidon partially refutes this in the Letter, but acknowledges that the site is reliant on maintenance of the existing open flood control channel across Huntington State Beach.

> *"While we disagree with the assumptions in the Surfrider report regarding closed barrier beach flooding, Poseidon recognizes that inlet management is important and is aware that Orange County Public Works currently conducts management of the inlet to the Huntington Beach wetlands to maintain tidal fluctuation within the wetlands and capacity within the flood control system. Moffat & Nichol also has reported that wetland inlet stability has improved since restoration efforts were completed in 2010, and there is no indication that the County will not continue this effort into the future."*

This rebut is unfounded. Poseidon acknowledges that this is an important issue to maintain tidal fluctuation and flood control capacity. The assumptions they disagree with are not identified and the Report actually uses a lower berm crest elevation than could have been used (13' vs 15'). In addition, the Letter talks about wetland inlet stability following restoration with no citation identified, or parameters considered in the statement about inlet stability. Inlet stability is typically governed by a complicated set of physical processes including watershed flows, tidal prism, wave characteristics including wave height, period, and direction, as well as sand grain size, beach width, and seepage through the beach.

Ongoing maintenance of this flood control channel is not guaranteed. As part of a 5-year permit renewal, the County must commit to complying with monitoring conditions associated with existing permits. In the future, the County must commit to both staff and financial resources to renewing a wide variety of permits and monitoring requirements placed on each permit from the Water Board, California Coastal Commission, Army Corps of Engineers, and State and Federal biological resource agencies. This includes annual reporting requirements to both U.S. Fish and Wildlife and National Marine Fisheries Service. The County also has to be granted an encroachment permit from CA State Parks and then fund the actual operations to maintain an open channel condition across the State Beach.

[15] SPL-2010-00868 expires November 2, 2023.
[16] CDP Amendment No. 5-02-031-A5 expires July 1, 2021.

While "*there is no indication that the County will not continue this effort into the future*", Poseidon and this proposed project depend on the continuation of this existing practice and has no ability to change or influence the permits or operations if this practice ceases. If the County does stop this operation, then flood levels will quickly impact the access and facility footprint as groundwater and ponded water levels rise.

ADDITIONAL CONSIDERATIONS

Since completion of the Report and receipt of the Letter, some time has passed. Integral has reviewed recent scientific publications, data sources, and state policies and guidance that raise some additional concern about the proposed project. These additional concerns include:

1. Clarified definition by the California Coastal Commission of shoreline and shoreline armoring which now includes the flood channel site perimeter;
2. Groundwater daylighting; USGS 2020 model results
3. Maladaptation

Tidally influenced shoreline and shoreline armoring

The Report evaluated coastal erosion hazards based on available model results and determined that coastal armoring was not likely to be necessary for the life of the project. However, subsequent conversations with the Coastal Commission and other interested parties, suggest that changes to the flood control channel or enhanced protection to the berm along the triangle wetland site may constitute shoreline armoring because it is tidally influenced. Thus, given the existing site configuration exposure to tides, reliance on the Orange County Flood Control District, and the elevations across the site, that additional shoreline armoring and or alterations to existing shoreline hardening should be anticipated.

Groundwater Daylighting

The Report reviewed available groundwater information and identified that a shallow near surface groundwater condition with average depths from 5 to 9 feet presently exist and vary based on tidal influence and seasonality.[17] The Report raised concerns about groundwater daylighting as sea level rises as well as potential for liquefaction during an earthquake that was beyond the scope of the study but worthy of additional examination.

The Letter did not refute or comment on this potential hazard.

[17] *Huntington Beach Desalination Review of Sea Level Rise Hazards.* Page 22.

In August of 2020, the USGS released results of a new study "Projected responses of the coastal water table for California using present-day and future sea-level rise scenarios" (Befus et al 2020). This study applied a widely accepted groundwater model (MODFLOW) with various assumption on hydraulic connectivity or the sediments and sea level rise scenarios to examine the groundwater depth and the potential for groundwater daylighting. The depths were calculated based on existing topography. Comparing the model results with monitoring data shows that a horizontal hydraulic conductivity of 0.1 Kh best matches existing monitoring data referenced in the Report (Figure 1).

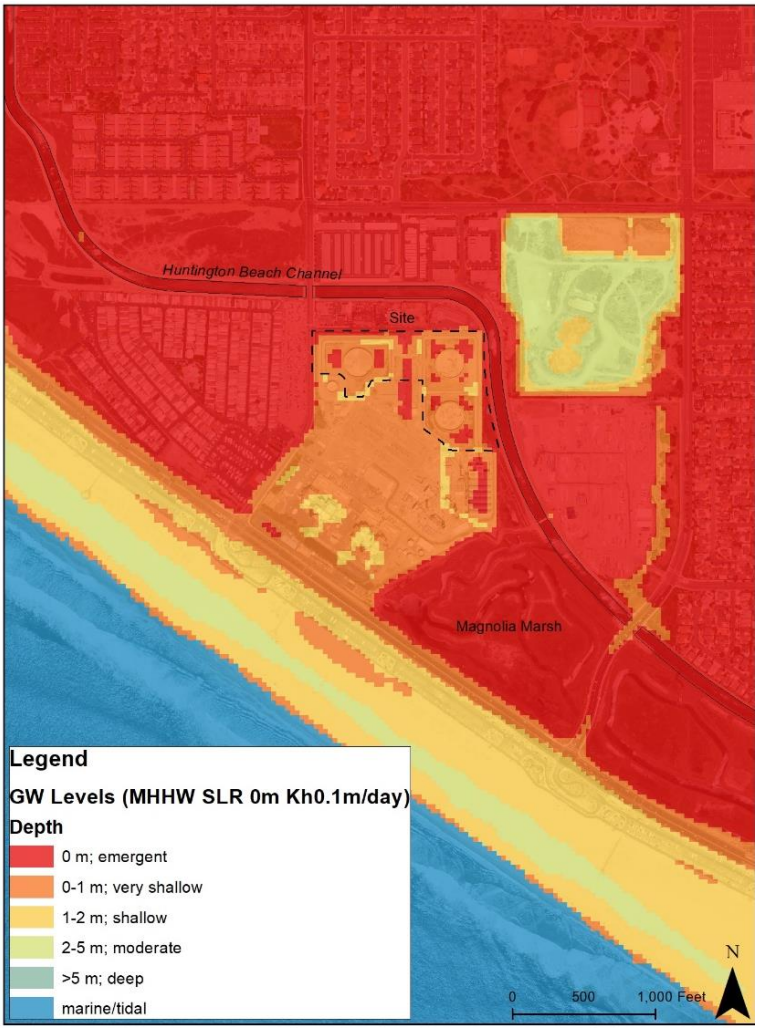

Figure 1. Model results showing existing groundwater levels of 1 to 2 meters is most consistent with available groundwater monitoring data described in Report.

Using that best model fit verification of hydraulic connectivity and adding 3.3 feet (~2050, 1m) and 6.6 feet (~ 2080, 2m) of sea level rise, groundwater levels at the site are shown in Figure 2. Note that the 3.3 foot projection is closest to being consistent with the OPC Strategic Plan used for planning purposes.

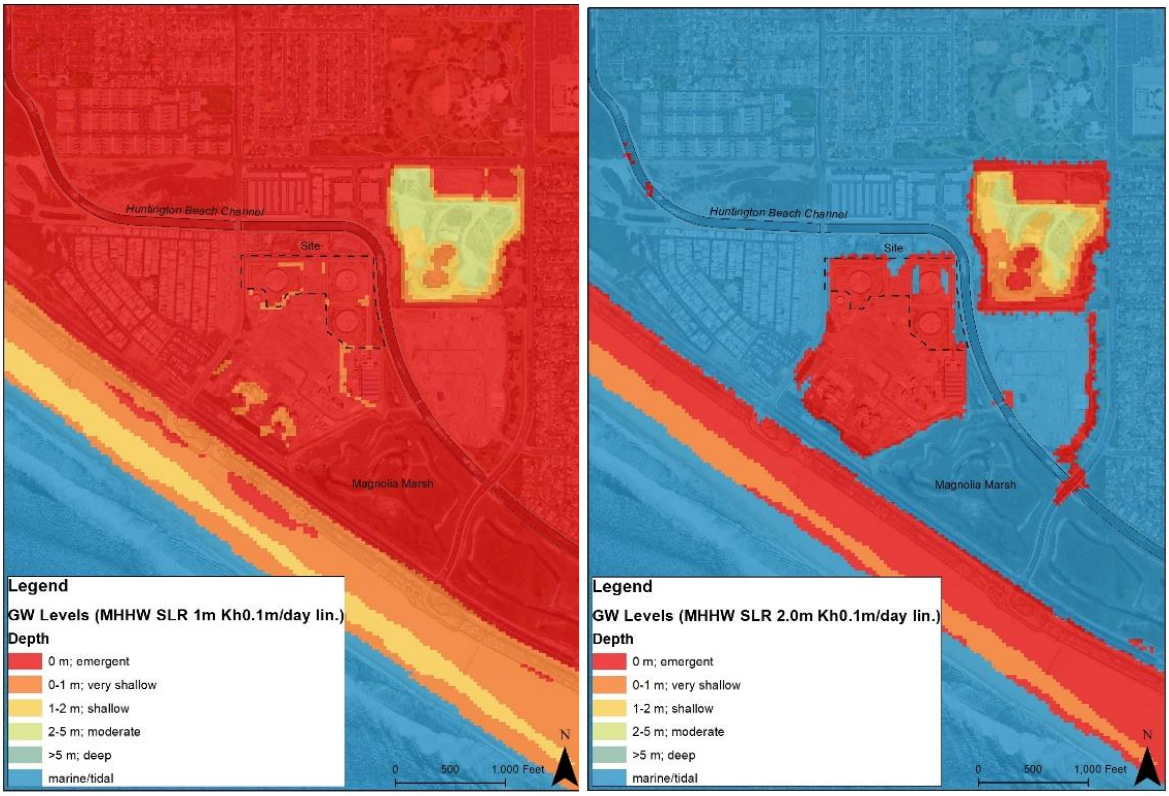

Figure 2. Groundwater conditions modeled with 3.3 feet of sea level rise (left) and 6.6 feet of sea level rise (right).

These results show that with 3.3 feet of sea level rise most of the site could have groundwater at or very near the surface, and during high king tides or other high water events, likely daylighting on the site. With 6.6 feet of sea level rise, the site becomes a man-made island surrounded by a manmade berm with periodic groundwater daylighting on the facility. The entire access to the site would likely be underwater during daily high tides. While Integral acknowledges that the groundwater depths were calculated based on existing topography and not the future finished grade (assumed to be 14ft NAVD). Despite that, areas outside of any elevated grade as well as access to the site will be affected.

These new groundwater results also raise concerns that with increased groundwater elevations may also come more rapid deterioration and increased buoyancy forces on all of the transmission pipelines critical to serving the proposed water supply.

The exposure of adjacent contaminated and remediated, "capped sites" may mobilize contaminants resulting in highly contaminated water moving through the system, out to the ocean, and likely transported north during south swells where the ocean intake pipes are located.

Additional work is likely required to evaluate the potential cumulative impacts of elevated groundwater on the proposed project, transmission pipeline infrastructure, and adjacent sites.

Maladaptation

The Report identified that this proposed facility was maladaptive based on the fact that redevelopment of this site places critical water supply infrastructure in a hazardous area that is likely to become isolated during a variety of coastal hazard events that will increase in frequency and duration as sea levels rise. Thus this proposed project discourages longer term adaptation planning by the City of Huntington Beach and the County of Orange to avoid future coastal hazards, by keeping critical infrastructure in a hazardous area.

In addition, the reliance on Orange County Water District to partially or fully maintain the water supply distribution network that may need substantial upgrades to maintain transmission services with maintanence costs that will escalate with sea level rise is not currently known as part of the project. These costs are likely to be passed onto rate payers.

From public trust doctrine principles, it is also in the City/County's best interest to proactively plan for adapting critical infrastructure well in advance of adverse sea-level rise impacts. Impairments to, losses of functionality of, and pollution events from the Poseidon Plant that negatively affect the coastal environment and public recreational resources would be in violation of the public trust doctrine and state and federal environmental laws[18].

After review of the Letter, however, there are additional considerations that fall under maladaptation, some of which are a bit outside the scope of this sea level rise analysis but still worth mentioning. The Letter states that:

> *The reverse osmosis seawater desalination process does not result in direct emissions of greenhouse gases. Therefore, the Project will not directly contribute significant amounts of air emissions that may exacerbate global warming. Nevertheless, we recognize that, as with nearly all water conveyance, treatment, and distribution facilities, the Project will*

[18]https://law.ucla.edu/sites/default/files/PDFs/Publications/Emmett%20Institute/_CEN_EMM_PUB%20Combatting%20Sea-Level%20Rise.pdf

> *use electrical energy, the generation of which will result in some level of indirect emissions. To lessen emissions that could contribute to global warming to the maximum extent possible, Poseidon will implement, industry-leading measures to ensure that the Project's indirect impacts are completely offset.*

However, the Letter indicates that the mechanisms by which Poseidon would actually implement these industry leading measures to achieve carbon neutrality are tied to receiving the NPDES permit with a condition that within 18 years they will submit a climate change action plan. This is the cart coming before the horse. While they identify a host of what they might do, it is difficult to determine whether this truly is a carbon neutral project.

REFERENCES

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