Draft Environmental Impact Report

APPENDIX

D

SEA LEVEL RISE AND CLIMATE CHANGE ADAPTATION

Appendix D-1

San Francisco Bay Regional Water Quality Control Board,
Water Code Section 13383,
Order Requiring Submittal of Information on Climate Change Adaption

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San Francisco Bay Regional Water Quality Control Board

Sent via email
Confirmation of receipt requested

January 8, 2021

To: Attached Mailing List

Subject: Water Code Section 13383 Order Requiring Submittal of Information on Climate Change Adaptation

This letter requires Chevron Products Company, Martinez Refining Company, Tesoro Refining and Marketing Company, Phillips 66 Company, and Valero Refining Company-California (Dischargers) to provide reports evaluating the risks posed to operations at their facilities by existing and future climate conditions, and proposing plans to mitigate or avoid such risks. Climate change is shifting precipitation and temperature patterns, exacerbating extreme weather events, and causing sea level and groundwater rise. These conditions have significant implications for wastewater and stormwater collection, treatment, and discharge operations. This request is made pursuant to Water Code section 13383 and Regional Water Board Orders R2-2015-0033, R2-2016-0044, R2-2016-0047, R2-2017-0039, and R2-2020-0033 (NPDES permits, Attachment D, provision V.A).

We consider the Ocean Protection Council's *Sea-Level Rise Guidance*[1] to be the most current authoritative source supporting planning for sea level rise in California. In May 2020, the California Coastal Commission adopted *Making California's Coast Resilient to Sea Level Rise: Principles for Aligned State Action*.[2] The California Environmental Protection Agency, including the State Water Resources Control Board, has endorsed these principles, which recommend using a minimum sea level rise target of 3.5 feet by 2050 for planning purposes. This target applies a safety factor to the California Ocean Protection Council's sea level rise estimates, which do not account for extreme storm surges, tides, or other weather events on top of sea level rise.

In addition to providing the information required below, Dischargers must update, as necessary, the contingency plan, spill prevention plan, operation and maintenance manual, and wastewater facilities status report as required by their NPDES permits (Attachment G, provisions I.C and I.D) to reflect their responses to this letter. Likewise,

[1] https://opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A_OPC_SLR_Guidance-rd3.pdf
[2] https://documents.coastal.ca.gov/reports/2020/5/w6g/w6g-5-2020-exhibits.pdf

Dischargers must notify us of any anticipated facility modifications as required by their NPDES permits (Attachment D, provisions II.B and V.F).

Requirements

By February 1, 2022, Dischargers shall provide the information described below. We hope each Discharger has already initiated some of this work, and Dischargers may rely on existing planning, to the extent that it is relevant, to respond to this requirement.

1. **Vulnerability Assessment**. Assess the vulnerability of the facility's wastewater and stormwater collection, treatment, and discharge systems to the following: (1) sea level rise, (2) groundwater rise, (3) changing climate and weather, and (4) power outages and wildfires.

    a. ***Sea Level Rise***. Explain how the Discharger manages <u>existing</u> flooding risks (e.g., protective measures already in place, planned, or proposed). Explain how the Discharger intends to manage <u>future</u> flooding risks over a 50-year time horizon (e.g., planning efforts and protective measures in place, planned, or proposed). What guidance and assumptions are being used to anticipate sea level rise? If the Discharger has not yet established a plan, explain the process and timeline for doing so in response to item 2, below.

    b. ***Groundwater Rise***. Explain how the Discharger intends to manage future flooding related to groundwater rise over a 50-year time horizon (e.g., ongoing planning efforts and protective measures in place, planned, or proposed). If the Discharger has not yet established a plan, explain the process and timeline for doing so in response to item 2, below. If the Discharger believes it will not be susceptible to flooding related to groundwater rise within 50 years, explain the basis for the conclusion.

    c. ***Changing Climate and Weather***. Assess how increased temperatures, greater rainfall intensity and more frequent storms, and longer and drier summers may affect the facility's collection, treatment, and discharge systems. Explain how the Discharger intends to manage future risks of this nature. If the Discharger has not yet established a plan, explain the process and timeline for doing so in response to item 2, below.

    d. ***Power Outages and Wildfires***. Assess critical equipment and any need for additional back-up power. This may be necessary due to increasing stress on the power grid from more extreme heat waves and expanded public safety power shutoffs to the facility's service area due to wildfires. Explain how the Discharger intends to manage future risks of this nature. If the Discharger has not yet established a plan, explain the process and timeline for doing so in response to item 2, below.

2. **Adaptation Strategies**. Based on the vulnerabilities of the facility's wastewater and stormwater collection, treatment, and discharge systems, identify mitigation and control measures needed to maintain, protect, and improve the Discharger's

wastewater infrastructure under existing and possible future conditions. This assessment should include the following:

a. ***Regional Collaboration***. Document how the Discharger plans to work with regional stakeholders to address sea level rise and groundwater rise in the facility area. A regional approach may best provide cost-effective ways to manage sea level rise and groundwater rise, while ensuring that the actions of one party do not adversely affect the adaptation plans of other parties.

b. ***Time-Critical Measures***. Identify any time-critical mitigation and control measures, and propose an implementation schedule to complete them.

c. ***Design Modifications and Improvements***. Explain how the Discharger will modify infrastructure identified as vulnerable to sea level rise, groundwater rise, or extreme weather events in the future. For example, it may be necessary to relocate critical equipment above projected flood levels or waterproof facilities at risk of flooding. As sea level rises, increasing the facility's pumping capacity may also be necessary to ensure it can discharge treated wastewater under an increased hydraulic pressure head.

d. ***Emergency Response Planning***. Describe actions the Discharger will take to keep its facilities operating, or to return to operation as quickly as practicable, if a climate-change-related emergency occurs. The Discharger's emergency response planning should also address how it will ensure the health and safety of its employees under such conditions.

Basis for Requirements

We require the information described above pursuant to Water Code section 13383 and the NPDES permits. Water Code section 13383, subdivision (a), authorizes the Regional Water Board to establish reporting and recordkeeping requirements, as authorized by Water Code sections 13160, 13376, or 13377, for any person who discharges to navigable waters. The NPDES permits (Attachment D, Provision V.A) implement 40 Code of Federal Regulations part 122.41(h) and require Dischargers to furnish any information the Regional Water Board requests to determine permit compliance or whether cause exists to modify the permit. Water Code section 13383, subdivision (b), further authorizes the Regional Water Board to require "any person subject to this section" to provide reasonably required information.

The Regional Water Board is therefore authorized to require Dischargers to report on climate change vulnerabilities and adaptation strategies. This information is necessary to determine whether each Discharger's contingency plan, spill prevention plan, operation and maintenance manual, and wastewater facilities status report are up-to-date as required by the NPDES permits (Attachment G, sections I.C and I.D) and to inform permit reissuance. The information is also reasonably required to prevent disruptions of facility operations by existing and future climate conditions.

Failure to comply with the requirements in this letter could subject each Discharger to administrative civil liability of up to $10,000 per day of violation pursuant to Water Code section 13385.

Any person aggrieved by this action may file a petition with the State Water Resources Control Board in accordance with Water Code section 13320 and California Code of Regulations, title 23, section 2050. The State Water Resources Control Board must receive the petition within 30 days of the date of this letter. Copies of the law and regulations that apply to water quality petitions may be found at http://www.waterboards.ca.gov/public_notices/petitions/water_quality. Any extension in the above deadline must be confirmed in writing by Regional Water Board staff.

If you have any questions regarding this letter, please contact Robert Schlipf at robert.schlipf@waterboards.ca.gov.

Sincerely,

Michael Montgomery
Executive Officer

Copy to (via email):

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Appendix D-2

Long-Term Flood Protection Report, Phillips 66 San Francisco Refinery

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LONG-TERM FLOOD PROTECTION REPORT

PHILLIPS 66 SAN FRANCISCO REFINERY

RODEO, CALIFORNIA

June 23, 2021

Project #: 703-133-211

SUBMITTED BY: Trihydro Corporation

2520 Stanwell Drive, Concord, CA 94520

ENGINEERING SOLUTIONS. ADVANCING BUSINESS.

CERTIFICATION

LONG-TERM FLOOD PROTECTION REPORT
PHILLIPS 66 SAN FRANCISCO REFINERY, RODEO, CALIFORNIA
June 23, 2021

I certify that I have reviewed this document. To the best of my knowledge, the data contained herein are true and accurate, and the work was performed in accordance with appropriate and customary professional standards.

6/23/2021

Johan Pae, P.G. Date
California Professional Geologist #7332
License expires 5/31/2023

PROFESSIONAL GEOLOGIST
JOHAN PAE
No. 7332
STATE OF CALIFORNIA

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1.0 INTRODUCTION

Trihydro Corporation (Trihydro) presents this report to summarize the impacts of the 100-year flood and sea-level rise within the Phillips 66 San Francisco Refinery (SFR), located at 1380 San Pablo Ave, Rodeo California (Figure 1). This long-term flood protection report was prepared in accordance with reporting requirements established in Waste Discharge Requirements (WDR) Order No. R2-2015-0046, which was issued by the Regional Water Quality Control Board (RWQCB). The WDR states:

> *"The Discharger shall submit a report, acceptable to the Executive Officer, for long-term flood and/or sea-level rise protection at the Refinery. The report shall include a consideration of feasible options for achieving protection from the 100-year flood to account for rising sea-levels and increased flood frequency and intensity. The report shall consider the methods developed by the San Francisco Bay Conservation and Development Commission to predict and protect against future flooding. The report shall be updated every five years throughout the operational life of the site, with the most recently available and credible information at the time of the update"*

The purpose of this report is to update information included in the 2016 *Long-Term Flood Protection Report* to detail the current protective configuration of refinery systems, including groundwater remediation systems, against potential hazards associated with the 100-year flood event and regional sea-level rise based on available information (Trihydro 2016). The objectives of this report are as follows:

- Assess the current flood risk at the SFR using Federal Emergency Management Agency (FEMA) Maps.
- Assess the projected flood risk due to sea-level rise at the SFR using Adapting to Rising Tides (ART) Bay Area Sea-Level Rise Maps from the Bay Conservation and Development Commission.
- Following the assessment, provide recommendations to address any areas currently at risk of inundation and areas that may become at risk of inundation following sea-level rise.

2.0 SITE BACKGROUND

The SFR, located in Rodeo, California, was constructed in 1896 on the eastern shoreline of the San Pablo Bay and expanded to areas on Tormey Ridge and the surrounding hills, and filled former tidal lands. The SFR spans an approximate area of 1,100 acres split into three zones divided by San Pablo Avenue and Highway 80 (Figure 1). Primary processing facilities, such as coking, hydrocracking, and hydrotreating, are located east of San Pablo Avenue and were constructed on the slopes of Tormey Ridge (200-300 feet above sea-level). Sections of the refinery west of San Pablo Avenue occupy lower elevation filled areas (previously tidal flats).

2.1 SURFACE IMPOUNDMENTS

Surface impoundments at SFR include the Effluent Safety Basin (ESB), Primary Basin (PB) and Main Storm Basin (MSB). The ESB, PB, and MSB are located within the lower portion of the central refinery valley, upgradient of the Bay Shore. The immediate vicinity of the basins is relatively flat ground, with rising topography several hundred feet away to the northeast and southwest. The PB and MSB temporarily hold excess storm and process water in the event of an emergency until the water can be processed in the Unit 100 wastewater treatment facility. A groundwater and FPLH extraction system in the Unit 100 area, consisting of nine wells located along the southwestern edge of the MSB and one well located about 100 feet west of the PB, was installed in 1997 and updated in 2010.

The ESB is used to temporarily retain non-contact, once-through cooling salt water, as well as stormwater originating from various places, including the main parking lot, undeveloped areas of SFR (non-process areas), a limited portion of San Pablo Avenue and nearby residential Rodeo, and a portion of Interstate 80. Water flowing through the ESB is discharged to San Pablo Bay through the E-003 outfall. A groundwater extraction system consisting of twelve wells located along the eastern edge of the ESB was constructed in 2017 as an extension of the Main Interceptor Trench, Alignment C to hydraulically control groundwater flow toward the ESB and minimize the potential for migration of free-phase liquid hydrocarbons (FPLH).

2.2 PERIMETER GROUNDWATER EXTRACTION SYSTEMS

Groundwater extraction well networks, trenches, and remediation system components are located along the western and northern refinery perimeter bordering the San Pablo Bay, to manage contaminated groundwater and control hydraulic migration of contaminants to the Bay (Figure 2). The Main Interceptor Trench (MIT) and accompanying extraction and monitoring well network is located along the western perimeter of the refinery along the shoreline of San Pablo Bay. The Marine Terminal Area (MTA) well network located along the north and northwestern perimeter was constructed in 2011 and the design incorporated placement of wells and equipment at elevations above base flood levels. Refinery perimeter extraction wells and selected system components have water-tight components that should withstand a short-term flood event. Where the Refinery Perimeter directly borders San Pablo Bay, rip rap revetments have been placed to provide shoreline protection from erosion.

3.0 FLOOD PROTECTION FOR CURRENT CONDITIONS

The evaluation of potential flood hazard and the need for flood protection at the SFR was performed by reviewing the available flood hazard information. Areas at risk of flood hazard are spatially identified by the Federal Emergency Management Agency (FEMA) using Flood Insurance Rate Maps (FIRMs) (obtainable online through the FEMA Flood Map Service Center (MSC)). FIRMs are maps used by a variety of stakeholders including insurance agents, local and state floodplain administrators, planners, developers, engineers, surveyors, and the general public. The engineering analysis for FIRM production includes data collection, hydrologic analysis, and hydraulic analysis. A 100-year flood is defined as having a 1 percent chance of being equaled or exceeded in any given year; a structure located within a special flood hazard area has a 26 percent chance of suffering flood damage within a 30-year period (the length of an average mortgage). A 100-year flood is a regulatory standard used by federal agencies such as the National Flood Insurance Program (NFIP) and is a valuable tool to assist in planning for potential inundations due to severe storm events. FIRMs display the zones that have a 1 percent and 0.2 percent chance of being inundated during a storm event, which are equal to the 100-year and 500-year flood events, respectively. A FIRM was obtained for the SFR property area (Appendix A) and relevant information for the 100-year flood event was transposed onto aerial imagery of the SFR property boundaries and key locations have been indicated (Figure 3a-3c).

While the FEMA FIRMs are a valuable tool for planning purposes, it is necessary to note that there are discrepancies between the FIRM predictions and the predictions of other mapping products available for California. For example, according to the Bay Conservation and Development Commission (BCDC), no flooding was predicted within the MTA Alignment for current tides during a 100-year storm event (see Appendix C) nor did the USGS Our Coast Our Future Interactive Flood Map (see Appendix D). The BCDC mapping products and their analysis are discussed further in Section 4.0. These discrepancies do not discount the information from any of the providing agencies, instead it highlights the importance of reviewing several data sources and mitigating for the most conservative estimates. Therefore, flooding areas as predicted by the FIRM have been evaluated in the following sections for conservative analysis purposes.

3.1 RISK TO INFRASTRUCTURE

From the FIRM for the 100-year flood event, the ESB and supporting drainage networks; the former PG&E outfall ditch (Figure 3b); and portions of the MTA (Figure 3c) have been identified as currently at risk of inundation by the 100-year flood. The ESB is used to temporarily retain non-contact, once-through cooling salt water and stormwater originating from various places, including the main parking lot, undeveloped areas of SFR (non-process areas), a limited portion of San Pablo Avenue and nearby residential Rodeo, and a portion of Interstate 80. Water in the ESB is discharged to San Pablo Bay through the E-003 outfall. To allow for drainage to the bay, this area is purposefully located at lower elevation and was constructed with a network of secondary containment basins and drainage networks. The ESB is therefore not at risk of hazardous inundation by the 100-year flood. In August 2012, construction was completed on the PG&E Outfall Area that isolated the PG&E Discharge Channel to San Pablo Bay (Trihydro 2013). With this feature isolated from the San Pablo Bay, inundation of the Discharge Channel is less likely, however even lesser amounts of flooding would not result in any damage to infrastructure. Portions of the MTA that have been identified by the FIRM include an area near the causeway and an area along the western shoreline. Neither locations contain refinery processing equipment, but remediation system components are present within the area. These components (monitoring and extraction wells) were constructed on elevated, concrete pads, to protect from inundation from flooding, and therefore not at risk of damage from inundation by the 100-year flood.

3.2 WATER QUALITY

The evaluation of potential water quality effects from a 100-year flood event based on the available FIRM must incorporate site-specific topographic features and other refinery-specific features in areas noted as having a 1-percent chance of being equaled or exceeded in any given year. As noted in Section 3.1, the Main Interceptor Trench and a portion of the MTA remediation area have small areas where the 1-percent annual chance of flood hazard exists. In the Main Interceptor Trench Area, the 1-percent area includes portions of E-003 Outfall Area, including the ESB and Ditch 6, as well as portions of the former PG&E Outfall Ditch (Figure 3b).

The E-003 area includes extraction wells and trenches for perimeter hydraulic control. Because the E-003 Outfall is primarily used for non-contact cooling water discharge to San Pablo Bay, water flooding the ESB and Ditch 6 is expected to continue to discharge through the E-003 Outfall. Although there may be a short-term net increase in groundwater levels from the flooding, the remediation system extraction pumps in the area operate based on groundwater-level set-points. Therefore, the remediation system will automatically account for a temporary rise in groundwater levels as a potential result of temporary flooding. Extracted groundwater from this area is conveyed to the refinery's Unit 100 wastewater treatment plant and eventually discharged to San Pablo Bay via a diffuser located on the wharf portion of the MTA. The Unit 100 wastewater treatment plant is located outside of the 1 percent flood zone area and would not be directly impacted by flood conditions, other than through increased flow under flood conditions.

The former PG&E Outfall area could be subject to flood conditions, but refinery operations maintains a pump at the distal end of the former PG&E Outfall area to remove collected stormwater and convey the water to the refinery's stormwater system. All collected stormwater is centrally treated at the Unit 100 wastewater treatment plant and eventually discharged to San Pablo Bay via a diffuser located on the wharf portion of the MTA.

The portion of the MTA where the 1-percent annual chance of flood hazard exists includes the area along the shoreline, north of Tank 302 and the shoreline area near the MTA elevated causeway. The area north of Tank 302 is part of the MTA remediation system and the extraction wells would not be affected by flooding through a series of well vault elevations (building up well vaults to raise the lids above the ground several inches). Both the area north of Tank 302 and the area near the MTA elevated causeway have both water-tight pump boxes and extraction well caps that are watertight. Similarly, the E-003 Outfall area, the extraction wells in the MTA, the remediation system extraction pumps in the area operate based on groundwater-level set-points. Therefore, the remediation system will automatically account for a temporary rise in groundwater levels. Similar to the E-003 area and the Former PG&E Outfall Area, extracted groundwater and collected stormwater in the MTA is conveyed to the refinery's Unit 100 waste-water treatment plant and eventually discharged to San Pablo Bay via a diffuser located on the wharf portion of the MTA.

4.0 FLOOD PROTECTION FOR SEA-LEVEL RISE

The effects from potential sea-level rise and the need for associated protection at SFR was evaluated by reviewing available sea-level rise information. The climate of the Earth is dynamic and constantly changing; however, recent observations and modeling have shown dramatic changes in rate and magnitude of global surface temperatures, unprecedented for the most recent geologic period (the Quaternary Period). As a result of increasing temperatures, thermal expansion of Earth's oceans and melting of the polar ice sheets have continued to increase global sea-levels. Sea-level is projected to continue to rise and the rate is expected to accelerate over time (Pacific Institute 2009).

The Ocean Protection Council produced the guidance document *State of California Sea-Level Rise Guidance* (California Guidance) in 2018 and was used as the basis for evaluation of the rising sea-levels based on current emission scenarios and risk tolerance. This guidance was used as a primary source of information SFR's sea-level rise risk assessment. While there are sea-level rise projections through the year 2150, the California Guidance states that the sea-level rise projections after 2050 are increasingly dependent on future greenhouse gas emissions and can therefore fluctuate. The long-lived nature of most greenhouse gases means that their impacts on the environment are felt and experienced long after being emitted. Therefore, this assessment utilized the near-term sea-level rise projected in 2050 that has been locked in based on past greenhouse gas emissions.

The California Guidance provided a range of risk scenarios from low risk aversion to medium-high risk aversion. These scenarios are based on the probability that the projected sea-level rise will occur or be exceeded, with low risk having a 66 percent probability of occurring and medium-high risk having a 0.5 percent probability of occurring. Included in these projections is also the H++ scenario, or the extreme risk aversion scenario, which does not have an associated likelihood of occurrence, but can be considered the highest sea-level rise that has potential to occur. The table for projected sea-level rise for San Francisco as provided by the California Guidance is included in Appendix B. This assessment utilized the H++ scenario for the basis of this plan as the SFR has a low tolerance for risk. The H++ scenario is a sea-level rise in 2050 of 2.7 feet.

Within the California Guidance there are a variety of recommended geospatial and visualization tools to assist decision makers in understanding the impacts of the identified sea-level rise for their targeted area. Among those suggested was the Adapting to Rising Tides (ART) program created by the BCDC. The ART program was developed by the BCDC as a means of providing staff support, guidance, tools, and information to help agencies and organizations understand, communicate, and begin to resolve complex climate change issues, including sea-level rise. In 2017, the ART program underwent a significant effort to update mapping products available for the Bay area to analyze and plan for future inundation due to sea-level rise. This effort produced several mapping products that are available for public and private entities. Details of this mapping project and best uses are provided in the published document *Adapting to Rising Tides Bay Area Sea Level Rise Analysis and Mapping Project* (AECOM 2017).

Due to the regional complexity of selecting sea-level rise scenarios, the ART program developed 10 individual sets of inundation maps ranging from 12 to 108 inches of sea-level rise, representing combinations of 0 to 66 inches of sea-level rise with extreme tide events (i.e., 1-year to 100-year flood events). The 10 scenarios were consistent among all counties, but because the water levels vary throughout the Bay, each county has different sets of representative combinations of sea-level rise and storm surge. The Sea-Level Rise and Extreme Tides Matrix for Contra Costa County (provided below) shows the relationship between each mapped scenario and different combinations of sea-level rise with extreme tides.

Contra Costa County Sea-Level Rise and Extreme Tides Matrix

Sea Level Rise Scenario	Daily Tide	Extreme Tide (Storm Surge)						
	+SLR (in)	1yr	2yr	5yr	10yr	25yr	50yr	100yr
		Water Level above MHHW (in)						
Existing Conditions	0	14	18	23	27	32	36	41
MHHW + 6"	6	20	24	29	33	38	42	47
MHHW + 12"	12	26	30	35	39	44	48	53
MHHW + 18"	18	32	36	41	45	50	54	59
MHHW + 24"	24	38	42	47	51	56	60	65
MHHW + 30"	30	44	48	53	57	62	66	71
MHHW + 36"	36	50	54	59	63	68	72	77
MHHW + 42"	42	56	60	65	69	74	78	83
MHHW + 48"	48	62	66	71	75	80	84	89
MHHW + 52"	52	66	70	75	79	84	88	93
MHHW + 54"	54	68	72	77	81	86	90	95
MHHW + 60"	60	74	78	83	87	92	96	101
MHHW + 66"	66	80	84	89	93	98	102	107

in = inch(es)
MHHW = Mean Higher High Water
SLR = sea level rise
yr = year(s)

Based on this matrix, the best fit scenario for the projected sea-level rise of 2.7 feet (~32 inches) for SFR corresponds to MHHW + 36" (boxed in black above). While the California Guidance estimates sea-level rise closer to 32 inches, this specific value was not available in the mapping products created by the ART program. Therefore, the next highest sea-level rise with an associated mapping product, i.e. 36 inches or 3 feet, was evaluated instead. Additionally, this assessment evaluated the flooding that may occur due to a sea-level rise of 36" combined with a 100-year flood event, or MHHW + 77" (boxed in black above). The maps summarizing these evaluations are presented in Figures 4a through 5c.

In May of 2020, the California Coastal Commission published *Making California Resilient to Sea-Level Rise: Principles for Aligned State Action* (California Coastal Commission, 2020), where they recommend 3.5 feet as the minimum sea-level rise target by 2050 for planning purposes. The target of 3.5 feet applies a safety factor to the California Guidance sea-level rise estimates stated previously. The California Environmental Protection Agency, including the State Water Resources Control Board, have also endorsed this minimum 3.5 feet sea-level rise for climate change planning. The closest available mapping products available from the ART program were for 4 feet (48 inches) of sea-level rise and site-specific applicable areas are shown in Figures 6a through 6c. When comparing the 3 feet and the 4 feet of sea-level rise, there is little additional flooding at the San Francisco Refinery. The increased inundation is mostly seen around the Effluent Safety Basin, where the effect is minimal flooding of the surrounding monitoring wells. The affected wells are included in the assessment of 77 inches of sea-level rise and therefore will be managed as outlined in Section 5.0 of this report. Because the increased flooding from 3 feet to 4 feet is minimal, it can be safely assumed that the assessment undertaken for 36 inches (3 feet) of sea-level rise and 77 inches (6.4 feet) have covered the potential areas that could be affected by 3.5 feet of sea-level rise. Assessment and management strategies for 36 and 77 inches of sea-level rise are outlined in the following sections.

While the data utilized for the BCDC ART mapping analysis have been through several processes of review, there are limitations in the data. The data were developed using an average of the highest tide in each month, which captures most storm surge within a year. However, the data do not include wave activity or local wind effects that occur during storms, which could have significant effect on the ultimate depth of inundation. The maps also do not account for potential increases in the groundwater table as sea-level rise, which may have a significant effect on the depth of inundation. Topographic features that may affect floodwater conveyance such as levee heights and the height of roadways, were derived from USGS and NOAA 2010 LiDAR data. Although this represents close approximation of the site topography, smaller-scale topographic features may be over or under-represented. However, by over-estimating the potential flood risk (i.e., utilizing 36 inches of sea-level rise versus the 32 inches predicted by the California Guidance) there is less of a chance future sea-level rise will result in unsuspected flooding due to the data limitations.

4.1 RISK TO INFRASTRUCTURE

Areas identified as at risk for inundation by 36 inches of sea-level rise and 36 inches of sea-level rise combined with a 100 year storm event (i.e., 77 inches of sea-level rise) are presented on Figure 4a through 5c. The areas at risk primarily expand upon previously discussed locations near the ESB, E-003 Outfall ditch and surrounding drainage networks (Figure 4b and 5b), and locations within the western portion of the MTA (Figure 4c).

Figure 4b illustrates areas near the E-003 outfall ditch and surrounding drainage networks affected by 36 inches of sea-level rise. There is little to no effect on these areas, besides an increase in surface water elevation. Currently, at high tide water, levels within the E-003 outfall rise and the rate of non-contact water discharging decreases. Using this as a model for the effect of rising surface water on the outfall system, the magnitude and direction of flux of discharging water could be impacted by rising sea-levels. However, a periodic evaluation of updated tidal data should be conducted to assess the future impacts of sea-level rise to the E-003 Outfall area and the need for structural updates. While the ESB and portions of Ditch 6 are at an elevation that would in theory be affected by rising sea levels, the presence of weirs in the ESB and in Ditch 6 would be preclude direct connecting with the sea-level rise and are not likely to be directly affected.

Figure 5b illustrates the same areas as above, but with 36 inches of sea-level rise combined with a 100-year storm event, which is estimated to result in 77 inches of sea-level rise. Most low-lying and channelized areas shown on Figure 5b are anticipated to be flooded with up to 2 feet of water in this scenario, whereas the area surrounding the ESB may be flooded with up to four feet of water. It is probable that sea-level rise at this magnitude will affect the efficiency of the E-003 outfall system. However, as this is a 100-year storm event prediction, the effects of such a rise in sea-level will be temporary. As described above, a periodic evaluation of updated tidal data will be required to assess the need for structural updates to the outfall system. Impacts at 77 inches of sea-level rise will additionally affect monitoring wells and extraction wells within the area. Monitoring wells and extraction wells that are within the predicted flood areas are listed in Table 1 and recommendations for remedial actions are discussed in Section 5.

Portions of San Pablo Ave, which separates the refineries Zone 1 and 2, are also affected by both 36 and 77 inches of sea-level rise. This area is publicly maintained but does affect transportation of materials and equipment from Zone 1 to Zone 2. As this area is maintained by the other entities, it is not incumbent upon SFR to create mitigating features to prevent flooding.

In the MTA alignment, shown in Figure 4c and 5c, there is no expected flooding at 36 inches of sea-level rise, and minimal flooding (i.e., zero to two feet) at 77 inches of sea-level rise. Monitoring wells that may be affected by the inundation have been listed in Table 1 and remedial actions are discussed in Section 5.

In addition to these locations, which are directly impacted by flood zones, the Primary Basin and Main Storm Basin are identified as low-lying areas that are disconnected from the flood path but have potential to become inundated if the higher elevation barriers are overrun. The Primary Basin (PB) is regulated by the Regional Water Quality Control Board (RWCB) and the Department of Toxic Control (DTSC) and is used for temporary storage of a combination of process and/or stormwater during operating emergencies or storm events that exceed the facility's wastewater treatment capacity. If the PB is inundated due to sea-level rise these discharges would be pumped into routine storage and the SFR Wastewater Treatment Plant (Unit 100). The PB is equipped with weep holes in the basin floor over the synthetic liner that lines the PB to allow groundwater beneath the basin to temporarily migrate upward, relieving hydrostatic head, and a dual sump pump system then recovers leachate (groundwater seepage) that accumulates between the basin floor and the synthetic liner system. If the PB capacity above the synthetic liner is reached, the water overflows to the MSB and water is then immediately pumped to assorted tank blocks near the SFR Wastewater Treatment Plant.

4.2 WATER QUALITY

Sea-level rise will likely result in a rise in groundwater levels, which has been demonstrated by tidal influence on groundwater levels observed in monitoring wells along the western perimeter of the Site. Groundwater monitoring locations that are within the predicted flood zones and have a constructed top-of-casing lower than the ground surface have a potential to become conduits for flood water infiltration into the subsurface if well caps are not in place. Table 1 lists monitoring locations that are within the predicted flood areas. Further discussion of actions to be taken to prevent any impacts to water quality are in the recommendations section (Section 5.0).

Sea-level rise could additionally result in a net increase in groundwater levels, which could influence the extraction system's ability to create a hydraulic gradient around the perimeter of the Bay and increase saltwater intrusion to perimeter aquifers. However, most of the remediation system extraction pumps in the Main Interceptor Trench area and all of the MTA operate based on groundwater level set-points and have the capability to process and treat saline waters. The portion of the Main Interceptor Trench where extraction is not level-based can be adjusted by increasing pumping frequency to compensate for increasing groundwater levels. The monitoring activities of the remediation system allows for evaluation of the need for larger/higher capacity pumps to maintain hydraulic control in the area. As noted previously, extracted groundwater from this area is conveyed to the refinery's Unit 100 wastewater treatment plant and eventually discharged to San Pablo Bay via a diffuser located on the wharf portion of the MTA. The additional flow from the remediation systems to the wastewater treatment plant is not expected to significantly affect the wastewater treatment plant. Extraction wells are also fitted with water-tight seals to limit potential inundation of floodwater to the groundwater wells.

5.0 RECOMMENDATIONS

The flood protection identified in this evaluation combined flood risk assessments for the near-term and long-term by reviewing information and mapping products for a 100-year storm surge and sea-level rise, respectively. This combined effort shows that while flooding in the near-term due to a 100-year storm surge may be minimal, flooding due to sea-level rise could affect low-lying areas adjacent to the coastline, such as the MTA alignment and the E-003 outfall channel. In these areas, there is not significant amounts of flooding at 36 inches of sea-level rise, but with 36 inches of sea-level rise plus a 100-year storm surge, there is potential for these areas to become inundated to an average depth of 2 feet. Currently, no SFR capital construction activities are planned for these locations and future activities will incorporate flood mitigation design, as appropriate. As recommended by the BCDC, flood mitigation design would include adaptation planning strategies and risk assessment.

Table 1 lists monitoring wells, piezometers, extraction wells, and recovery wells that are within the areas subject to flooding in the event of 77 inches of sea-level rise (i.e., 36 inches of sea-level rise combined with a 100-year storm surge). Included in the table are the estimated depth of inundation, the elevation of the top of casing, the elevation of the surrounding ground surface, and the surface completion type (i.e., flush mounted versus stove pipe). These locations are at risk of becoming potential conduits for floodwater infiltration into the subsurface due to poor water-proofing, therefore, it is recommended that a survey be completed of these locations to confirm there is adequate water-proofing. Adequate water-proofing, according to the Department of Water Resources (DWR) Monitoring Well Standards, requires the top of the well casing to terminate above ground surface and known levels of flooding, except where site conditions, such as vehicular traffic, will not allow (DWR 1991). In effect, where feasible, flush mount well completions will be converted to stove pipes. Where such a transition is not possible or there is already a stove pipe, the surface completion will be inspected to ensure adequate sealing from surface water infiltration. If it is found that the seal is not adequate, mitigating measures will include such actions as resurfacing the seal or including a better watertight cap. Specific mitigating actions will be dependent upon the location and will be identified in subsequent work plans.

To continue monitoring sea-level rise and to mitigate potential impacts, Trihydro recommends the following actions be completed over the next five years:

- Perform an elevation survey of monitoring wells where elevation data is not available (i.e., ground surface elevation) included in Table 1.
- Conduct a conditions survey of monitoring wells under risk of future flood damage included in Table 1 and assess maintenance that may be required to establish adequate waterproofing as defined by the DWR.

- Catalogue required modifications and repairs for monitoring wells, as warranted, and develop subsequent work plans to address these needs. With the volume of repairs, work may have to be phased in order to accommodate time availability of field staff.

- Continue to update sea-level rise data and maps from BCDC accredited sources and reassess areas of risk.

- Continue to assess requirement for increased extraction rate at the shoreline extraction wells and interceptor trench due to increased groundwater elevations due to sea-level rise. Evaluate need to replace extraction pumps with higher capacity pumps if groundwater extraction rates cannot maintain desired groundwater drawdown (hydraulic control) due to groundwater level rise.

- Include updated tidal data from E-003 outfall area in 2026 Report to assess the efficiency of the system and evaluate whether structural updates are required.

Trihydro will incorporate these findings into the next Long-Term Flood Protection Plan due to the RWQCB on June 31, 2026.

6.0 REFERENCES

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TABLE

TABLE 1. MONITORING WELLS WITHIN FLOOD ZONES
LONG-TERM FLOOD PROTECTION REPORT
PHILLIPS 66 SAN FRANCISCO REFINERY, RODEO, CALIFORNIA

Well ID[1]	Well Type	Surface Completion[2]	Feet of Inundation[3]	Ground Surface Elevation (ft amsl)	Monitoring Point Elevation (ft amsl)	Inundation Elevation[3] (ft amsl)
PZ-76	PIEZOMETER	Flush Mount	6 - 8	13.96	13.64	19.96 - 21.96
S-12	GROUNDWATER EXTRACTION	Flush Mount	2 - 4	10.01	10.06	12.01 - 14.01
S-15	GROUNDWATER EXTRACTION	Flush Mount	2 - 4	10.29	9.97	12.29 - 14.29
MW-161	MONITORING WELL	Flush Mount	2 - 4	11.07	10.96	13.07 - 15.07
MW-245	MONITORING WELL	Flush Mount	2 - 4	10.29	9.38	12.29 - 14.29
MW-298	MONITORING WELL	Flush Mount	2 - 4	—	10.25	—
MW-387	MONITORING WELL	Flush Mount	2 - 4	10.43	10.27	12.43 - 14.43
PZ-47	PIEZOMETER	Flush Mount	2 - 4	9.72	9.44	11.72 - 13.72
PZ-49	PIEZOMETER	Flush Mount	2 - 4	10.15	9.92	12.15 - 14.15
PZ-84	PIEZOMETER	Flush Mount	2 - 4	9.90	9.62	11.9 - 13.9
PZ-85	PIEZOMETER	Flush Mount	2 - 4	9.73	9.51	11.73 - 13.73
PZ-89	PIEZOMETER	Flush Mount	2 - 4	10.38	10.04	12.38 - 14.38
PZ-91	PIEZOMETER	Flush Mount	2 - 4	10.76	10.35	12.76 - 14.76
MW-192	EFFLUENT MONITORING POINT	Flush Mount	0 - 2	11.90	11.68	11.9 - 13.9
MW-195	EFFLUENT MONITORING POINT	Flush Mount	0 - 2	11.00	10.75	11 - 13
MW-19B	GAUGING STATION	Flush Mount	0 - 2	11.88	11.67	11.88 - 13.88
MW-28	GAUGING STATION	Flush Mount	0 - 2	12.39	12.06	12.39 - 14.39
ES-2	GROUNDWATER EXTRACTION	Flush Mount	0 - 2	12.26	11.31	12.26 - 14.26
ES-3	GROUNDWATER EXTRACTION	Flush Mount	0 - 2	12.08	11.16	12.08 - 14.08
MW-204	GROUNDWATER EXTRACTION	Flush Mount	0 - 2	12.17	11.69	12.17 - 14.17
MW-212	GROUNDWATER EXTRACTION	Flush Mount	0 - 2	11.76	11.51	11.76 - 13.76
MW-221	GROUNDWATER EXTRACTION	Flush Mount	0 - 2	11.2	10.94	11.2 - 13.2
MW-222	GROUNDWATER EXTRACTION	Flush Mount	0 - 2	11.75	11.26	11.75 - 13.75
MW-263	GROUNDWATER EXTRACTION	Flush Mount	0 - 2	12.19	11.66	12.19 - 14.19
MW-264	GROUNDWATER EXTRACTION	Flush Mount	0 - 2	12.07	11.37	12.07 - 14.07
MW-267	GROUNDWATER EXTRACTION	Flush Mount	0 - 2	11.3	10.79	11.3 - 13.3
MW-268	GROUNDWATER EXTRACTION	Flush Mount	0 - 2	11.45	10.90	11.45 - 13.45
MW-275	GROUNDWATER EXTRACTION	Flush Mount	0 - 2	12.04	11.51	12.04 - 14.04

TABLE 1. MONITORING WELLS WITHIN FLOOD ZONES
LONG-TERM FLOOD PROTECTION REPORT
PHILLIPS 66 SAN FRANCISCO REFINERY, RODEO, CALIFORNIA

Well ID[1]	Well Type	Surface Completion[2]	Feet of Inundation[3]	Ground Surface Elevation (ft amsl)	Monitoring Point Elevation (ft amsl)	Inundation Elevation[3] (ft amsl)
S-11	GROUNDWATER EXTRACTION	Flush Mount	0 - 2	11.15	10.79	11.15 - 13.15
S-14	GROUNDWATER EXTRACTION	Flush Mount	0 - 2	10.93	10.59	10.93 - 12.93
S-8	GROUNDWATER EXTRACTION	Flush Mount	0 - 2	11.46	11.78	11.46 - 13.46
S-9	GROUNDWATER EXTRACTION	Flush Mount	0 - 2	11.88	11.48	11.88 - 13.88
MW-146R	MONITORING WELL	Flush Mount	0 - 2	12.08	12.03	12.08 - 14.08
MW-160	MONITORING WELL	Flush Mount	0 - 2	11.04	11.01	11.04 - 13.04
MW-178	MONITORING WELL	Flush Mount	0 - 2	11.83	11.82	11.83 - 13.83
MW-179	MONITORING WELL	Flush Mount	0 - 2	11.91	11.73	11.91 - 13.91
MW-181	MONITORING WELL	Flush Mount	0 - 2	12.35	11.69	12.35 - 14.35
MW-243	MONITORING WELL	Flush Mount	0 - 2	11.67	11.10	11.67 - 13.67
MW-248	MONITORING WELL	Flush Mount	0 - 2	10.61	9.85	10.61 - 12.61
MW-249	MONITORING WELL	Flush Mount	0 - 2	11.46	10.95	11.46 - 13.46
MW-250	MONITORING WELL	Flush Mount	0 - 2	—	11.54	—
MW-251	MONITORING WELL	Flush Mount	0 - 2	—	11.38	—
MW-258	MONITORING WELL	Flush Mount	0 - 2	12.02	11.46	12.02 - 14.02
MW-261	MONITORING WELL	Flush Mount	0 - 2	—	11.43	—
MW-265	MONITORING WELL	Flush Mount	0 - 2	—	11.46	—
MW-266	MONITORING WELL	Flush Mount	0 - 2	—	11.47	—
MW-270	MONITORING WELL	Flush Mount	0 - 2	—	11.51	—
MW-271	MONITORING WELL	Flush Mount	0 - 2	—	10.62	—
MW-272	MONITORING WELL	Flush Mount	0 - 2	—	11.43	—
MW-273	MONITORING WELL	Flush Mount	0 - 2	—	10.42	—
MW-280	MONITORING WELL	Flush Mount	0 - 2	—	12.03	—
MW-297	MONITORING WELL	Flush Mount	0 - 2	—	12.04	—
MW-342	MONITORING WELL	Flush Mount	0 - 2	12.28	11.59	12.28 - 14.28
MW-375	MONITORING WELL	Flush Mount	0 - 2	12.37	11.94	12.37 - 14.37
MW-376	MONITORING WELL	Flush Mount	0 - 2	12.48	12.00	12.48 - 14.48
MW-377	MONITORING WELL	Flush Mount	0 - 2	12.43	11.84	12.43 - 14.43

TABLE 1. MONITORING WELLS WITHIN FLOOD ZONES
LONG-TERM FLOOD PROTECTION REPORT
PHILLIPS 66 SAN FRANCISCO REFINERY, RODEO, CALIFORNIA

Well ID[1]	Well Type	Surface Completion[2]	Feet of Inundation[3]	Ground Surface Elevation (ft amsl)	Monitoring Point Elevation (ft amsl)	Inundation Elevation[3] (ft amsl)
MW-392	MONITORING WELL	Flush Mount	0 - 2	11.74	11.24	11.74 - 13.74
PZ-102	MONITORING WELL	Flush Mount	0 - 2	12.44	11.87	12.44 - 14.44
PZ-103	MONITORING WELL	Flush Mount	0 - 2	12.54	11.92	12.54 - 14.54
PZ-96	MONITORING WELL	Flush Mount	0 - 2	12.11	11.66	12.11 - 14.11
PZ-21	PIEZOMETER	Flush Mount	0 - 2	11.26	10.49	11.26 - 13.26
PZ-22	PIEZOMETER	Flush Mount	0 - 2	11.74	11.20	11.74 - 13.74
PZ-23	PIEZOMETER	Flush Mount	0 - 2	12.52	11.90	12.52 - 14.52
PZ-29	PIEZOMETER	Flush Mount	0 - 2	11.32	10.87	11.32 - 13.32
PZ-35	PIEZOMETER	Flush Mount	0 - 2	11.80	11.59	11.8 - 13.8
PZ-4	PIEZOMETER	Flush Mount	0 - 2	12.05	11.67	12.05 - 14.05
PZ-48	PIEZOMETER	Flush Mount	0 - 2	12.22	12.02	12.22 - 14.22
PZ-50	PIEZOMETER	Flush Mount	0 - 2	10.95	10.79	10.95 - 12.95
PZ-58	PIEZOMETER	Flush Mount	0 - 2	—	12.10	—
PZ-59	PIEZOMETER	Flush Mount	0 - 2	—	12.26	—
PZ-60	PIEZOMETER	Flush Mount	0 - 2	—	12.29	—
PZ-68	PIEZOMETER	Flush Mount	0 - 2	12.25	11.61	12.25 - 14.25
PZ-69	PIEZOMETER	Flush Mount	0 - 2	12.21	11.76	12.21 - 14.21
PZ-72	PIEZOMETER	Flush Mount	0 - 2	12.37	12.20	12.37 - 14.37
PZ-79	PIEZOMETER	Flush Mount	0 - 2	11.42	11.08	11.42 - 13.42
PZ-80	PIEZOMETER	Flush Mount	0 - 2	11.76	11.44	11.76 - 13.76
PZ-82	PIEZOMETER	Flush Mount	0 - 2	11.03	10.71	11.03 - 13.03
PZ-83	PIEZOMETER	Flush Mount	0 - 2	10.77	10.49	10.77 - 12.77
PZ-86	PIEZOMETER	Flush Mount	0 - 2	11.27	11.00	11.27 - 13.27
PZ-88	PIEZOMETER	Flush Mount	0 - 2	11.17	10.95	11.17 - 13.17
PZ-90	PIEZOMETER	Flush Mount	0 - 2	10.85	10.39	10.85 - 12.85
PZ-92	PIEZOMETER	Flush Mount	0 - 2	—	11.51	—
MW-300	RECOVERY WELL	Flush Mount	0 - 2	—	10.77	—
MW-301	RECOVERY WELL	Flush Mount	0 - 2	—	11.30	—

TABLE 1. MONITORING WELLS WITHIN FLOOD ZONES
LONG-TERM FLOOD PROTECTION REPORT
PHILLIPS 66 SAN FRANCISCO REFINERY, RODEO, CALIFORNIA

Well ID[1]	Well Type	Surface Completion[2]	Feet of Inundation[3]	Ground Surface Elevation (ft amsl)	Monitoring Point Elevation (ft amsl)	Inundation Elevation[3] (ft amsl)
MW-302	RECOVERY WELL	Flush Mount	0 - 2	—	10.84	—
MW-303	RECOVERY WELL	Flush Mount	0 - 2	—	11.02	—
MW-304	RECOVERY WELL	Flush Mount	0 - 2	—	10.87	—
MW-305	RECOVERY WELL	Flush Mount	0 - 2	—	11.02	—
MW-306	RECOVERY WELL	Flush Mount	0 - 2	—	11.06	—
MW-326	RECOVERY WELL	Flush Mount	0 - 2	—	9.85	—
MW-340	RECOVERY WELL	Flush Mount	0 - 2	12.4	11.64	12.4 - 14.4
MW-341	RECOVERY WELL	Flush Mount	0 - 2	12.23	11.73	12.23 - 14.23
MW-343	RECOVERY WELL	Flush Mount	0 - 2	12.37	11.57	12.37 - 14.37
R00W05	RECOVERY WELL	Flush Mount	0 - 2	12.25	11.09	12.25 - 14.25
S-17	RECOVERY WELL	Flush Mount	0 - 2	—	10.45	—
MW-215	WASTE SAMPLE	Flush Mount	0 - 2	11.65	11.17	11.65 - 13.65
MW-22	WASTE SAMPLE	Flush Mount	0 - 2	11.45	11.34	11.45 - 13.45
MW-194	EFFLUENT MONITORING POINT	Stove Pipe	2 - 4	10.39	13.30	12.39 - 14.39
EEI-30	GAUGING STATION	Stove Pipe	2 - 4	10.43	12.88	12.43 - 14.43
MW-164	GAUGING STATION	Stove Pipe	2 - 4	10.35	10.60	12.35 - 14.35
MW-29A	GAUGING STATION	Stove Pipe	2 - 4	9.29	11.93	11.29 - 13.29
MW-29B	GAUGING STATION	Stove Pipe	2 - 4	9.32	10.56	11.32 - 13.32
MW-7B	GAUGING STATION	Stove Pipe	2 - 4	9.53	10.65	11.53 - 13.53
MW-8A	GAUGING STATION	Stove Pipe	2 - 4	10.45	11.68	12.45 - 14.45
MW-8B	GAUGING STATION	Stove Pipe	2 - 4	10.45	11.86	12.45 - 14.45
MW-193	EFFLUENT MONITORING POINT	Stove Pipe	0 - 2	11.53	14.10	11.53 - 13.53
EEI-17	GAUGING STATION	Stove Pipe	0 - 2	10.77	13.28	10.77 - 12.77
EEI-29	GAUGING STATION	Stove Pipe	0 - 2	10.71	13.52	10.71 - 12.71
MW-165	MONITORING WELL	Stove Pipe	0 - 2	10.97	13.14	10.97 - 12.97
MW-166	MONITORING WELL	Stove Pipe	0 - 2	11.08	13.62	11.08 - 13.08
MW-252	MONITORING WELL	Stove Pipe	0 - 2	—	13.85	—
MW-253	MONITORING WELL	Stove Pipe	0 - 2	—	13.67	—

TABLE 1. MONITORING WELLS WITHIN FLOOD ZONES
LONG-TERM FLOOD PROTECTION REPORT
PHILLIPS 66 SAN FRANCISCO REFINERY, RODEO, CALIFORNIA

Well ID[1]	Well Type	Surface Completion[2]	Feet of Inundation[3]	Ground Surface Elevation (ft amsl)	Monitoring Point Elevation (ft amsl)	Inundation Elevation[3] (ft amsl)
MW-9R	MONITORING WELL	Stove Pipe	0 - 2	12.47	12.77	12.47 - 14.47

Notes:

[1] Locations are organized by wells most at risk of damage from flooding to those with the least risk

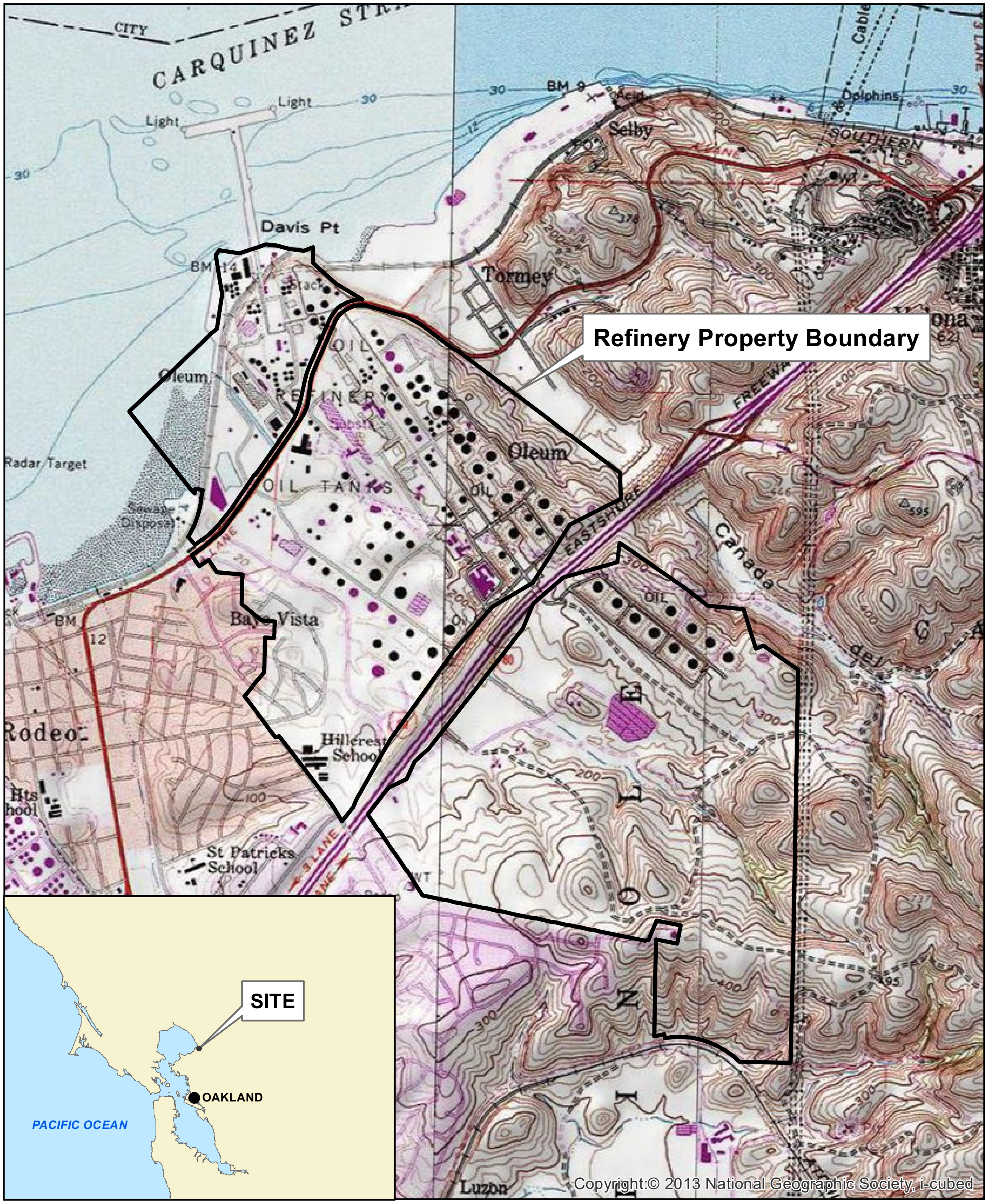
[2] Surface completions were derived from elevation data where available and from boring logs otherwise

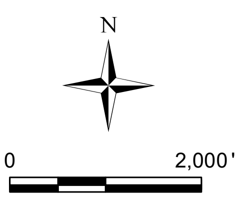
[3] Feet of Inundation and Inundation Elevation are derived from the ART program GIS database and assume 77 inches of sea level rise.

— = Data unavailable

ft amsl = feet above mean sea level

FIGURES





SOURCE: USGS 7.5' QUAD SHEET BENICIA & MARE ISLAND, CA PHOTOREVISED 1980

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FIGURE 1

SITE LOCATION

PHILLIPS 66
SAN FRANCISCO REFINERY
RODEO, CALIFORNIA

Drawn By: DH	Checked By: CG	Scale: 1" = 2,000'	Date: 4/15/21	File: Fig1_SFR_SiteLoc.mxd

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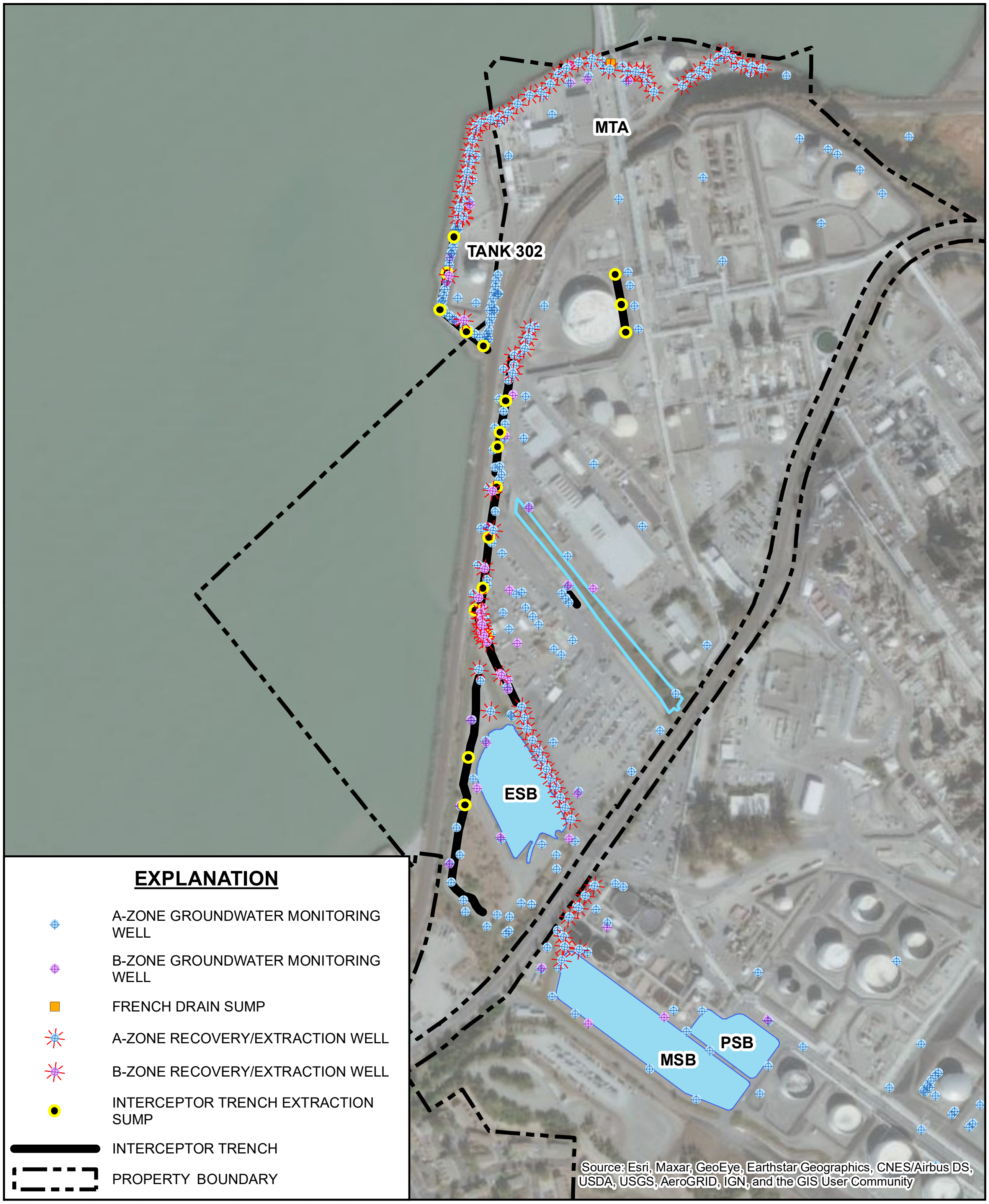

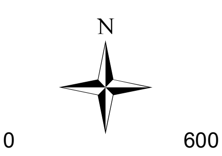

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FIGURE 2

SITE MAP

PHILLIPS 66
SAN FRANCISCO REFINERY
RODEO, CALIFORNIA

Drawn By: DH	Checked By: CG	Scale: 1 " = 600 '	Date: 6/11/21	File: SFR_Fig2_SiteMap.mxd

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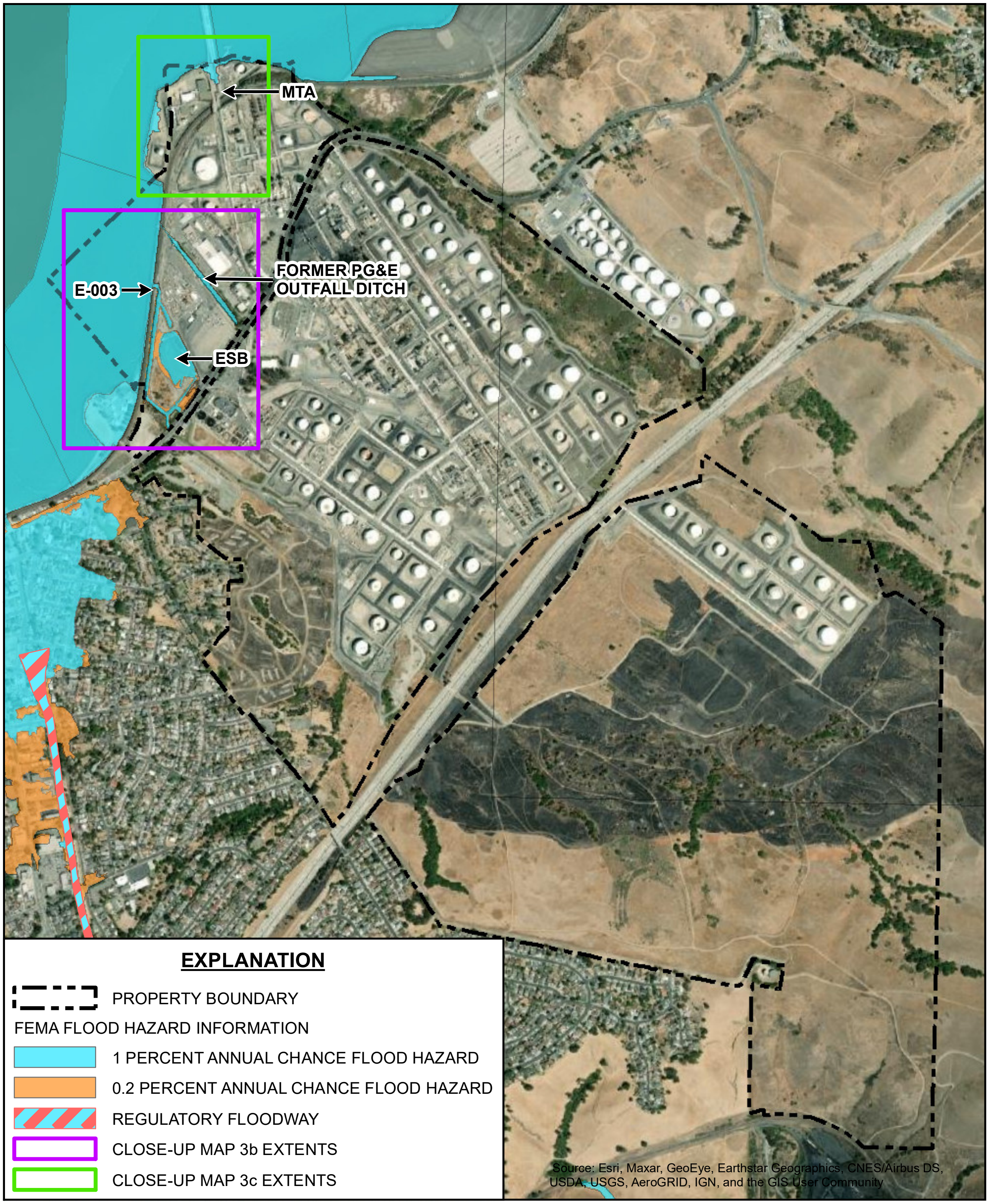

NOTE:

FEMA = FEDERAL EMERGENCY MANAGEMENT AGENCY

N

0 1,500 '

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FIGURE 3a

FEMA FLOOD ZONES

PHILLIPS 66
SAN FRANCISCO REFINERY
RODEO, CALIFORNIA

Drawn By: DH	Checked By: CG	Scale: 1 " = 1,500 '	Date: 6/3/21	File: SFR_Fig3a_FEMA_Map.mxd

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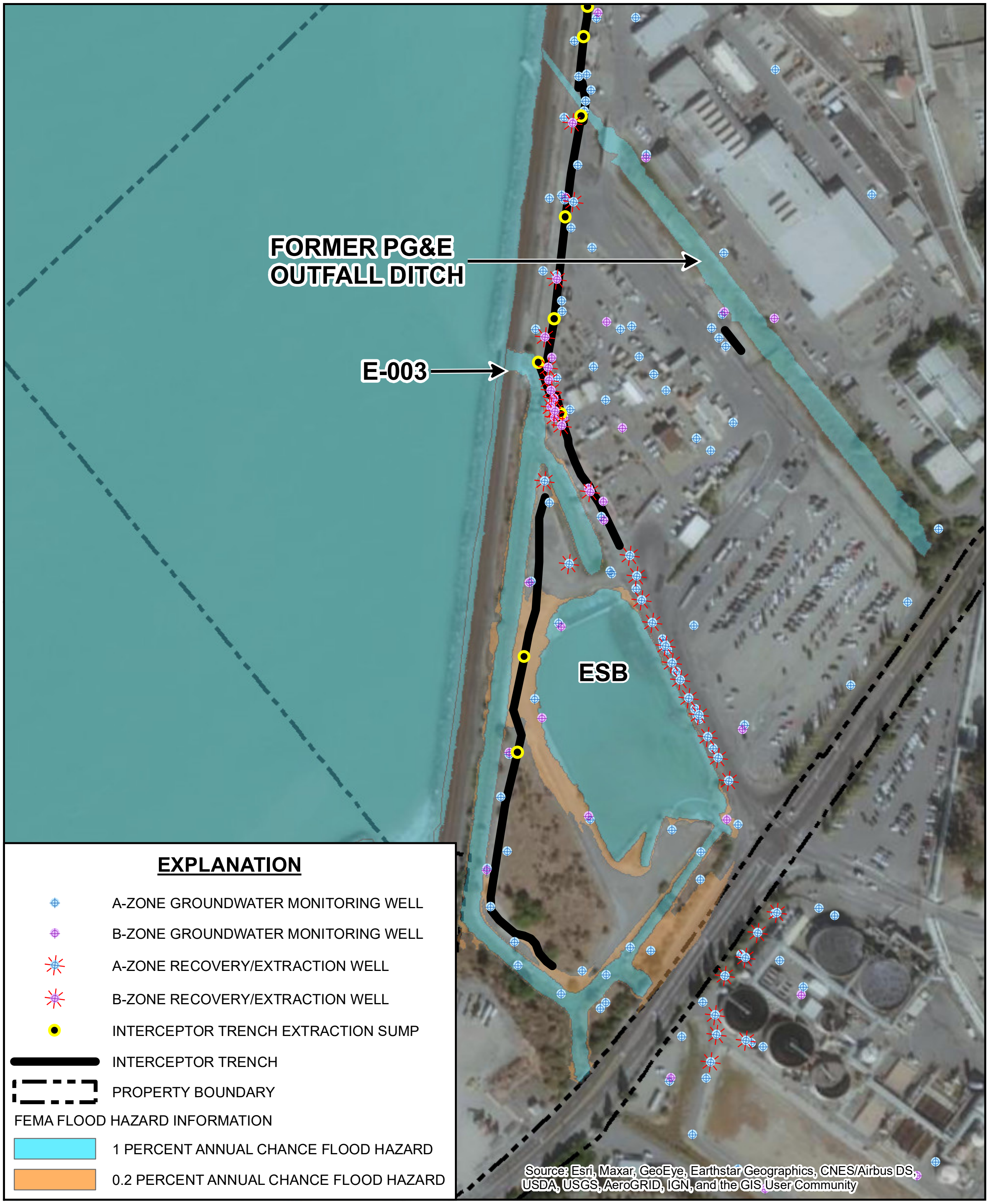

NOTE:

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N

0 300 '

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FIGURE 3b

**FEMA FLOOD ZONES
MAIN INTERCEPTOR TRENCH**

**PHILLIPS 66
SAN FRANCISCO REFINERY
RODEO, CALIFORNIA**

Drawn By: DH	Checked By: CG	Scale: 1 " = 300 '	Date: 6/3/21	File: SFR_Fig3b_FEMA_Map.mxd

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EXPLANATION

- A-ZONE GROUNDWATER MONITORING WELL
- B-ZONE GROUNDWATER MONITORING WELL
- FRENCH DRAIN SUMP
- A-ZONE RECOVERY/EXTRACTION WELL
- B-ZONE RECOVERY/EXTRACTION WELL
- FUTURE TANK 302 EXTRACTION WELL
- INTERCEPTOR TRENCH EXTRACTION SUMP
- INTERCEPTOR TRENCH
- PROPERTY BOUNDARY

FEMA FLOOD HAZARD INFORMATION

- 1 PERCENT ANNUAL CHANCE FLOOD HAZARD

NOTE:

FEMA = FEDERAL EMERGENCY MANAGEMENT AGENCY

N

0 200 '

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FIGURE 3c

FEMA FLOOD ZONES
MARINE TERMINAL AREA

PHILLIPS 66
SAN FRANCISCO REFINERY
RODEO, CALIFORNIA

Drawn By: DH	Checked By: CG	Scale: 1 " = 200 '	Date: 6/11/21	File: Fig3c_FEMA_Map.mxd

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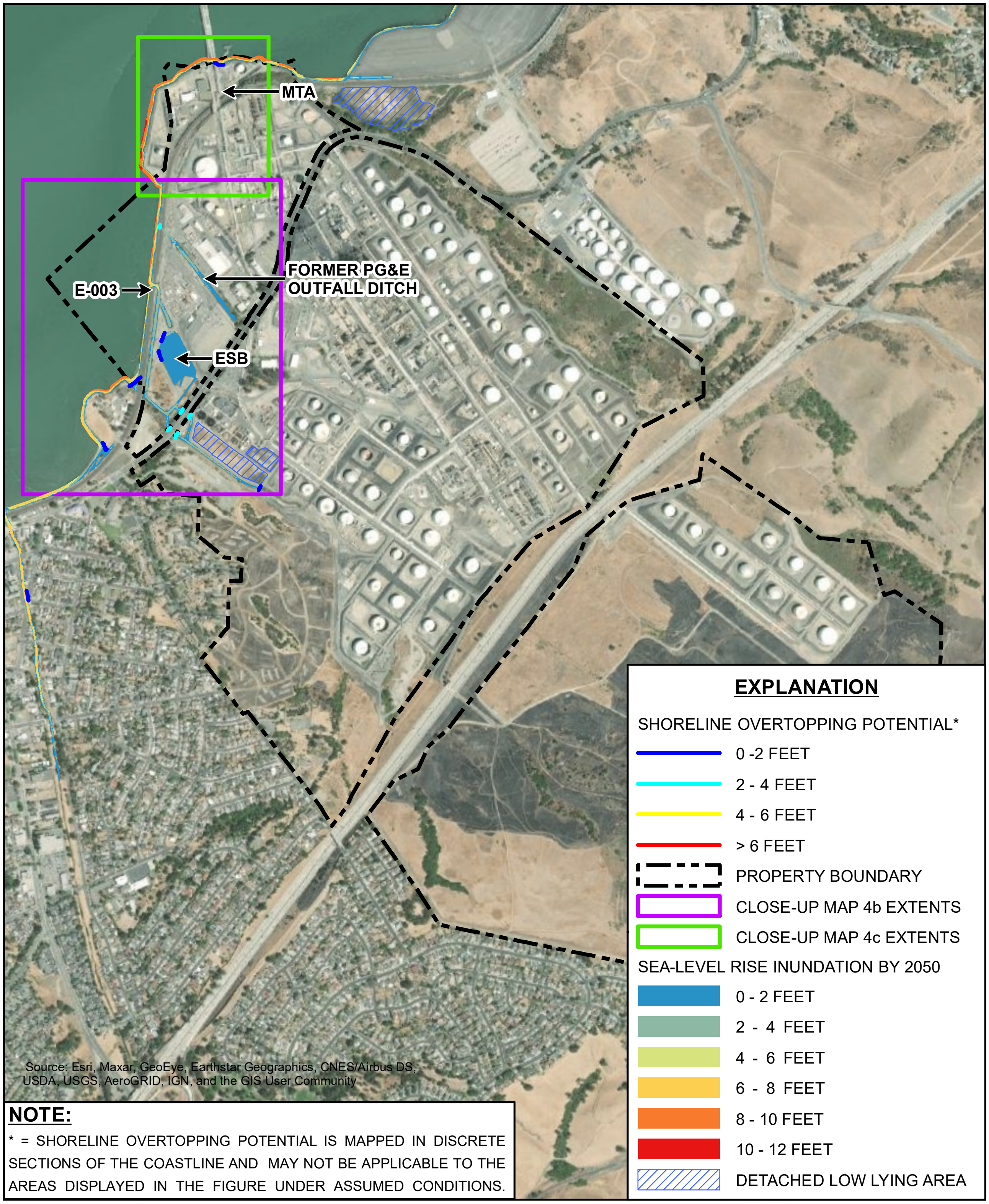

NOTE:

* = SHORELINE OVERTOPPING POTENTIAL IS MAPPED IN DISCRETE SECTIONS OF THE COASTLINE AND MAY NOT BE APPLICABLE TO THE AREAS DISPLAYED IN THE FIGURE UNDER ASSUMED CONDITIONS.

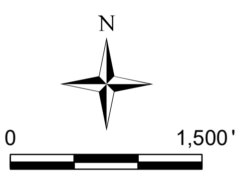

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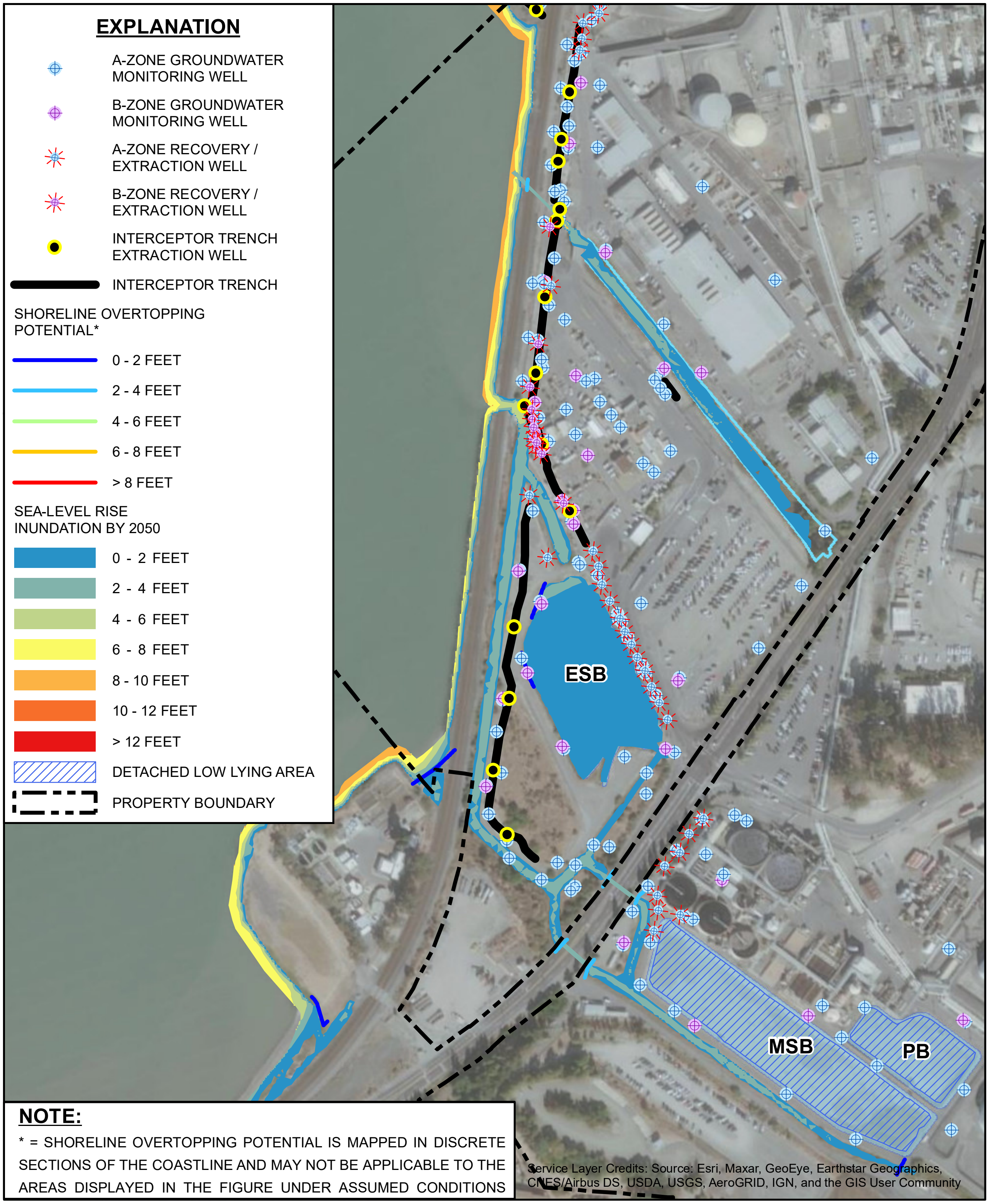
FIGURE 4a

FLOOD HAZARD DUE TO 36-INCH SEA-LEVEL RISE BY 2050

PHILLIPS 66
SAN FRANCISCO REFINERY
RODEO, CALIFORNIA

Drawn By: DH	Checked By: CG	Scale: 1 " = 1,500 '	Date: 6/3/21	File: Fig4a_SFR_SLR36.mxd



NOTE:

* = SHORELINE OVERTOPPING POTENTIAL IS MAPPED IN DISCRETE SECTIONS OF THE COASTLINE AND MAY NOT BE APPLICABLE TO THE AREAS DISPLAYED IN THE FIGURE UNDER ASSUMED CONDITIONS

N

0 400'

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FIGURE 4b

FLOOD HAZARD DUE TO 36-INCH SEA-LEVEL RISE BY 2050 MAIN INTERCEPTOR TRENCH

PHILLIPS 66 SAN FRANCISCO REFINERY RODEO, CALIFORNIA

Drawn By: DH	Checked By: CG	Scale: 1 " = 400 '	Date: 6/3/21	File: Fig4b_SFR SLR36.mxd

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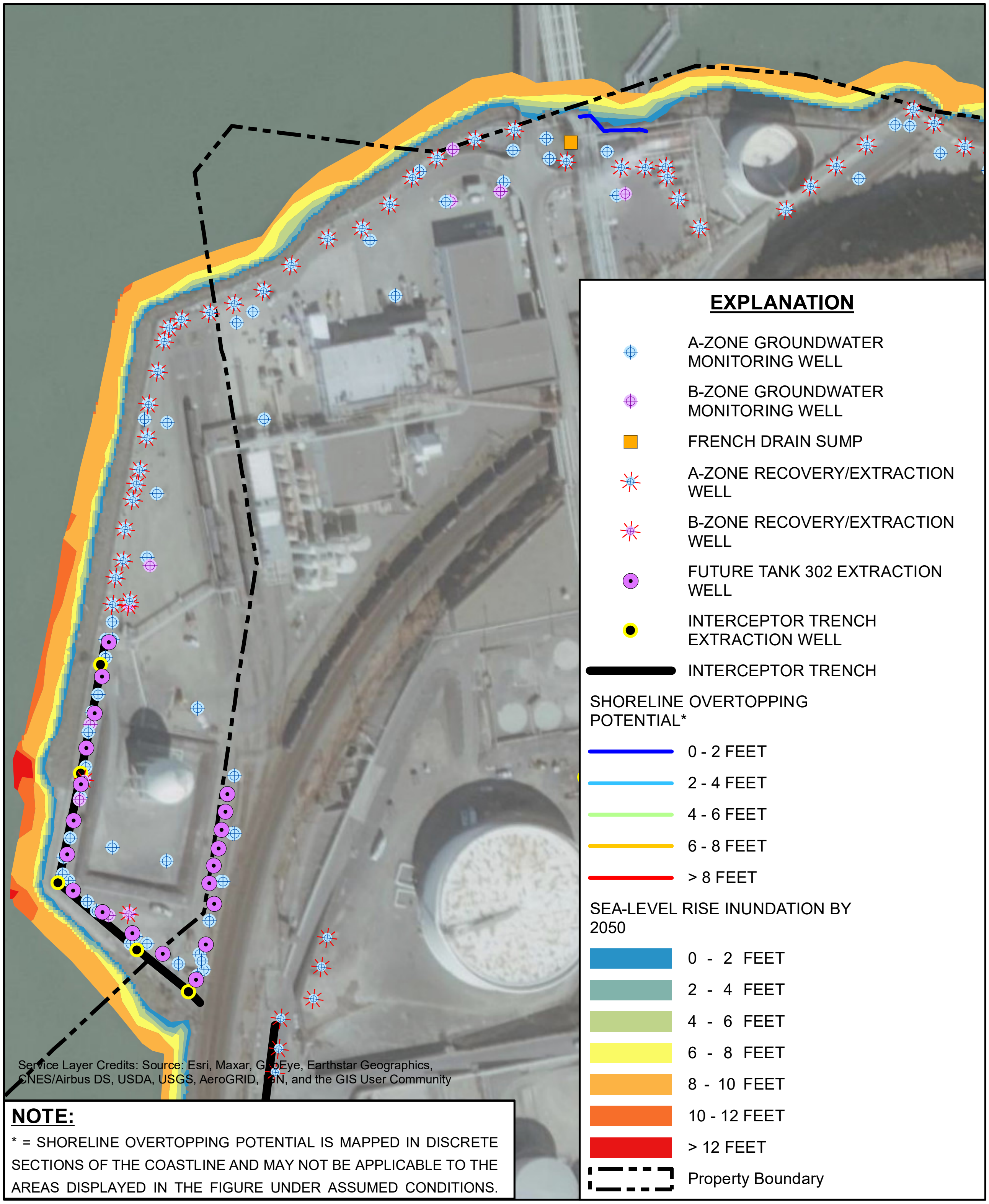

NOTE:

* = SHORELINE OVERTOPPING POTENTIAL IS MAPPED IN DISCRETE SECTIONS OF THE COASTLINE AND MAY NOT BE APPLICABLE TO THE AREAS DISPLAYED IN THE FIGURE UNDER ASSUMED CONDITIONS.

N

0 200'

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FIGURE 4c

FLOOD HAZARD DUE TO 36-INCH SEA-LEVEL RISE BY 2050 MARINE TERMINAL AREA

PHILLIPS 66 SAN FRANCISCO REFINERY RODEO, CALIFORNIA

Drawn By: DH	Checked By: CG	Scale: 1 " = 200 '	Date: 6/3/21	File: Fig4c_SFR_SLR36.mxd

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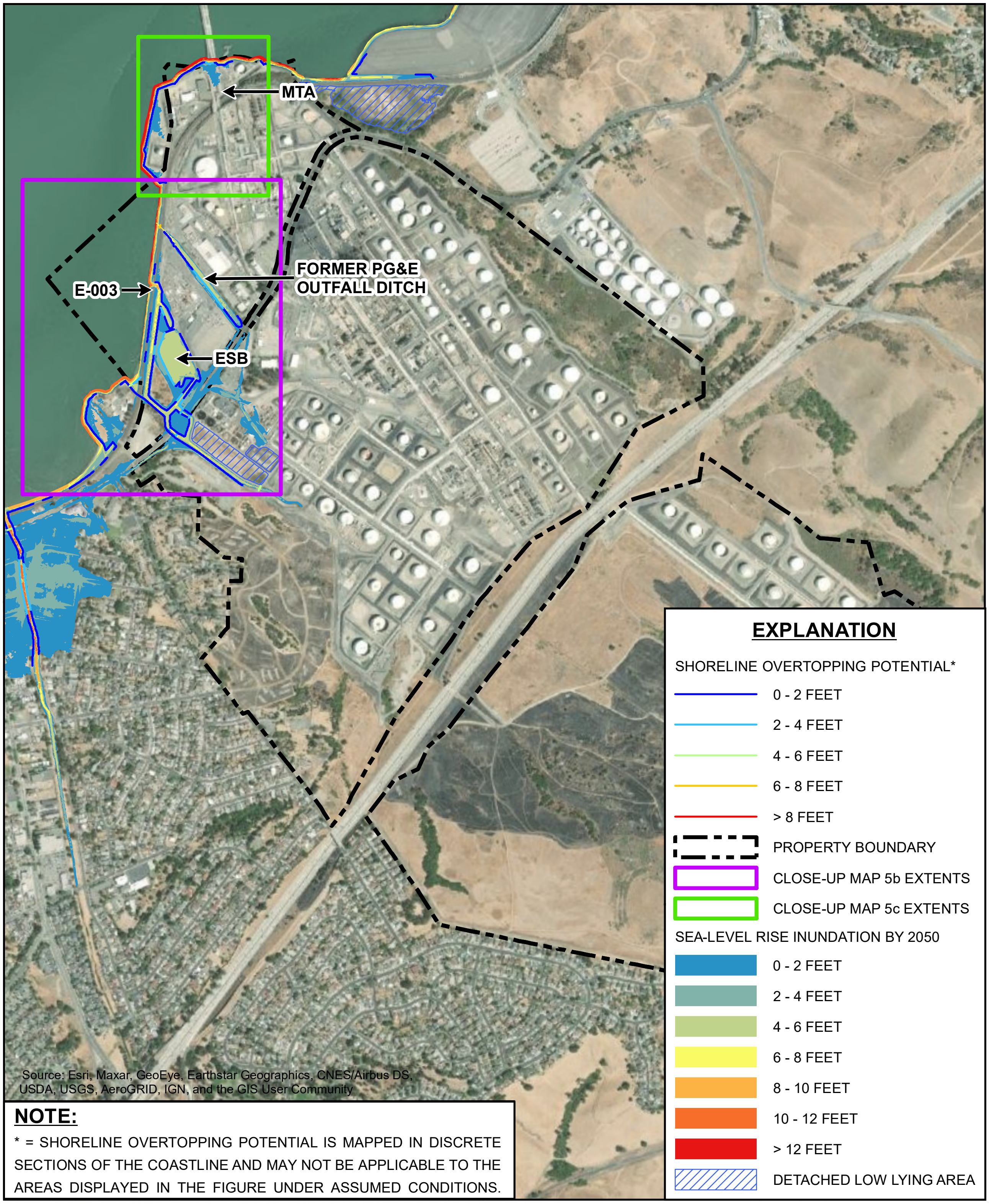

EXPLANATION

SHORELINE OVERTOPPING POTENTIAL*
- 0 - 2 FEET
- 2 - 4 FEET
- 4 - 6 FEET
- 6 - 8 FEET
- > 8 FEET

PROPERTY BOUNDARY

CLOSE-UP MAP 5b EXTENTS

CLOSE-UP MAP 5c EXTENTS

SEA-LEVEL RISE INUNDATION BY 2050
- 0 - 2 FEET
- 2 - 4 FEET
- 4 - 6 FEET
- 6 - 8 FEET
- 8 - 10 FEET
- 10 - 12 FEET
- > 12 FEET

DETACHED LOW LYING AREA

NOTE:

* = SHORELINE OVERTOPPING POTENTIAL IS MAPPED IN DISCRETE SECTIONS OF THE COASTLINE AND MAY NOT BE APPLICABLE TO THE AREAS DISPLAYED IN THE FIGURE UNDER ASSUMED CONDITIONS.

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FIGURE 5a

FLOOD HAZARD DUE TO 77-INCH SEA-LEVEL RISE BY 2050

PHILLIPS 66 SAN FRANCISCO REFINERY RODEO, CALIFORNIA

Drawn By: DH	Checked By: CG	Scale: 1 " = 1,500 '	Date: 6/3/21	File: Fig5a_SFR_SLR77.mxd

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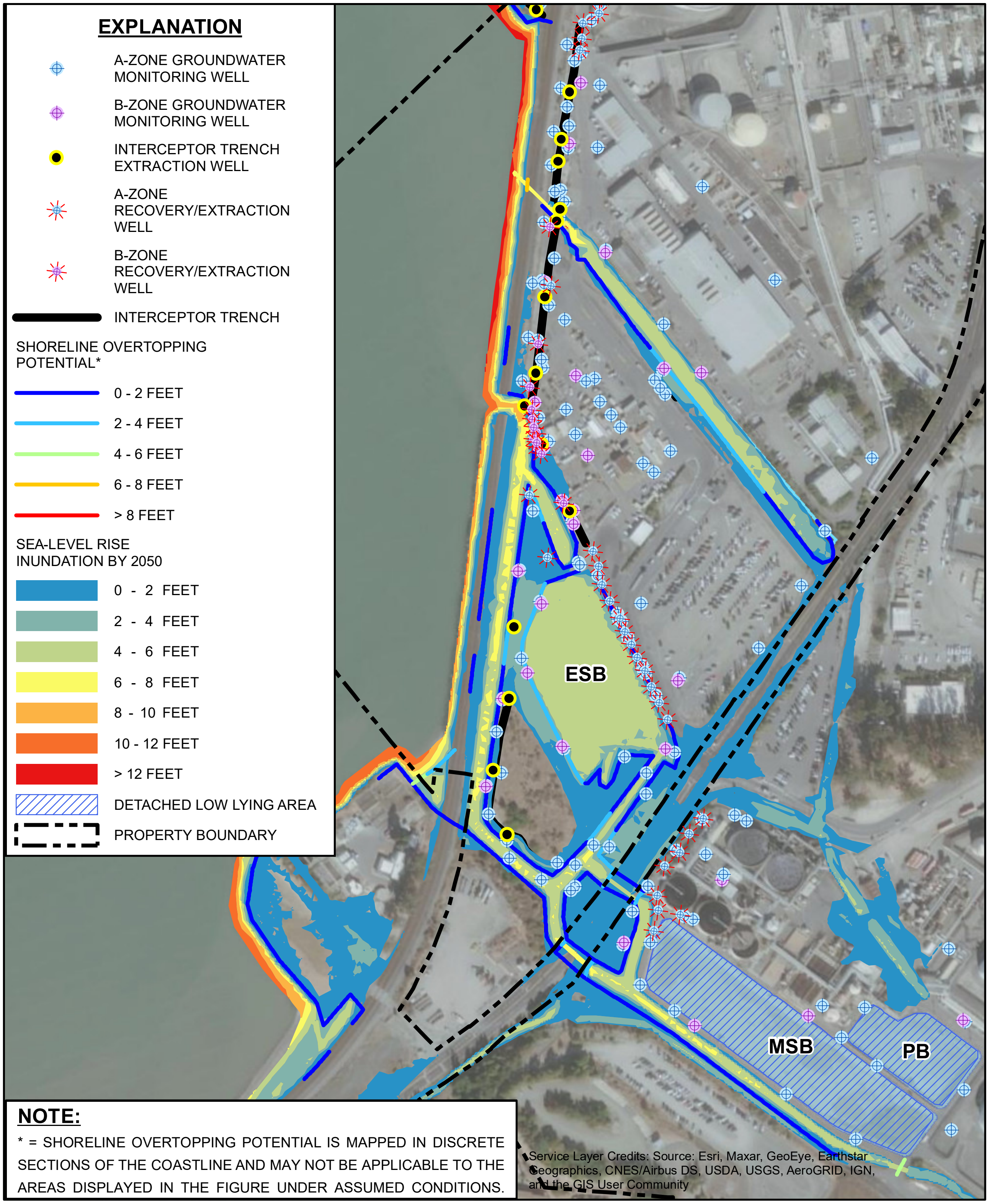

NOTE:

* = SHORELINE OVERTOPPING POTENTIAL IS MAPPED IN DISCRETE SECTIONS OF THE COASTLINE AND MAY NOT BE APPLICABLE TO THE AREAS DISPLAYED IN THE FIGURE UNDER ASSUMED CONDITIONS.

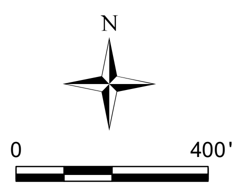

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FIGURE 5b

FLOOD HAZARD DUE TO 77-INCH SEA-LEVEL RISE BY 2050 MAIN INTERCEPTOR TRENCH

PHILLIPS 66 SAN FRANCISCO REFINERY RODEO, CALIFORNIA

Drawn By: DH	Checked By: CG	Scale: 1 " = 400 '	Date: 6/3/21	File: Fig5b_SFR SLR77.mxd

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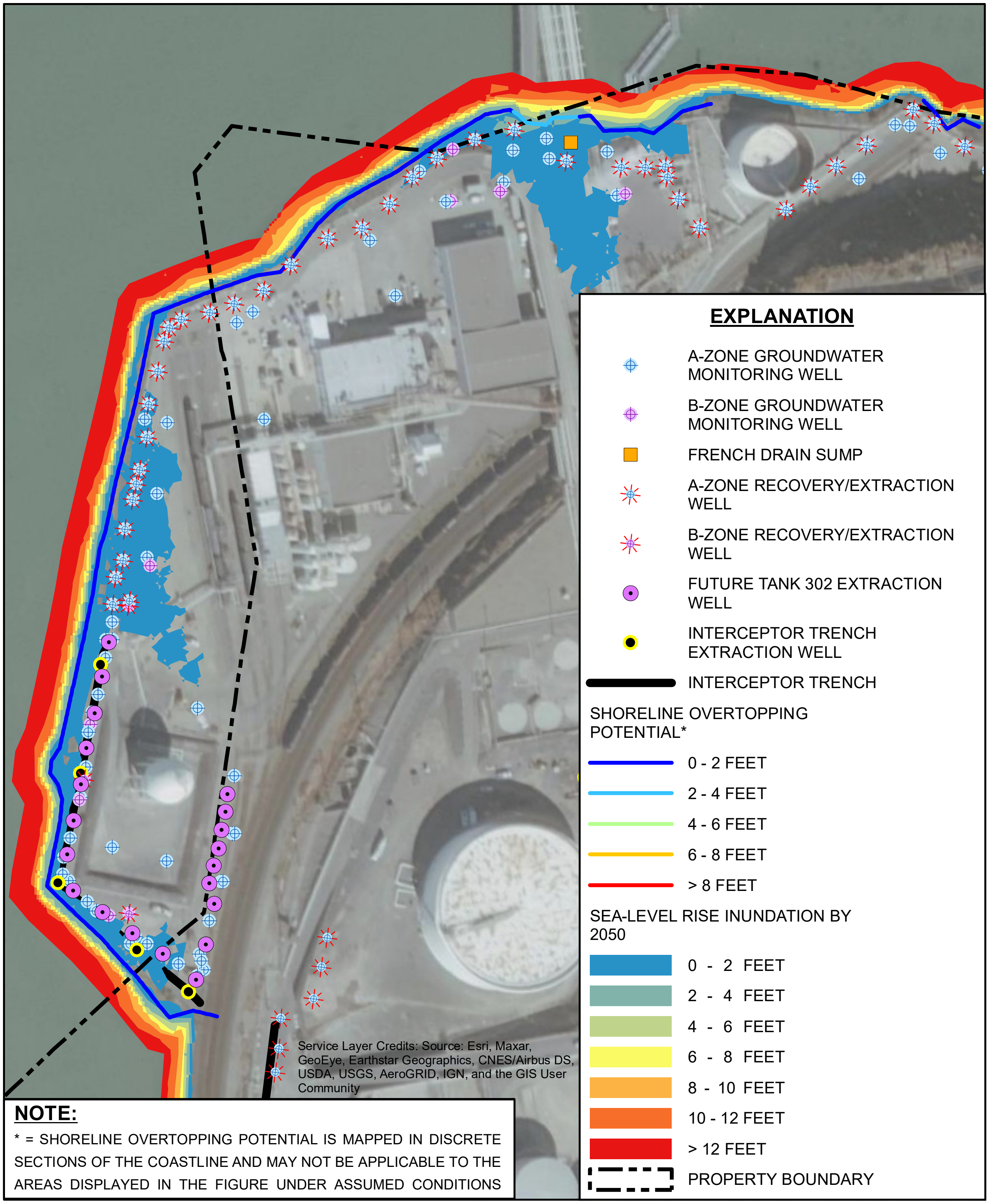

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FIGURE 5c

FLOOD HAZARD DUE TO 77-INCH SEA-LEVEL RISE BY 2050 MARINE TERMINAL AREA

PHILLIPS 66 SAN FRANCISCO REFINERY RODEO, CALIFORNIA

Drawn By: DH	Checked By: CG	Scale: 1 " = 200 '	Date: 6/3/21	File: Fig5c_SFR SLR77.mxd

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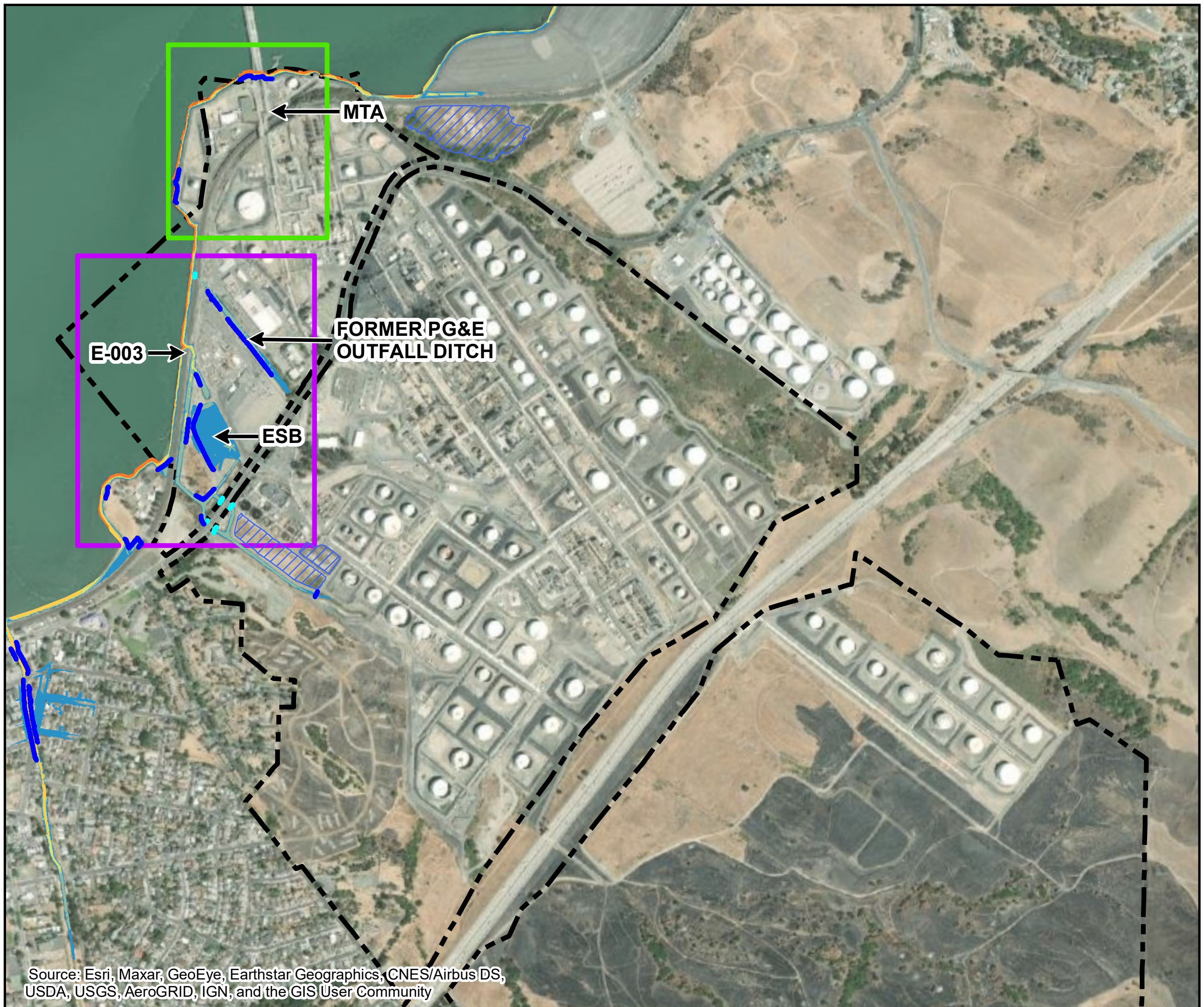

EXPLANATION

SHORELINE OVERTOPPING POTENTIAL	SEA-LEVEL RISE INUNDATION BY 2050
0 -2 FEET	0 - 2 FEET
2 - 4 FEET	2 - 4 FEET
4 - 6 FEET	4 - 6 FEET
> 6 FEET	6 - 8 FEET
PROPERTY BOUNDARY	8 - 10 FEET
CLOSE-UP MAP 3b EXTENTS	10 - 12 FEET
CLOSE-UP MAP 3c EXTENTS	DETACHED LOW LYING AREA

NOTE:

SHORELINE OVERTOPPING POTENTIAL IS MAPPED IN DISCRETE SECTIONS OF THE COASTLINE AND MAY NOT BE APPLICABLE TO THE AREAS DISPLAYED IN THE FIGURE UNDER ASSUMED CONDITIONS

N

0 1,500 '

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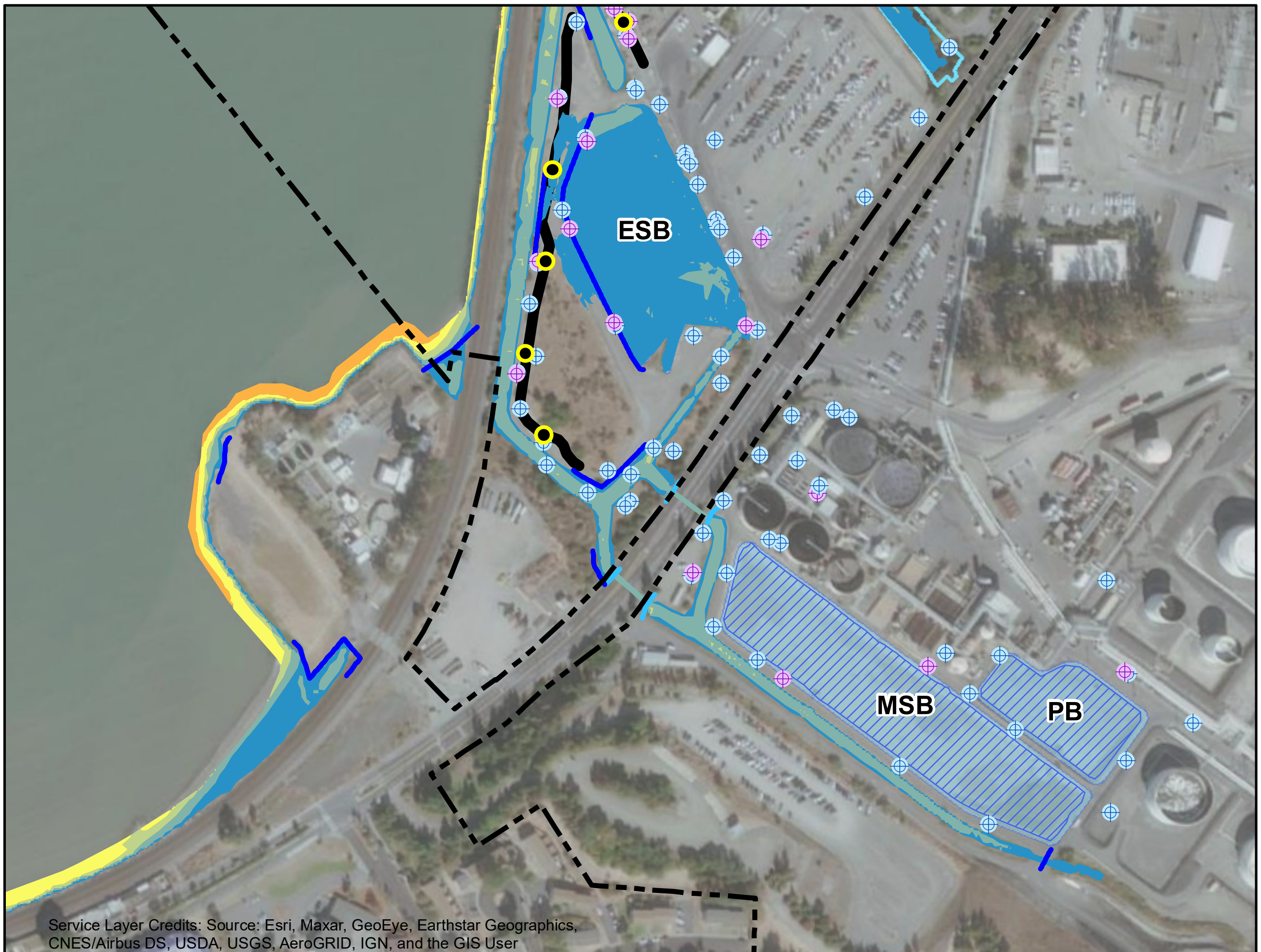
FIGURE 6a

FLOOD HAZARD DUE TO 48-INCH SEA-LEVEL RISE BY 2050

**PHILLIPS 66
SAN FRANCISCO REFINERY
RODEO, CALIFORNIA**

Drawn By: DH	Checked By: CG	Scale: 1 " = 1,500 '	Date: 6/21/21	File: Fig6a_SFR_SLR48.mxd

M:\CHEVRON\CEMC_COP\RODEO\GIS\PROJECTS\GROUNDWATER_REPORTS\202105_LTFLOODPROTECTIONRPT\FIG6A_SFR_SLR48.MXD



EXPLANATION

- A-ZONE GROUNDWATER MONITORING WELL
- B-ZONE GROUNDWATER MONITORING WELL
- FRENCH DRAIN SUMP
- INTERCEPTOR TRENCH EXTRACTION WELL
- INTERCEPTOR TRENCH

SHORELINE OVERTOPPING POTENTIAL

- 0 - 2 FEET
- 2 - 4 FEET
- 4 - 6 FEET
- 6 - 8 FEET
- > 8 FEET

SEA-LEVEL RISE INUNDATION BY 2050

- 0 - 2 FEET
- 2 - 4 FEET
- 4 - 6 FEET
- 6 - 8 FEET
- 8 - 10 FEET
- 10 - 12 FEET
- > 12 FEET
- PROPERTY BOUNDARY
- DETACHED LOW LYING AREA

NOTE:

SHORELINE OVERTOPPING POTENTIAL IS MAPPED IN DISCRETE SECTIONS OF THE COASTLINE AND MAY NOT BE APPLICABLE TO THE AREAS DISPLAYED IN THE FIGURE UNDER ASSUMED CONDITIONS

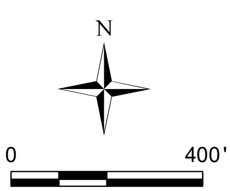


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FIGURE 6b

FLOOD HAZARD DUE TO 48-INCH SEA-LEVEL RISE BY 2050 MAIN INTERCEPTOR TRENCH

PHILLIPS 66 SAN FRANCISCO REFINERY RODEO, CALIFORNIA

Drawn By: DH	Checked By: CG	Scale: 1 " = 400 '	Date: 6/21/21	File: Fig6b_SFR_SLR48.mxd

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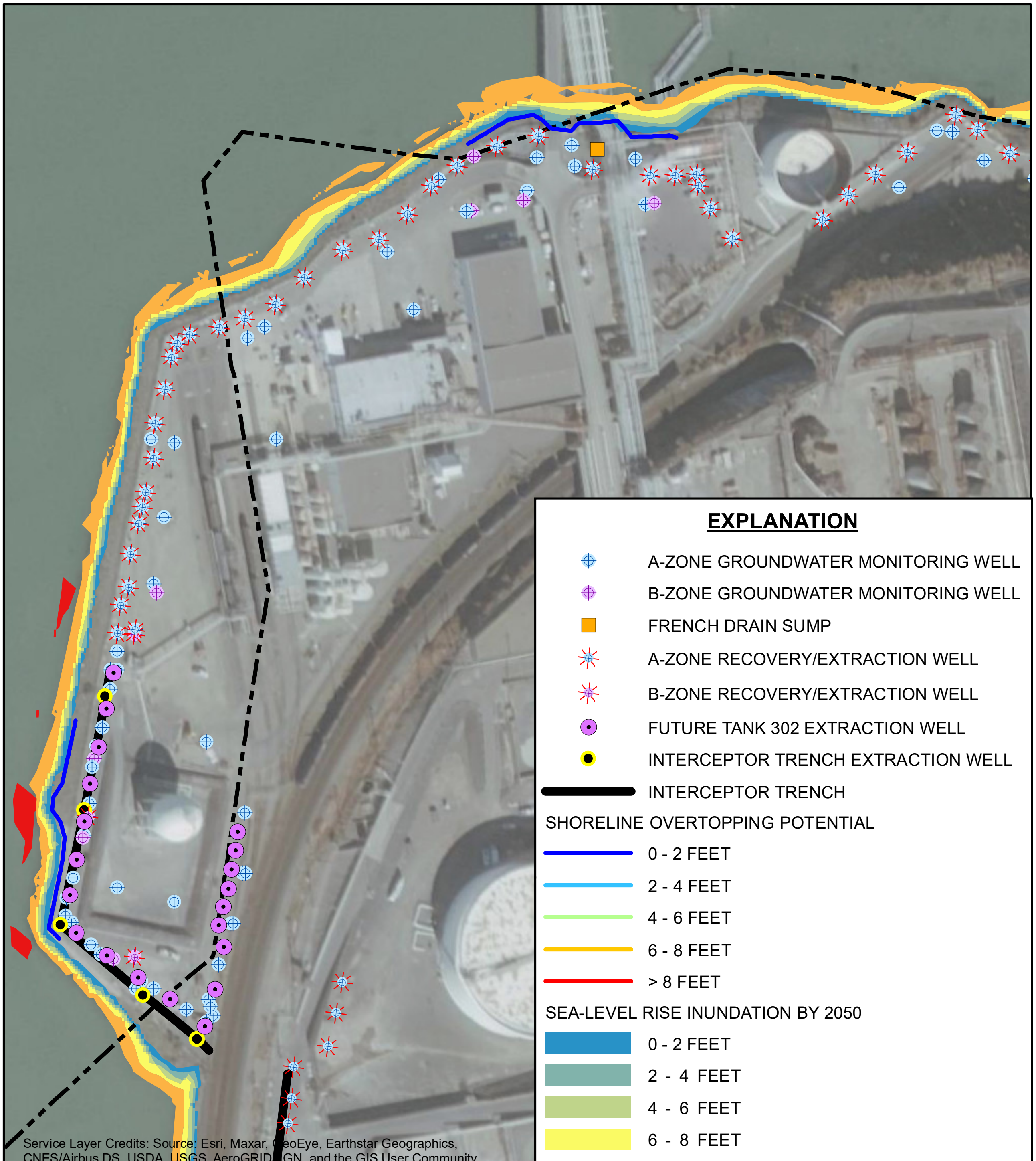

EXPLANATION

- A-ZONE GROUNDWATER MONITORING WELL
- B-ZONE GROUNDWATER MONITORING WELL
- FRENCH DRAIN SUMP
- A-ZONE RECOVERY/EXTRACTION WELL
- B-ZONE RECOVERY/EXTRACTION WELL
- FUTURE TANK 302 EXTRACTION WELL
- INTERCEPTOR TRENCH EXTRACTION WELL
- INTERCEPTOR TRENCH

SHORELINE OVERTOPPING POTENTIAL

- 0 - 2 FEET
- 2 - 4 FEET
- 4 - 6 FEET
- 6 - 8 FEET
- > 8 FEET

SEA-LEVEL RISE INUNDATION BY 2050

- 0 - 2 FEET
- 2 - 4 FEET
- 4 - 6 FEET
- 6 - 8 FEET
- 8 - 10 FEET
- > 12 FEET
- PROPERTY BOUNDARY

NOTE:

SHORELINE OVERTOPPING POTENTIAL IS MAPPED IN DISCRETE SECTIONS OF THE COASTLINE AND MAY NOT BE APPLICABLE TO THE AREAS DISPLAYED IN THE FIGURE UNDER ASSUMED CONDITIONS

N

0 200 '

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FIGURE 6c

FLOOD HAZARD DUE TO 48-INCH SEA-LEVEL RISE BY 2050 MARINE TERMINAL AREA

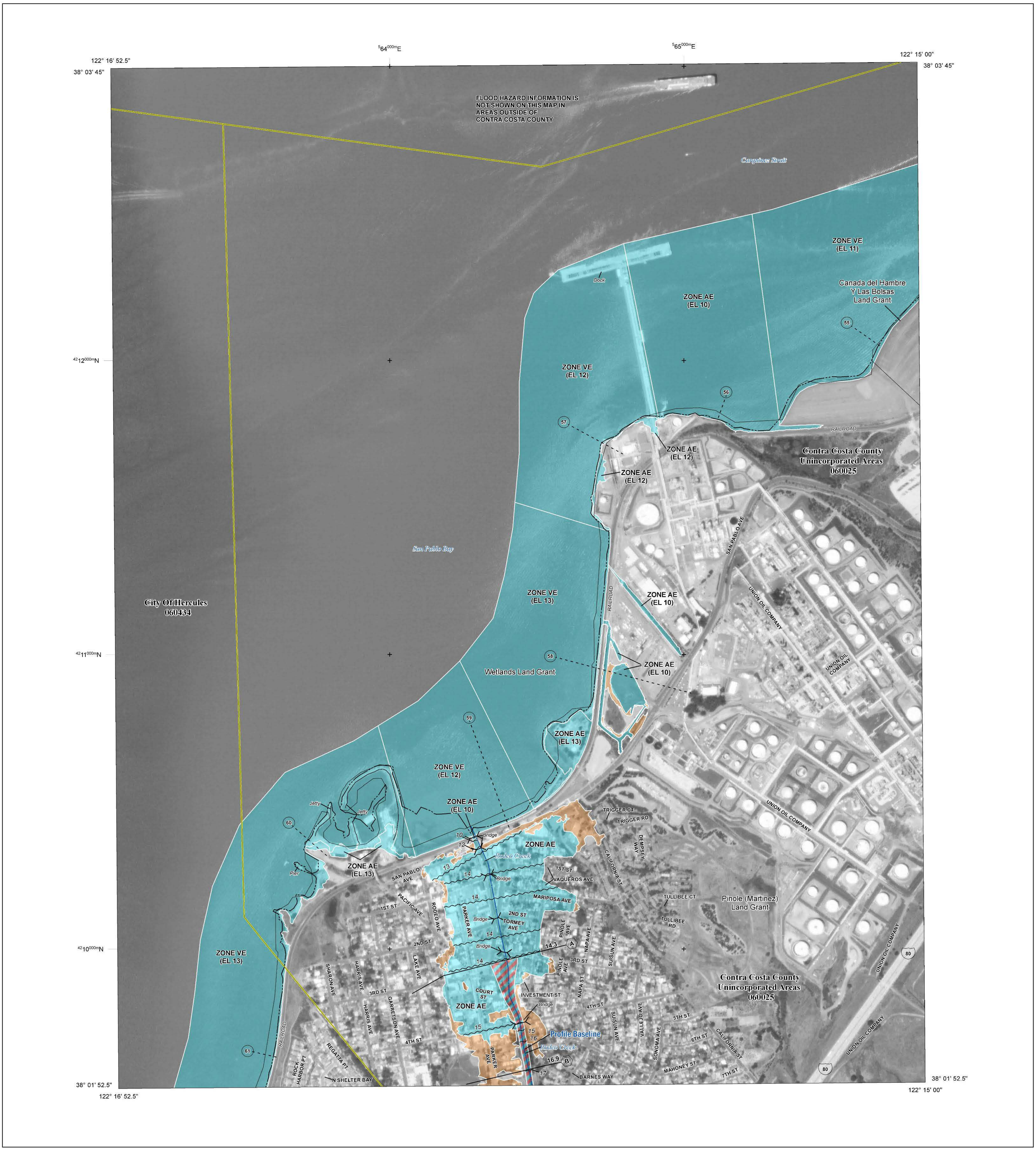
PHILLIPS 66 SAN FRANCISCO REFINERY RODEO, CALIFORNIA

Drawn By: DH	Checked By: CG	Scale: 1 " = 200 '	Date: 6/21/21	File: Fig6c_SFR_SLR48.mxd

M:\CHEVRON\CEMC_COP\RODEO\GIS\PROJECTS\GROUNDWATER_REPORTS\202105_LTFLOODPROTECTIONRPT\FIG6C_SFR_SLR48.MXD

APPENDIX A

FEDERAL EMERGENCY MANAGEMENT AGENCY
FLOOD INSURANCE RATE MAP (PANEL 42)



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTP://MSC.FEMA.GOV

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) *Zone A,V, A99*
	With BFE or Depth *Zone AE, AO, AH, VE, AR*
	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
	Future Conditions 1% Annual Chance Flood Hazard *Zone X*
	Area with Reduced Flood Risk due to Levee See Notes. *Zone X*
OTHER AREAS	NO SCREEN Areas Determined to be Outside the 0.2% Annual Chance Floodplain *Zone X*
	Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES	Channel, Culvert, or Storm Sewer
	Levee, Dike, or Floodwall
OTHER FEATURES	E 18.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
	8 Coastal Transect
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
	513 Base Flood Elevation Line (BFE)
	Limit of Study
	Jurisdiction Boundary

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in the community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on this FIRM was provided in digital format by the USDA National Agriculture Imagery Program (NAIP). This information was photogrammetrically compiled at a scale of 1:12,000 from aerial photography dated 2012.

SCALE

Map Projection:
NAD 1983 UTM Zone 10N;
Western Hemisphere; Vertical Datum: NAVD 88

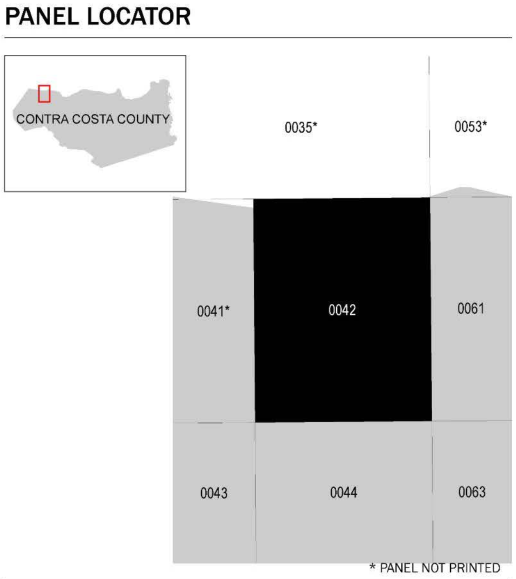
N

1 inch = 500 feet 1:6,000

0 500 1,000 2,000 Feet

0 125 250 500 Meters

PANEL LOCATOR



* PANEL NOT PRINTED

FEMA

National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

CONTRA COSTA COUNTY, California
And Incorporated Areas

PANEL 42 OF 602

FEMA

Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
CONTRA COSTA COUNTY	060025	0042	H
HERCULES, CITY OF	060434	0042	H

VERSION NUMBER
2.3.3.2

MAP NUMBER
06013C0042H

EFFECTIVE DATE
March 21, 2017

APPENDIX B

PROJECTED SEA-LEVEL RISE FOR SAN FRANCISCO AS PROVIDED BY THE STATE OF CALIFORNIA SEA-LEVEL RISE GUIDANCE

TABLE 13: Projected Sea-Level Rise (in feet) for San Francisco

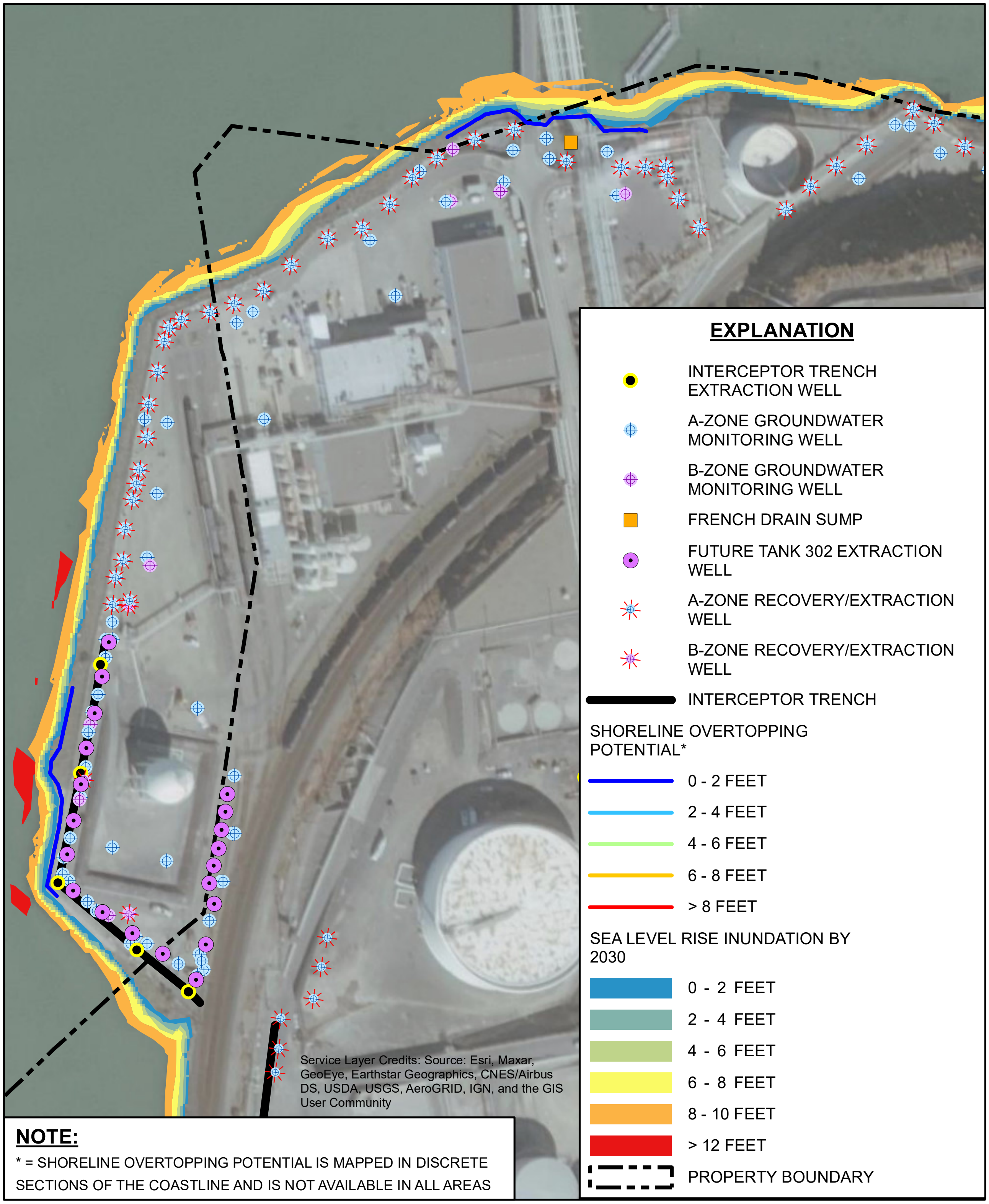
Probabilistic projections for the height of sea-level rise shown below, along with the H++ scenario (depicted in blue in the far right column), as seen in the Rising Seas Report. The H++ projection is a single scenario and does not have an associated likelihood of occurrence as do the probabilistic projections. Probabilistic projections are with respect to a baseline of the year 2000, or more specifically the average relative sea level over 1991 - 2009. High emissions represents RCP 8.5; low emissions represents RCP 2.6. ***Recommended projections for use in low, medium-high and extreme risk aversion decisions are outlined in blue boxes below.***

		Probabilistic Projections (in feet) (based on Kopp et al. 2014)						H++ scenario (Sweet et al. 2017) *Single scenario
		MEDIAN	LIKELY RANGE			1-IN-20 CHANCE	1-IN-200 CHANCE	
		50% probability sea-level rise meets or exceeds...	66% probability sea-level rise is between...			5% probability sea-level rise meets or exceeds...	0.5% probability sea-level rise meets or exceeds...	
					Low Risk Aversion		Medium - High Risk Aversion	Extreme Risk Aversion
High emissions	2030	0.4	0.3	-	0.5	0.6	0.8	1.0
	2040	0.6	0.5	-	0.8	1.0	1.3	1.8
	2050	0.9	0.6	-	1.1	1.4	1.9	2.7
Low emissions	2060	1.0	0.6	-	1.3	1.6	2.4	
High emissions	2060	1.1	0.8	-	1.5	1.8	2.6	3.9
Low emissions	2070	1.1	0.8	-	1.5	1.9	3.1	
High emissions	2070	1.4	1.0	-	1.9	2.4	3.5	5.2
Low emissions	2080	1.3	0.9	-	1.8	2.3	3.9	
High emissions	2080	1.7	1.2	-	2.4	3.0	4.5	6.6
Low emissions	2090	1.4	1.0	-	2.1	2.8	4.7	
High emissions	2090	2.1	1.4	-	2.9	3.6	5.6	8.3
Low emissions	2100	1.6	1.0	-	2.4	3.2	5.7	
High emissions	2100	2.5	1.6	-	3.4	4.4	6.9	10.2
Low emissions	2110*	1.7	1.2	-	2.5	3.4	6.3	
High emissions	2110*	2.6	1.9	-	3.5	4.5	7.3	11.9
Low emissions	2120	1.9	1.2	-	2.8	3.9	7.4	
High emissions	2120	3	2.2	-	4.1	5.2	8.6	14.2
Low emissions	2130	2.1	1.3	-	3.1	4.4	8.5	
High emissions	2130	3.3	2.4	-	4.6	6.0	10.0	16.6
Low emissions	2140	2.2	1.3	-	3.4	4.9	9.7	
High emissions	2140	3.7	2.6	-	5.2	6.8	11.4	19.1
Low emissions	2150	2.4	1.3	-	3.8	5.5	11.0	
High emissions	2150	4.1	2.8	-	5.8	7.7	13.0	21.9

**Most of the available climate model experiments do not extend beyond 2100. The resulting reduction in model availability causes a small dip in projections between 2100 and 2110, as well as a shift in uncertainty estimates (see Kopp et al. 2014). Use of 2110 projections should be done with caution and with acknowledgement of increased uncertainty around these projections.*

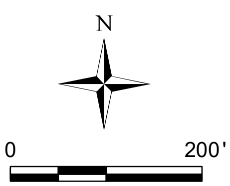
APPENDIX C

BAY CONSERVATION AND DEVELOPMENT COMMISSION (BCDC) –
2021 FLOOD POTENTIAL DUE TO 100-YEAR STORM SURGE



NOTE:

* = SHORELINE OVERTOPPING POTENTIAL IS MAPPED IN DISCRETE SECTIONS OF THE COASTLINE AND IS NOT AVAILABLE IN ALL AREAS



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APPENDIX C

BAY CONSERVATION AND DEVELOPMENT COMMISSION (BCDC) - 2021 FLOOD POTENTIAL DUE TO 100-YEAR STORM SURGE

MARINE TERMINAL AREA PHILLIPS 66 SAN FRANCISCO REFINERY RODEO, CALIFORNIA

Drawn By: DH	Checked By: CG	Scale: 1 " = 200 '	Date: 6/3/21	File: APP_C_SFR_SLR48.mxd

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APPENIDX D

OUR COAST OUR FUTURE INTERACTIVE FLOOD MAP

APPENDIX D. OUR COAST OUR FUTURE INTERACTIVE FLOOD MAP
2021 FLOOD POTENTIAL DUE TO 100-YEAR STORM SURGE
PHILLIPS 66 SAN FRANCISCO REFINERY, RODEO, CA