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Subject: Evaluation of Terminal One Base Flood Elevation and Area of Inundation

REMARKS:

The following summarizes our investigation of the potential depth of flooding within the Terminal One property located in Richmond resulting from rainfall, storm induced waves, and sea level rise. The project team will use this information to establish the elevations of buildings and roadways as well as to complete hydraulic analysis of the project's storm water conveyance system.

In general, the Federal Emergency Management Administration (FEMA) defines locations that are subject to inundation resulting from a storm that has a 1-percent chance of occurring in any year (sometimes known as the 100-year storm). While the 100-year storm has a low probability of occurring, the resulting rainfall can create severe inundation. FEMA defines the areas of inundation by the 1-percent-annual-chance flood event as Zone A in the federal agency's Flood Insurance Rate Maps (FIRMs). When known, the FIRM defines the Base Flood Elevation (BFE), which FEMA typically bases on the North American Vertical Datum of 1988. Most municipalities do not allow construction within Zone A unless the applicant raises the development above the BFE.

The June 16, 2009 FIRM for Terminal 1 as attached for reference indicates that the BFE applicable to the Terminal One site is 9.0 feet and that the property is not within a Flood Zone. However, on June 20, 2014, FEMA released a revised FIRM for Terminal One, which we have also attached for reference.

The revised FIRM indicates the area of the bay to the south of the existing shoreline is situated in Zone VE with a BFE elevation of 11 feet. Areas that are designated VE Zones are subject to inundation by the 1-percent-annual-chance flood event with additional hazards that result from storm-induced velocity wave action by a 3-foot or higher wave. The 2014 FIRM shows that portions of the shoreline underlying the existing warehouse and extending to the east are within Zone VE. Additionally, it shows that a portion of the site is subject to a 0.2% (500-year storm) annual chance flood hazard.

Based upon our topographic survey of the site, existing grades are as low as about 8 feet near the southeast corner of the warehouse rising to about 16 feet along Brickyard Cove Road. Thus, FEMA's FIRM does not depict the limits of the flood zone correctly. The existing dock is not in the Flood Zone as it has an elevation of approximately 12.5.

FEMA allowed public comments on the revised FIRM until December 16, 2014. Assuming there were no comments, FEMA will likely publish the revised FIRM for Terminal 1 in early 2015. Thus, the final design of the Terminal One project should accommodate a BFE of 11.0 feet.

The development of the Terminal One site should also accommodate the potential increases in tides resulting from climate change. In a report entitled, "Vulnerability and Risk Assessment Report" dated September 2012 prepared by the Bay Conservation and Development Commission and the NOAA Coastal Services Center, sea levels are predicted to rise 16 inches by 2050 and 55 inches by the end of the century. Since the mean higher high water tidal datum in this location is at elevation 6 feet, tides could rise to an elevation of 7.3 feet mid-century and 10.6 feet by the end of century.



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Based upon our discussion with staff from the City's planning and engineering departments, Richmond does not have a policy or guidelines for designing to accommodate climate change. Since FEMA does not account for rising tides due to climate change in their FIRM maps, we recommend that the project incorporate the following two-part strategy to mitigate the potential impacts of sea level rise:

1. To address the potential for a mid-century rise in sea level of 16 inches, all buildings should be set above an adjusted BFE of 12.3 feet (11 feet plus 16 inches). As an additional measure of safety, building floor elevations should be set 24-inches above the adjusted BFE of 12.3 feet.
2. Since the end-of-century sea level rise is more difficult to predict and mitigation strategies are expected to evolve in the interim period, instead of raising the site to accommodate an increase in tidal elevation of 55 inches, the Terminal One project should provide an area along the shoreline for an adaptive response such as an earthen berm or a floodwall at such time as it is needed.

Some of the proposed single-family homes are located in areas where existing elevations are below 11 feet. According to section R322.3 of the 2013 California Residential Building Code, buildings cannot be set atop structural fill when located within coastal high-hazard areas (V zones). Rather, they must be elevated above the base flood elevation using structural components. We do not believe that Richmond has an exemption to this requirement and we recommend further evaluation with the building official.

In summary, we note and recommend the following:

1. Terminal 1 is subject to wave action. Using the newest FIRM map prepared by FEMA, the BFE is 11 feet. With a mid-century tide rise of 16 inches, the tides could inundate the site to a depth of 12.3 feet.
2. Set all residential buildings to a finished floor elevation of 24 inches above the adjusted BFE at 12.3 feet. Thus, all buildings should be at an elevation of at least 14.3 feet.
3. Set all public roadways at or above 12.3 feet to allow for emergency vehicle circulation.
4. For hydraulic calculations, set the tail water elevation to mean higher high water tidal datum plus 16 inches, or 7.3 feet.

If there are any questions or comments, please contact Jason White at 925.940.2218 or jwhite@bkf.com.