Feasibility Study

Ferry Facility at Berkeley Municipal Pier

CITY OF BERKELEY

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→ The Power of Commitment

GHD, Inc.

2300 Clayton Road, Suite 920

Concord, California 94520, United States

T +1 925 849 1000 | **E** Craig.Lewis@ghd.cominfo-northamerica@ghd.com | **ghd.com**

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Executive Summary

Project Background

In July of 2015, the Berkeley Municipal Pier was closed due to structural problems related to the concrete decking and pilings (based on visual inspections and preliminary structural calculations). In 2017, the City initiated a ferry terminal study to evaluate the feasibility of a renovated pier with small-scale passenger ferry service.

In February of 2016, the Water Emergency Transportation Authority (WETA) approved their Strategic Plan that identified a network of sixteen potential locations for expanded ferry service throughout the Bay Area region, including the Berkeley Marina, to help provide alternative transportation for passengers and emergency response. In 2018, WETA and City discussed the possibility of new ferry service at the Berkeley Waterfront based on the idea of a new dual-purpose pier that could be used by the public for recreation as well as ferry service. In 2019, the City and WETA executed a memorandum of understanding (MOU) to jointly fund the planning feasibility phase of a project to renovate a portion of the pier to provide both public recreation and large-scale ferry service.

Process

Over a two-year period, the planning and feasibility phase involved a series of technical studies, a robust public process, and the development of a preferred concept that was presented to the Berkeley City Council (December 7, 2021) and the WETA Board of Directors (April 7, 2022), whereby both entities expressed support.

Ferry Terminal Facility Feasibility Study Report

The primary goal of this report is to provide a recommendation on the most feasible location and configuration of a dual-purpose pier that would restore the recreational value of the existing pier while providing large-scale ferry service. In addition, the recommendation contains goals to minimize potential impacts to recreation users and the environment. The preferred concept used the following preliminary technical studies:

– Waterside studies evaluated wind, wave, storms, and dredging data.
– Landside studies evaluated public transportation needs such as drop-offs (bus, rideshare, car), pathways (pedestrian and bicycle), site amenities (e.g., restrooms, bicycle facilities), and transportation and parking demand management strategies.
– A WETA Berkeley Business Plan Study provided an assessment of ridership forecasts over the next twenty years, as well as a forecast of mode-split travel (e.g., the growth of non-automobile travel to reach the ferry service).

Recommendation – A Preferred Concept

The preferred concept includes the operation of zero-emission electric battery ferry vessels and the following elements:

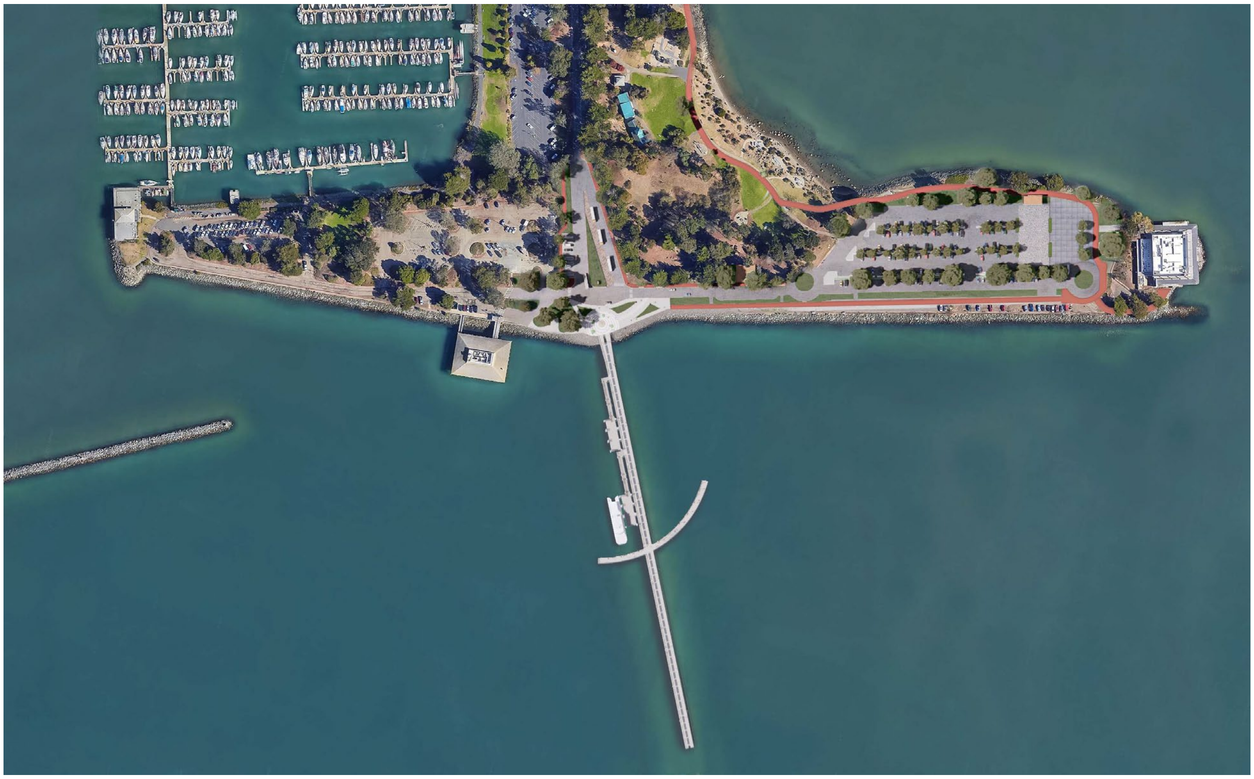
Waterside

– A new dual-purpose pier in the same location as the existing municipal pier will extend from the shoreline at Seawall Drive westward to a new breakwater (580 ft long);
– A new breakwater will create a safe harbor from the predominant southwesterly wind and waves for ferry boarding on the north side of the new pier (400 ft long). The breakwater will have surface decking to allow public access for recreation;
– An extension of the new pier westward from the new breakwater will provide 500 ft of additional pier for recreational use. All together, these elements will provide approximately 1,480 feet of pier available for public access;
– The new pier will be 22 ft wide to accommodate both ferry foot traffic, recreational activities, and emergency and maintenance vehicles. (Note the current Berkeley Municipal Pier is 22 ft wide); and
– On the north side of the renovated pier, the new ferry access point will include ferry berthing floats, float piles, ADA gangways, and security gates.

Landside

– The existing 320 car parking lot at 199 Seawall Drive will allocate 250 parking spots for weekday ferry users;
– The entire 320-car parking lot will be renovated with new pavement surfacing, new striping, and new stormwater bioswales to treat stormwater;
– The southwestern side of University Ave and portions of Seawall Drive will be renovated to provide new spaces for public buses, shuttles, rideshares, and family vehicles;
– The existing pedestrian pathways will be renovated to include safety lighting, a new restroom, a new fish cleaning area, trash cans, a new public plaza and events space, and other amenities (e.g., drinking fountain, area for potential food trucks, etc.);
– The existing Seawall Drive vista parking zone will be shifted from the west side to the east side of the road and a new Bay Trail pathway will be installed on the west side;
– A new water access point for windsurfing, etc. will be installed at the small peninsula at the southwest corner of Seawall Drive; and
– The City plans to use Transportation Demand Management (TDM) methods to improve circulation at the Berkeley Waterfront for pedestrians, bicycles, cars, mass transit, service and delivery vehicles, and emergency vehicles in ways that minimize impacts to existing uses and the environment.

Preferred Concept Exhibit



Next Steps

WETA and City will jointly seek funding from local, state, and federal agencies and other funders for the next phases of the project such as environmental reviews (CEQA & NEPA), final design, permitting, and construction. For current project information, please visit: https://berkeleyca.gov/your-government/our-work/capital-projects/berkeley-pier-ferry-access-project

Table of Contents

Appendices

Figure Index

Table index

1 Introduction

1.1 Background

The current Berkeley Municipal Pier was originally constructed in 1926 as an over-water automobile causeway providing access to a ferry terminal in the Bay just north of Treasure Island for tips to San Francisco. In 1937 the Pier was acquired by the City of Berkeley (City) and operated as a recreational pier. Renovations/repairs were performed on the Pier in 1959-61 and 1984. The Pier was indefinitely closed to the public in 2015 due to structural safety issues.

The City contracted with GHD Inc. (GHD) in 2017 to complete a condition assessment and structural evaluation of the existing Municipal Pier. The study objective was to perform a visual condition survey of the structure, prepare a report of the structural condition, and provide conceptual repair alternatives with budgetary cost estimates. Results of the 2017 assessment, as shown in the 2018 Structural Assessment Report, confirmed the City's decision to close the pier for public use.

GHD's 2017 evaluation showed that the Pier would require extensive structural repair as a result of the deterioration the concrete has sustained due to exposure to the marine environment. Due to the relatively high estimated construction cost for rehabilitation (including strengthening of the pier) and recurring maintenance costs, replacement of the structure was recommended to provide a safe recreational and viewing opportunity for the public.

In 2018, the City and the San Francisco Bay Area Water Emergency Transportation Authority (WETA) began dialogue about a new ferry service in Berkeley. In 2019, the City and WETA executed a memorandum of understanding (MOU) to jointly fund the planning feasibility phase of a renovation project at the Pier. Several planning documents were used as a guide for the potential development of a ferry service from Berkeley, including:

– **City of Berkeley General Plan, 2001**, Policy T-9 Ferry Service recommends the continued evaluation of the possibility of working with the City of Albany, racetrack owners, regional transportation agencies, and AC Transit to establish a ferry terminal and regular San Francisco ferry service from Berkeley at the foot of Gilman Street or at the foot of University Avenue as an alternative to the Bay Bridge and as an essential recovery element following a significant seismic event. Emphasis was placed on a ferry service that is less environmentally detrimental than the automobile.
– **WETA Strategic Plan 2016**, envisions ferry service in Berkely starting by 2026, including potential use of "green technology". Implementation of the Strategic Plan is guided by WETA's System Expansion Policy, which provides a framework for evaluating the feasibility of new ferry projects.
– **WETA Emergency Response Plan 2016**, identifies an operational ferry terminal in Berkeley as a potential site for emergency transit in response to a catastrophic incident affecting Bay Area regional transportation operations.
– **City of Berkeley Local Hazard Mitigation Plan (LHMP), 2019**, identifies that the Interstate 80 north-south route along the eastern edge of the Marina bisects the area from the rest of the city, which along with the limited number of egress routes, would slow evacuations in the event of a catastrophic incident such as a tsunami.
– **WETA Short Range Transit Plan 2020 – 2029**, provides a forecast of operating expenses, revenues, capital expenditures, and funding, as well as operations and planning activities. The Plan was prepared in accordance

with the Federal Transit Administration's requirements for receiving federal funding and includes reference to the feasibility and planning phase to implement ferry service in Berkeley within that time frame.

– **Metropolitan Transportation Commission (MTC) Plan Bay Area 2050**, provides the region's long-range strategic plan focused on the interrelated elements of housing, the economy, transportation, and environment. The MTC Plan identifies the Berkely ferry service as a "Regionally Significant Project".
– **MTC's Core Capacity Transit Study**, a collaborative effort that identifies and prioritizes investments to improve public transportation to and from the core of San Francisco. The Study recognizes the Berkeley ferry service as vital to meeting growing demands of transbay public transit.

GHD was retained to perform the feasibility study evaluating the waterside and landside improvements needed for a new, dual-purpose pier that could be used by the public for recreation and also provide a ferry facility. GHD's scope of work included engineering feasibility studies and assisting with the City's public engagement process regarding the proposed improvements and potential impacts as a result of ferry passenger volumes. The study focused on the waterside and landside improvements needed for a ferry facility and integration of the facility with a replacement dual-purpose pier that could be used by the public for recreation. The waterside studies included evaluation of rehabilitating or replacing the existing pier for the concept of a dual-purpose pier (ferry terminal and recreation), access to the terminal, and wave protection assessment of the ferry terminal. The feasibility study also included review of facility parking and landside improvements.

2 Feasibility Study

GHD's scope of work for the ferry facility feasibility study included development of planning-level concepts for a dual-purpose pier and ferry facility to be developed in combination with Berkeley Municipal Pier rehabilitation or replacement. The project location is shown on Figure 2-1. As part of the analysis, the GHD team evaluated dual-purpose pier configurations, developed essential design criteria for WETA ferry operation, and reviewed site coastal conditions, ferry facility wave protection, sedimentation, channel and berth depth alternatives and their respective operational limitations, and generated navigation channel/berth layouts with estimated dredging volumes. Recreational use of a dual-purpose pier was also reviewed and included wave protection and immediately adjacent landside amenities such as shelters for wind, shade and rain, seating, bathroom facilities, and fish cleaning facilities. The GHD team also developed a parking and Transportation Demand Management (TDM) strategy that consisted of analyzing existing conditions and transportation resources near the proposed ferry terminal location and identified preliminary TDM and shared parking opportunities.

Based on these conditions and opportunities, the project team developed a baseline mode share and a TDM-supported mode share for future ferry riders traveling to and from the marina. To demonstrate the potential for TDM and shared parking strategies to support increased ferry ridership, the project team analyzed three parking and TDM scenarios.

The study scope also included refinement of dual-purpose pier initial concept plans for different facility configurations and demonstrating schematic waterside and landside improvements, including recreational amenities. The conceptual ferry facility will generally follow current WETA standards, and pier conceptual plans were focused on efficiency of WETA ferry operations at the terminal while minimizing potential impacts to recreational uses.

The GHD team identified types of passenger ferry vessels that would be suitable for operation at Berkeley Municipal Pier. In addition, conceptual modifications to the pier structure needed for ferry vessel berthing, mooring, and passenger loading and unloading were also identified.

The team evaluated the required channel depths considering navigation effects (vessel motions, under-keel clearance requirements, etc.), sedimentation, advanced maintenance dredging, and other factors. These analyses served as input in the development of the proposed dredging depth at the berth and in the channel, as well as estimated maintenance dredging volumes.

Finally, the feasibility study scope of work included rough order magnitude (ROM) cost estimates for the conceptual ferry facility, dual purpose pier, related amenities, and shoreside improvements.

Figure 2-1 **Proposed project site location**

2.1 Ferry Facility Conceptual Design Criteria

The conceptual design criteria developed are intended to provide and document the concept design assumptions, ferry vessel operational criteria, safety, and other requirements for the ferry facility.

2.2 Ferry Vessel Type and Operations

Ferry vessel types were evaluated to determine which types of vessels are desirable and the channel depths the vessels require for safe operation. Downtime evaluation was performed to evaluate the potential frequency of cancelled sailings or sailings that must proceed at low speed due to lack of sufficient under-keel clearance, which may occur periodically for certain types of vessels due to a combination of minus tides and/or high winds (waves). Ferry vessel behavior at speed and in waves were based on discussion with boat builders – no numerical modeling of vessel motions was performed.

2.3 Dredging and Sedimentation Requirements

As part of the ferry terminal feasibility analysis, capital and maintenance dredging requirements were estimated using existing and new hydrographic survey data and estimated sedimentation at the site. Estimates included volumes for dredging to various channel bottom elevations, as required by particular types of vessels under consideration. Channel depth and length alternatives were evaluated, and conceptual-level cost estimates developed for the capital and maintenance dredging. Cost estimates were developed using a basic methodology and discussion with contractors and are feasibility-level in nature. Work included evaluation of coastal conditions, site bathymetry and sedimentation, development of terminal channel and berthing area concepts, and potential downtime associated with shallow water limitations for various navigation channel and berth depths.

2.4 Terminal Electrification to Support Electric Ferry Vessels

A feasibility-level review of electrification for the ferry facility to accommodate zero emission vessels was performed as part of the feasibility study. The review included research of the existing electrical utility infrastructure in the area of the Berkeley Marina and was primarily concerned with the basic estimation of utility service capacity and major infrastructure requirements to support charging systems required for electric ferry vessels.

2.5 Dual-Purpose Pier and Ferry Facility Concepts

Five conceptual configurations were developed for the multi-purpose pier:

- Concept 1A, “Sword” with existing pier alignment
- Concept 1B, “Sword” with pier alignment moved to the south
- Concept 2, “Dog Leg”
- Concept 3, “Fish Hook”
- Concept 4, “Circle”

The feasibility of each concept was reviewed in terms of public use, safety, security, vessel navigation and operations, and cost. ADA-accessibility requirements for the ferry terminal gangway were also reviewed using varying tide levels and consideration of future sea level rise (SLR). See Sections 3 and 4 for details on waterside and landside development, respectively.

3 Conceptual Design Development Process: Waterside

3.1 Basis of Design Considerations for Waterside Concepts

The waterside component of the overall project is comprised of the pile-supported pier segment starting at the shoreline, ferry facility (gangway, berthing float, passenger shelter, wave protection, etc.), and other project elements located in the water.

Preliminary design criteria was developed for the conceptual ferry facility at Municipal Pier (Appendix D.) WETA typically requires that the pier segment accessing the ferry terminal and ferry facility be designed to Essential Facility standards per 2022 California Building Code (Title 24.) The following criteria and facility requirements for the feasibility report were developed in coordination with WETA Operations staff members.

- The facility will be used by WETA ferry vessels for passenger loading and unloading. Two vessel berths will be accommodated through the use of two ferry floats or a single double-sided float. Routine maintenance and overnight berthing of ferry vessels is not anticipated to be required at the facility.
- Site-specific geotechnical criteria and parameters for preliminary and final design of the ferry terminal float guide piles and other piles will be based on a site investigation and engineering studies, including a hazard risk assessment to be conducted in a later phase of the project.
- Gangways and ramps used at the facility will meet requirements of ADA-ADAAG and Draft Passenger Vessel Accessibility Guidelines. Minor deviations from accessibility standards are possible at the most extreme tides, which may occur approximately several hours per year.
- The configurations of ferry approach channels, approach areas and berths are unique and, therefore, the facility concepts were developed with WETA operations in mind. Ferry facility concepts in this context refer to the channel layout, berth layout, float location and float alignment. The concepts were developed based on the following criteria:
  - The ferry vessels will utilize the Berkeley Marina entrance channel until reaching the shoreline area. It should be noted that the entrance channel would not be reserved strictly for ferry traffic and is used by vessels entering and exiting the Marina, and the channel width of 100 feet may require widening for safe navigation at high speed.
  - Demolish a portion of the existing pier as required for safe maneuvering from the Marina entrance channel to areas south of the existing pier.
  - Ferry vessels are expected to have good open water maneuvering capability. Therefore, pinwheel turns are assumed to be feasible, with stern berthing on both sides of the float.
  - Berth layout considerations:
    - Provide ease in maneuvering between Marina entrance channel and berthing area.
    - Maneuvering time required to slow, stop, turn and berth with bows pointing seaward.
    - Allow sufficient space between float and pier, considering commonly energetic wind and wave conditions.
    - Avoid conflicts with small craft in the Marina entrance channel.
    - Maximize convenience relative to dual purpose pier.
    - Provide a float orientation aligned reasonably well with predominant wave directions. It should be noted that the float orientation can be modified in any terminal location.
- The GHD team assumed that vessel fueling, and sewage outflow will take place at WETA's Central Bay Operations and Maintenance Facility in Alameda.

The pier and ferry facility will be designed to be adaptable to accommodate SLR. The estimated increase in water level used in design represents the 50-year service life of the facility. The conceptual design considered SLR based on the 2018 State of California Sea Level Rise Guidance document (OPC, 2018).

3.1.1 Ferry Vessel Type, Navigation and Operations

The conceptual ferry facility at Berkeley Municipal Pier is planned to be served by electric ferry vessels operated by WETA. The vessels are expected to have an overall approximate length of 135', a 35' beam and capacity for 200 to 325 passengers (pax.) Specific characteristics of the electric ferry vessel class were unknown at the time of this report.

Table 3-1 Ferry vessel characteristics

Parameter	Design Vessel
Vessel	WETA 200 to 325 Passenger Ferry
Length Overall, L	~135 feet
Beam	~35 feet
Pax Boarding Locations	Dual Entrances

3.1.1.1 Channel Depth Evaluation

Channel depth is a critical element of the feasibility study as it significantly affects dredging costs and overall project costs. Water depths in the berth and approach areas are presently insufficient for WETA operations. WETA does not have standard requirements for channel depth or under-keel clearance. Therefore, this analysis was performed as a sensitivity analysis to evaluate the potential limitations imposed on operations by various channel depth alternatives and their respective dredging volumes. Limitations were computed based on the vessel under-keel clearance and frequency of potential cancelled sailings (or slow transits, or other result) due to insufficient water depth during the period 2013-2014 (typical 2-year period).

3.1.1.2 Vessel Under-keel Clearance

Depending on the chosen channel depth, under-keel clearance limitations may arise periodically based on a combination of different coastal conditions. Figure 3-1 shows a schematic demonstrating factors that contribute to reduced under-keel clearance. For the analysis in the feasibility study, the vessel draft was assumed fixed at 4.5 feet, tidal disadvantage (negative tides) was taken from predicted tides, and vessel movements were estimated based on the vessel and its speed and depth, as well as vessel's predicted wave-induced motions, which were computed using industry data for similar vessels.

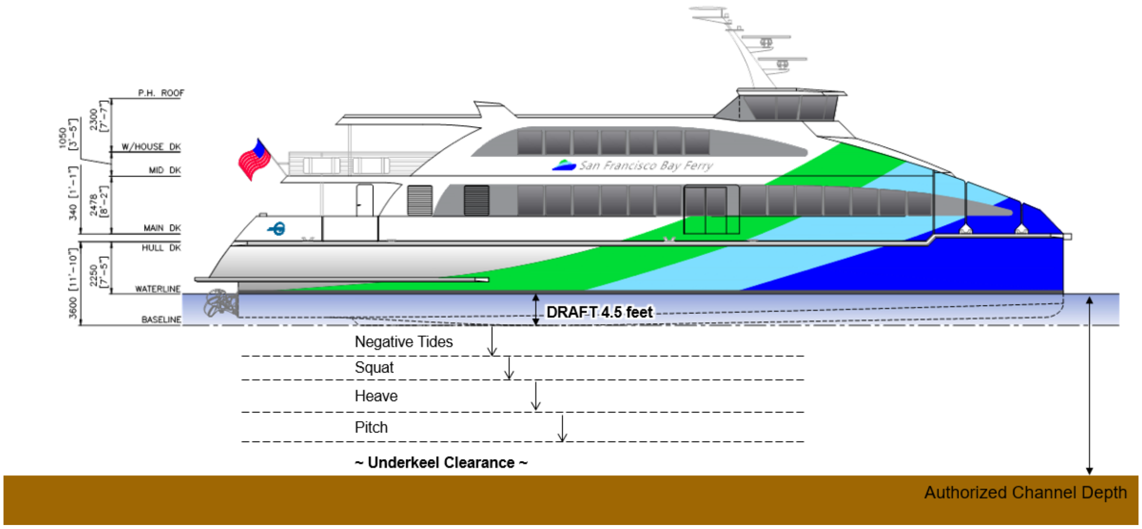


Figure 3-1 **Factors affecting under-keel clearance**

Vessel motions most strongly affecting under-keel clearance include squat, heave, and pitch. Roll effects in the navigation channel are expected to be relatively low since the wave directions at the site are consistently aligned with the channel. Squat effects cause vessels to sit lower in the water while underway at higher speed in relatively shallow water. For these types of vessels, however, literature review indicates that squat is not expected to be a significant contributor to reduced under-keel clearance. Heave (vertical motion of the entire vessel) and pitch (forward/aft rotation about the center of the vessel) are induced by waves and must be considered. Trim effects were unknown and, therefore, not included.

Vessel motions in waves are described by Response Amplitude Operators (RAOs). RAOs for a similar catamaran ferry were taken from literature, including a similar vessel moving at 30 knots in head seas (normal to wave crests, similar to Berkeley). Figure 3-2 shows the RAO curves that include dimensionless motion as a function of wave frequency. These curves were used as lookup tables to compute wave-induced motions during each hourly record in the 2013-2014 period based on the maximum wave height (converted from significant wave height) and peak wave period.

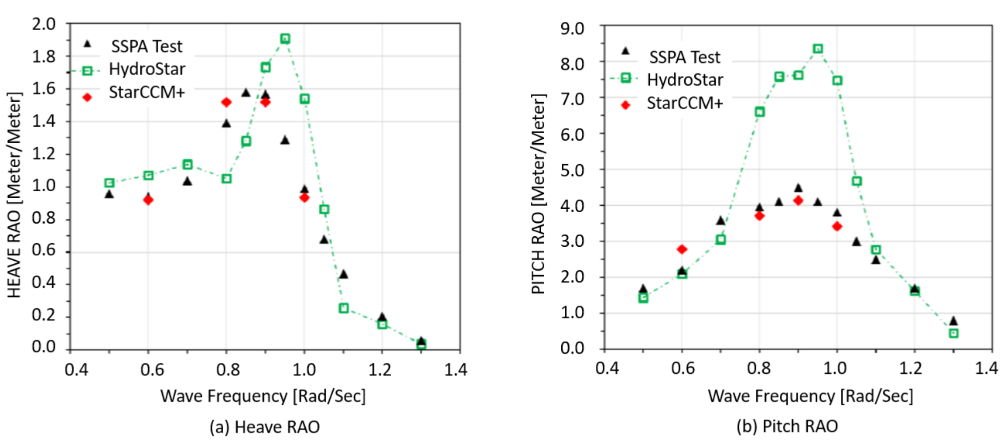


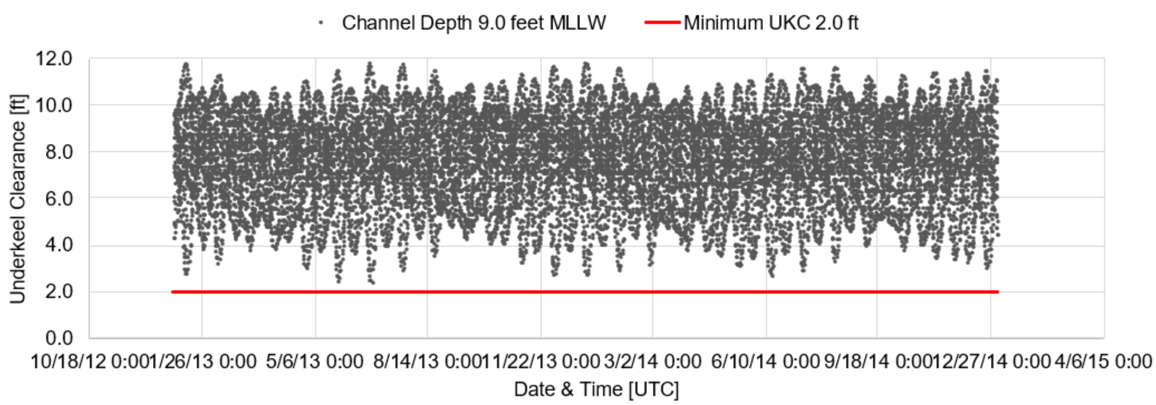
Figure 3-2 **RAOs for heave (left) and pitch (right) for catamaran ferry at 30 knots in head seas (Lin et al 2017).**

3.1.1.3 Channel Evaluation Results

Using the predicted coastal conditions and a range of assumed channel depths, under-keel clearances were calculated for the entire hourly record covering two years (2013-2014). Table 3-2 summarizes the number of hourly records within which the under-keel clearance was less than 1, 2, or 3 feet for each of these channel depths between -7.5 and -9.0 feet (MLLW). Figure 3-3 shows the calculated hourly under-keel clearances during the two-year period for channel depths of -9.0 and -8.5 feet (MLLW). The red line on the plots represents an under-keel clearance of 2 feet for reference.

Table 3-2 Annual hourly instance for under keel clearance less than 1 to 3 feet for channel depths -7.5 to -9.0 feet (MLLW)

Under keel Clearance (ft)	Channel Depth			
	-7.5 ft MLLW	-8.0 ft MLLW	-8.5 ft MLLW	-9.0 ft MLLW
1	1	0	0	0
2	39	13	1	0
3	210	95	39	13



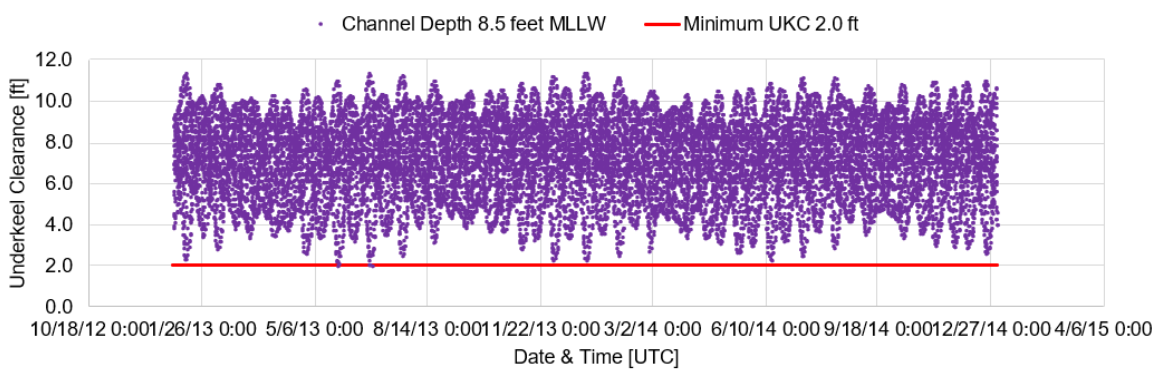


Figure 3-3 Under-keel clearances for channel depths between -9.0 feet MLLW (top) and -8.5 feet MLLW (bottom)

The number of hourly instances when under-keel clearance would have been less than 1, 2, or 3 feet represent a small portion of the time, considering 8,760 hours in a year. These occurrences of low under-keel clearance were further investigated to determine when they occur during the day and likely impacts to operations. Figure 3-4 shows a histogram of wind speeds greater than 10 mph for different times of the day and, predictably, the data show that stronger winds occur during the afternoon. However, low tides tend to control under-keel clearance more strongly than winds or waves. Figure 3-5 shows a histogram demonstrating the times during the day at which under-keel clearances less than 3 feet occur for channel depth -7.5 feet (MLLW), as an example. Analysis indicated that low tides generate the majority of the hourly instances of low under-keel clearance. The negative tides (those below MLLW) tend to occur most often in the 5-6am and 5-6pm time frames, which are likely to affect early morning and evening commutes when ferry service is likely to be concentrated. Therefore, any occurrences of low under-keel clearance should be assumed to coincide with heavy operations.

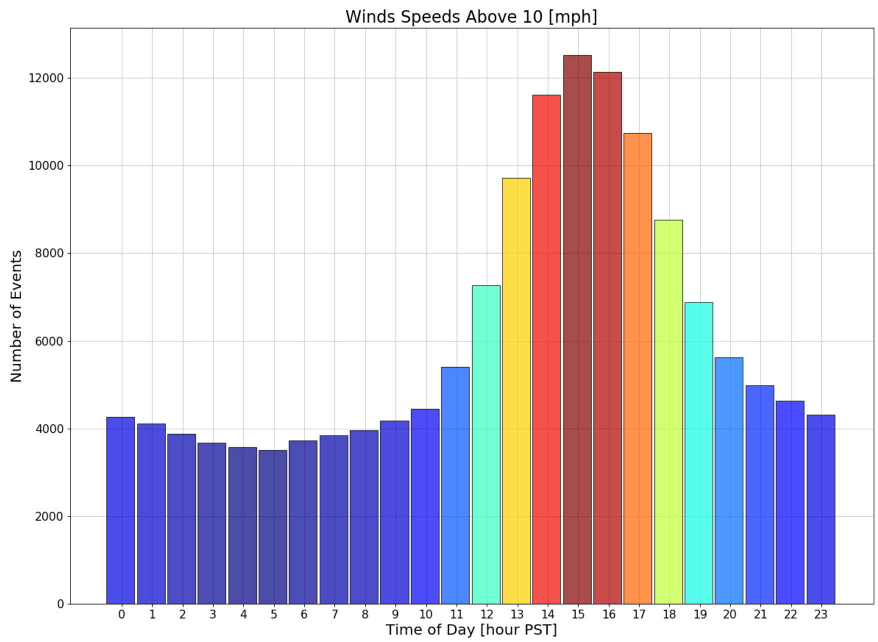


Figure 3-4 **Daily (hour by hour) distribution of wind speeds greater than 10 mph**

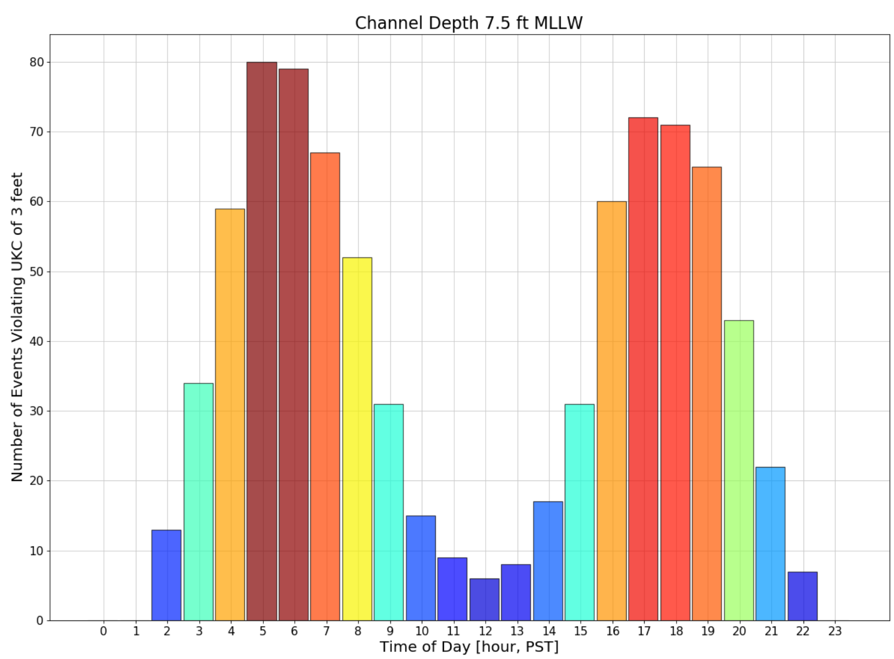


Figure 3-5 **Daily (hour by hour) distribution of under keel clearances less than 3 feet for channel depth -7.5 feet (MLLW)**

3.1.1.4 Conceptual Dredging Design and Sedimentation Rates

Dredge volumes for a range of different channel dimensions (depths and widths) were generated for the study. It is noted that different vessel drafts will change the dredge volume assumptions provided. Dredging volumes for different terminal entrance channel depths were computed using elevation model surfaces.

Sedimentation at the site is expected to be minimal; however, some level of over-dredging is recommended due to an expected high cost per cubic yard for maintenance dredging. The marina entrance channel requires deepening, and the channel may also require widening for safe navigation as small craft also use the channel.

3.1.1.5 Site Coastal Conditions

Coastal conditions analysis was performed to evaluate existing depths at the site, potential navigation channel and berth sedimentation, conditions that affect safe navigation, and terminal float alignments. Site coastal conditions of interest include bathymetry and sedimentation, winds, wind-waves, and tides. The analysis showed tidal currents are generally not significant at the site.

3.1.1.6 Site Conditions – Bathymetry and Sedimentation

Previous hydrographic surveys were compiled and analyzed to assess the depths surrounding the proposed terminal locations, historical/current patterns, and rates of sedimentation. The available hydrographic surveys near the project site include the following:

– May 2018 multibeam (eTrac)
– August 2007 single beam (United States Army Corp of Engineers)
– April 2007 single beam (Coast & Harbor Engineering)
– October 1978 to April 1979 single beam (NOAA)

Figure 3-6 to Figure 3-8 show the three primary hydrographic survey datasets utilized in the sedimentation analysis. The black dotted line shows the extents of the Berkeley Pier, including the remnants of the pier that once extended over 3 miles into the Bay. Depths range from -5 to -6 feet (MLLW) to more than -17 feet (MLLW) at the pier's offshore extent, with flat slopes in the range of 1000H:1V. Note that the 2007 hydrographic survey is a combination of a USACE 2007 survey and Coast & Harbor Engineering (2007) survey.

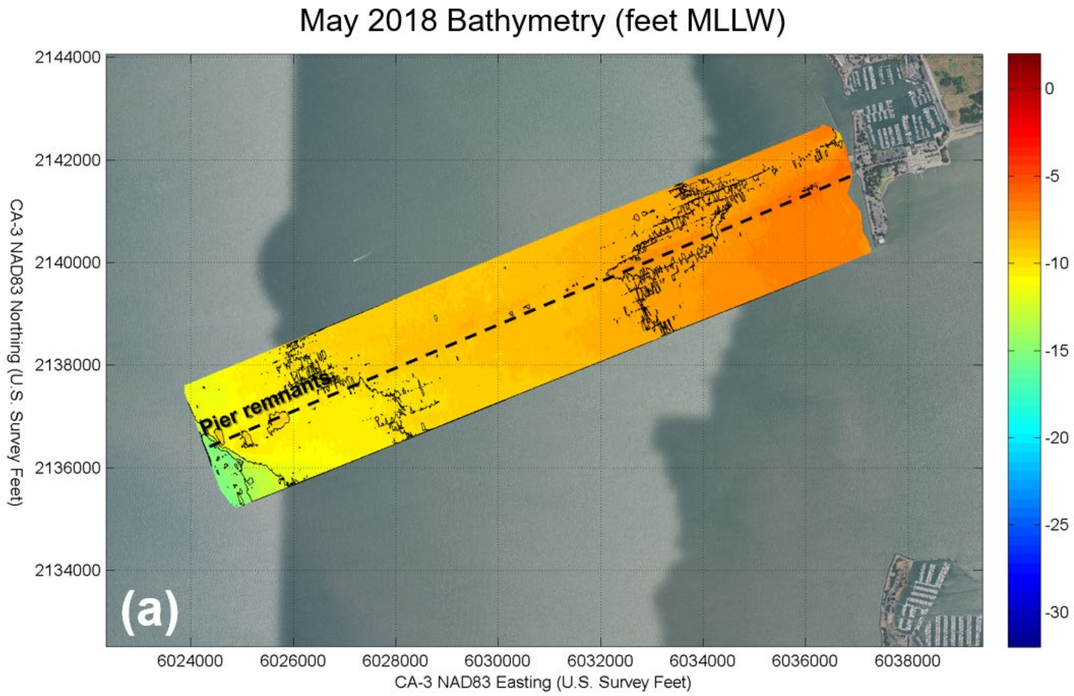


Figure 3-6 **May 2018 multibeam hydrographic survey at Berkeley Pier (eTrac)**

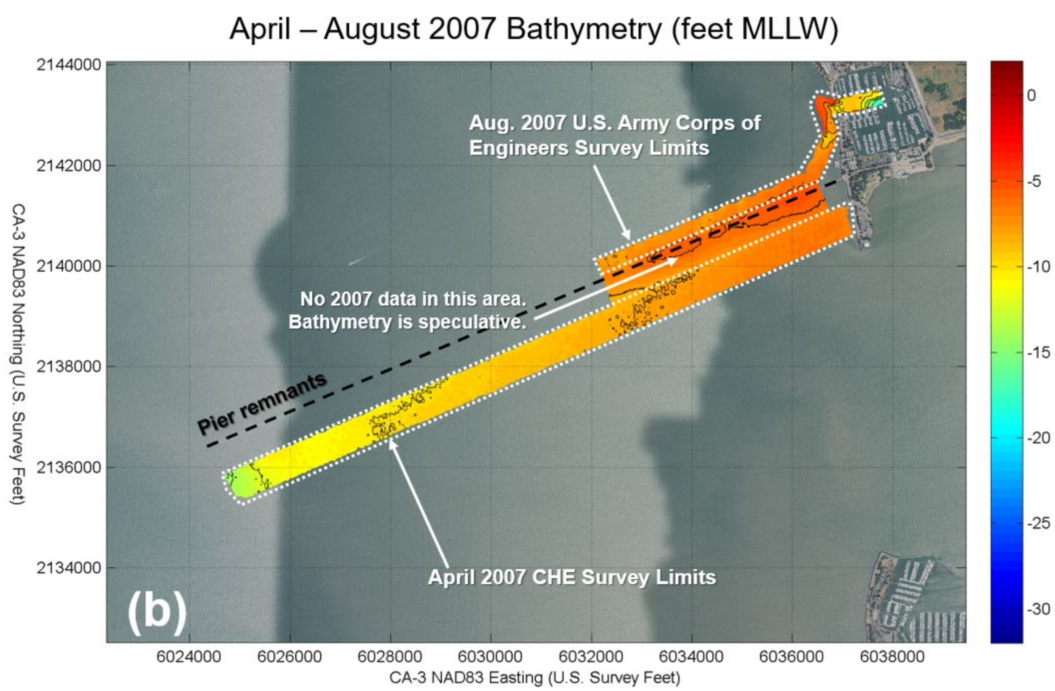


Figure 3-7 **Combined 2007 single beam hydrographic survey at Berkeley Pier (USACE and Coast & Harbor Engineering)**

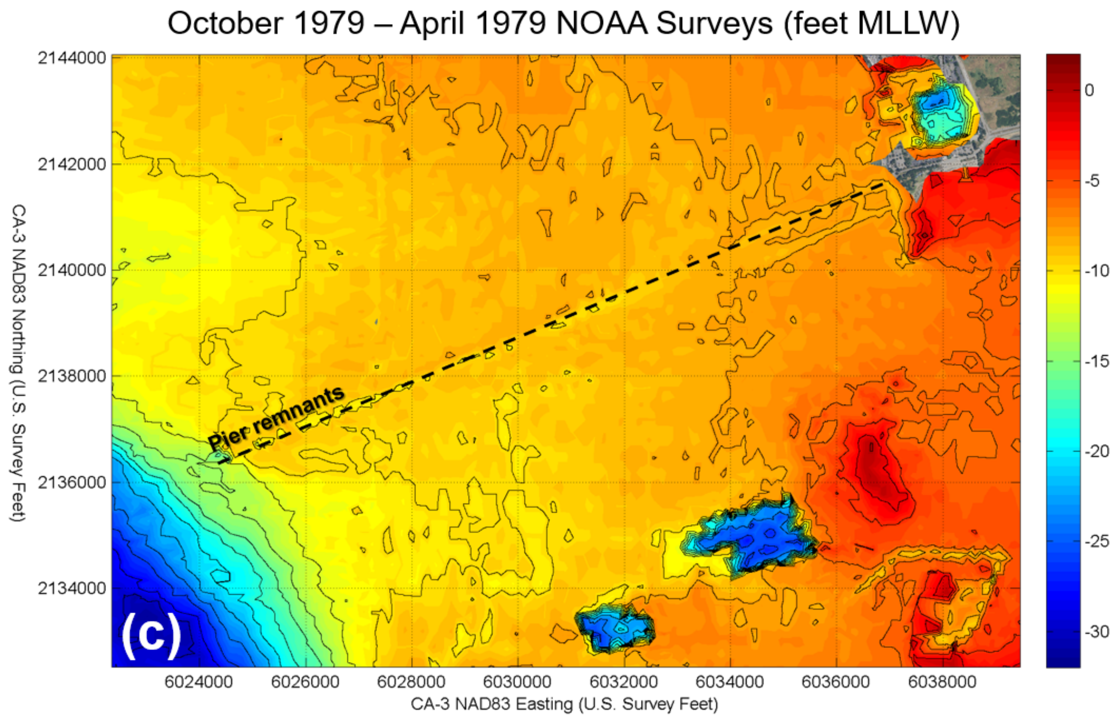


Figure 3-8 1978-1979 single beam hydrographic survey at Berkeley Pier (NOAA)

Figure 3-9 shows measured depth changes from 1979 to 2018, and Figure 3-10 shows measured depth changes in the more recent period 2007 to 2018. In both survey comparisons, changes are minimal on an annual basis, and generally within the accuracy feasible in the analysis based on single-beam survey data. The analysis does show clearly, however, that sedimentation is minimal, but present, in the shallower portion of the navigation channel. A general sedimentation rate of 0.1 feet per year is recommended for consideration of navigation channel and berth dredging options.

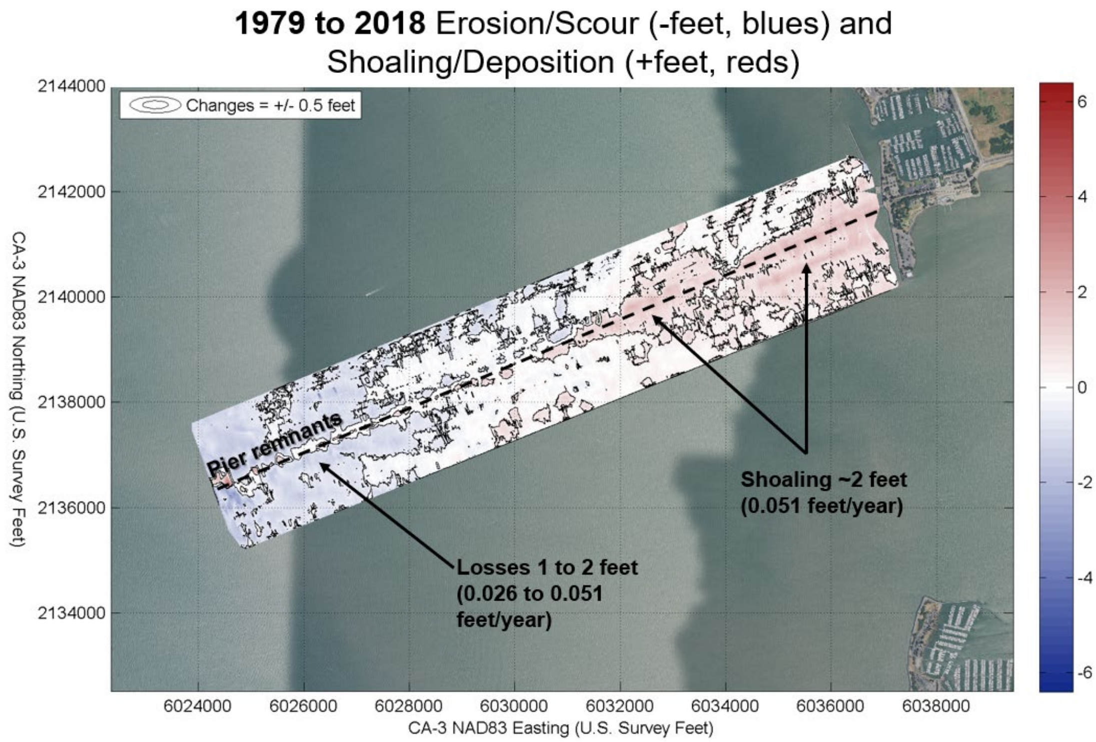


Figure 3-9 Measured sedimentation, 1979 to 2018

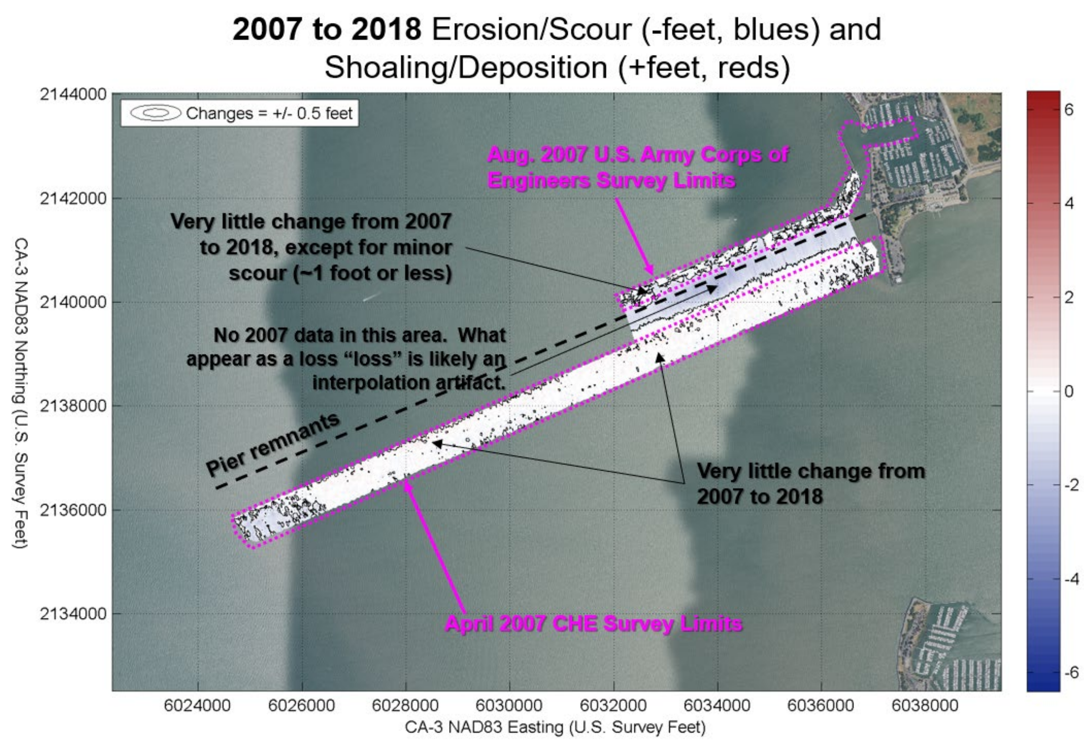


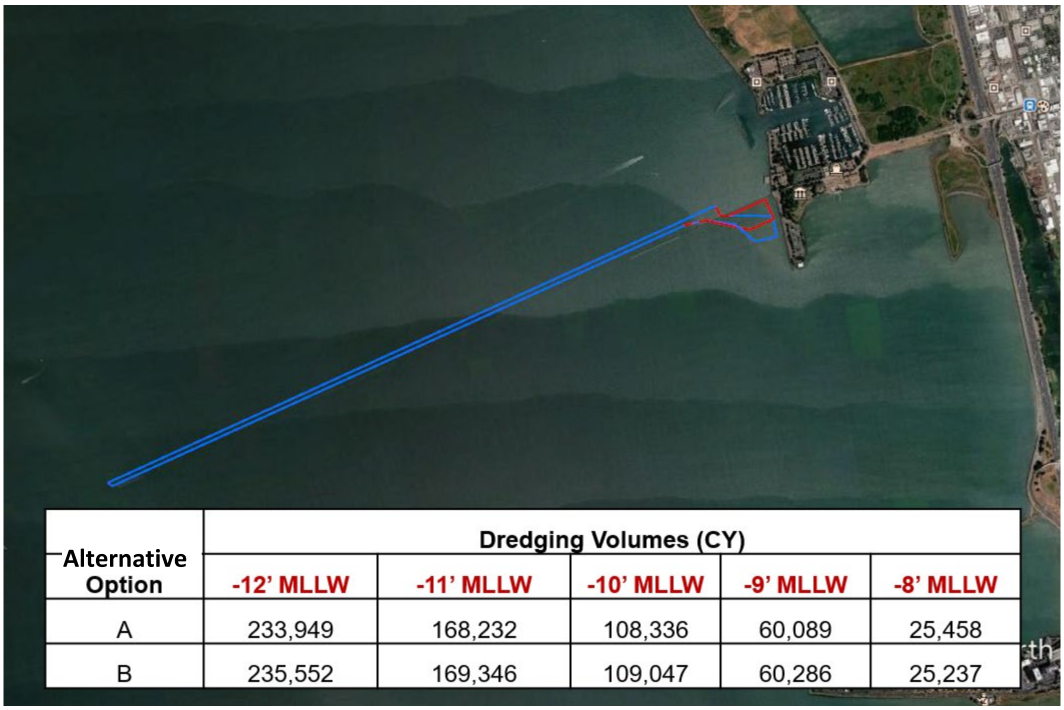
Figure 3-10 Measured sedimentation, 2007 to 2018

3.1.1.7 Conceptual Dredging Volumes

As future channel and berth depths are still under evaluation in coordination with the City and WETA, volumes for a range of different channel dimensions (depths and widths) were generated for this study. Note that different vessel drafts will change the dredge volume assumptions provided in this study.

Dredging volumes for different terminal entrance channel depths were computed using elevation model surfaces. At present, the channel width is assumed to remain at 100 feet and sit within the marina entrance channel. 3H:1V side slopes were assumed for both the channel and berth areas. Figure 3-11 shows the dredging layouts and volumes for Dredge Alternatives 1A and 1B, for various dredging depths between -8 and -12 feet (MLLW). Results show the optimal dredging depth is -9 feet (MLLW). No construction tolerance or advanced maintenance was included in the calculations.

Although sedimentation is expected to be minimal, some level of over-dredging is recommended due to an expected high cost per cubic yard for maintenance dredging. The marina entrance channel requires deepening, as noted; however, and the channel may also require widening for safe navigation as small craft also use the channel.



Alternative Option	Dredging Volumes (CY)				
	-12’ MLLW	-11’ MLLW	-10’ MLLW	-9’ MLLW	-8’ MLLW
A	233,949	168,232	108,336	60,089	25,458
B	235,552	169,346	109,047	60,286	25,237

Figure 3-11 Dredging volumes for Alternatives A and B, for various dredging depths

3.1.2 Water levels

The tides in Central California are mixed semidiurnal, meaning there are two unequal low and high tides each lunar day, an approximately 25-hour time period. Tidal datums and extreme water levels for the San Francisco Bay shoreline have been calculated at over 900 locations by AECOM in the San Francisco Bay Tidal Datums and Extreme Tides Study (2016), with Point ID 519 as the best representation of the project site. Tidal datums associated to this location are presented in Table 3-3.

Analysis of the tidal record indicated that negative tides affecting under-keel clearance occur approximately 5% of the time at Berkeley.

Table 3-3 Tidal datums for Berkely Pier: Point ID 519 (AECOM, 2016)

Datum	NAVD88 (ft)	MLLW (ft)
1-Year Extreme Tide Elevation	7.43	7.5
Mean Higher High Water (MHHW)	6.20	6.27
Mean High Water (MHW)	5.63	5.7
Mean Tide Level (MTL)	3.32	3.39
Mean Sea Level (MSL)	3.31	3.38
NAVD88	0.00	0.07
Mean Low Water (MLW)	1.01	1.08
Mean Lower Low Water (MLLW)	-0.07	0

The water levels listed above provide a representation of baseline water levels within the Bay to consider in combination with SLR projections. MHHW of 6.20 feet (NAVD88) represents typical high tide water levels with annual return period high water levels that can reach upwards of 8 feet. The annual return period extreme tide elevation is representative of a spring tide (king tide), which occurs twice per lunar month when gravitational forces are increased by the alignment of the sun and the moon.

3.1.2.1 Extreme Water Levels

Ocean water levels typically vary within predictable astronomical tide ranges; however, sea level anomalies caused by El Niño Southern Oscillation or storm surge events can increase the water levels above the predicted astronomical tide. These events, in combination with high astronomical tides, can result in extreme water levels and increased potential for flooding of low-lying coastal areas. As discussed above, extreme water levels within the San Francisco Bay were calculated by AECOM at a location adjacent to the project site. These elevations represent various return periods (e.g., 100-year return period has a 1% annual exceedance probability) and do not include wave action. The extreme water levels for the project site are provided in Table 3-4.

Table 3-4 Extreme water levels for Berkeley Pier: point id 519 (AECOM, 2016)

Annual Exceedance Probability	Return Period (years)	Feet Above NAVD88
0.2%	500	10.90
1%	100	9.72
2%	50	9.30
4%	25	8.92
10%	10	8.47
50%	2	7.75

It should be noted that other agencies provide extreme water level estimates for the San Francisco Bay, including National Oceanic and Atmospheric Administrating (NOAA) and the Federal Emergency Management Agency (FEMA). The AECOM tidal datums and extreme water levels are in general agreement with nearby NOAA tidal gauges and FEMA flood elevations. The AECOM calculations were chosen due to the range of water levels predicted in close proximity to the Project site.

3.1.2.2 Dynamic Water Levels

Dynamic water levels are those which include astronomical forces, storm surge, sea level anomalies, and wave components (wave setup and runup). Aside from the wave components, all other potential water level components are included in the AECOM estimates of extreme water levels. Given the Project's exposure to wind-generate waves, there is potential for the wave component to result in dynamic water levels higher than those listed in Table 3-4. When waves propagate nearshore, the waves tend to shoal and the wave crest elevation can be estimated as 70% of the total wave height above the stillwater level (i.e., water level excluding wave components). A wind-wave analysis and wave protection study were performed by Mott MacDonald (2019) that determined the significant wave height for the 'worst case scenario'. The maximum significant wave height expected at the Berkeley Pier is 2.6 feet, thus 1.8 feet (2.6*0.7=1.8) was added to the normal high and extreme water levels.

FEMA provides Flood Insurance Rate Maps (FIRMs) for the project area, which define a Base Flood Elevation (BFE) with a zone to further characterize the primary flood hazards. A BFE is the flood elevation for a 1% annual chance storm, corresponding to a 100-year return period interval. Depending on location, a BFE may or may not include wave action. In the case of the Berkely Pier within the San Francisco Bay, it is identified as Zone VE with a BFE of 13 feet (Figure 3-12). Zone VE is defined by FEMA as an area vulnerable to a 1-percent annual chance coastal storm with additional storm wave hazards. This BFE of 13 feet is then interpreted as the extreme stillwater elevation with wave setup and runup included. However, the wave setup and runup only occurs at the shoreline and landside area. So, this BFE of 13 feet should be used to evaluate landside vulnerabilities as it may not accurately represent extreme water levels further offshore around the Berkley Pier.

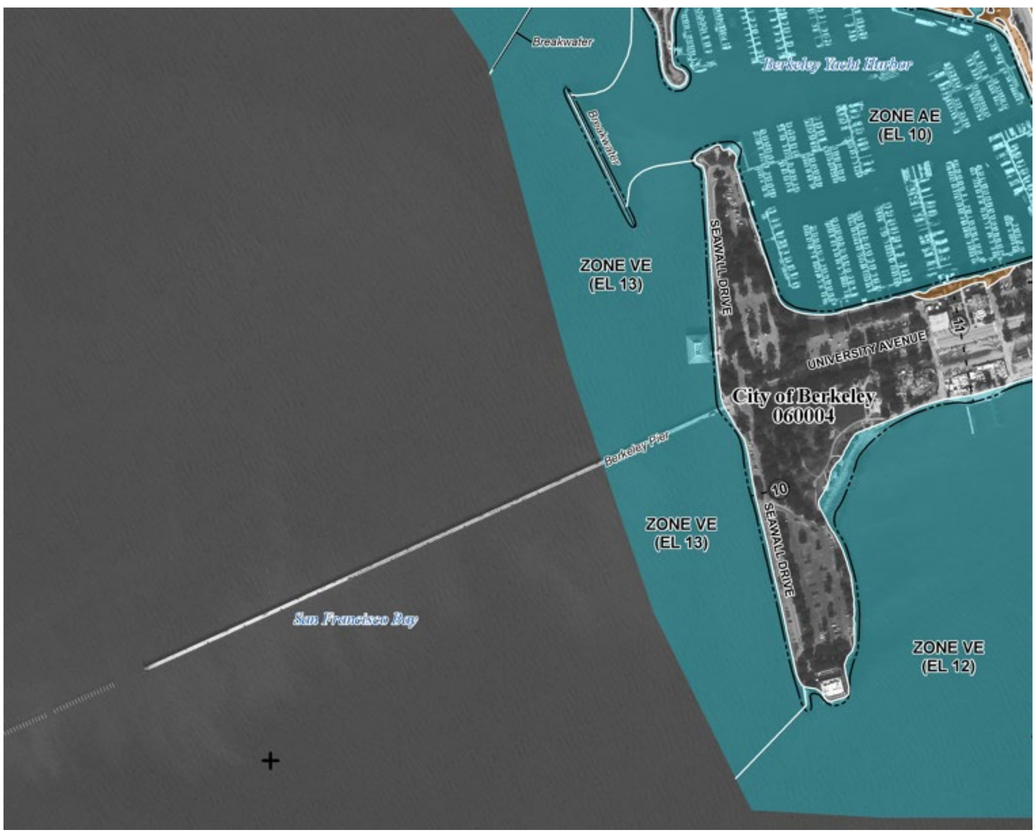


Figure 3-12 FEMA Flood Insurance Rate Map (06001C0052H)

3.1.2.2.1 Sea Level Rise

SLR projections along the west coast of California are provided in the 2018 State of California Sea Level Rise Guidance document (OPC, 2018) for 12 active tide gauges. The California Coastal Commission SLR Policy Guidance, updated in 2018 to reflect the latest projections, refers to these as the "best available science" on SLR projections in California. San Francisco is the nearest tide gauge to the Project site for which SLR projections are provided in the Ocean Protection Council SLR Guidance document.

Risk tolerance and design life are important factors to consider when evaluating SLR projections and their effect on coastal hazards. The Ocean Protection Council (2018) categorizes these projections based on risk aversion. Risk aversion refers to, "… the strong inclination to avoid taking risks in the face of uncertainty (OPC, 2018)". The state guidance outlines three different risk aversion categories:

- Low risk aversion: Refers to the high end of the "likely range" and is intended for projects which would suffer little or no damage or disruption if SLR exceeded this projection.
- Medium-high risk aversion: Refers to the 1-in-200 chance projection and applies to projects which would suffer greater consequences (damage and disruption) if SLR exceeded this projection.
- Extreme risk aversion (H++): Refers to the worst case SLR projections and is intended for projects that would pose a major threat to life, public health and safety, or to the environment if damaged or disruption would be expected under an extreme SLR scenario.

The SLR projections for the San Francisco Station are listed in Table 3-5 and Figure 3-13 for a range of probabilistic scenarios and time horizons provided in the guidance.

Table 3-5 Sea level rise projections for San Francisco (OPC, 2018)

Time Horizon	Low Risk Aversion		Medium Risk Aversion	Medium-High Risk Aversion	Extreme Risk Aversion
	66% Probability SLR is between (ft)		5% Chance Probability Projection (ft)	0.5% Probability Projection (ft)	H++ Scenario Projection (ft)
2030	0.3	0.5	0.6	0.8	1.0
2050	0.6	1.1	1.4	1.9	2.7
2070	1.0	1.9	2.4	3.5	5.2
2100	1.6	3.4	4.4	6.9	10.2

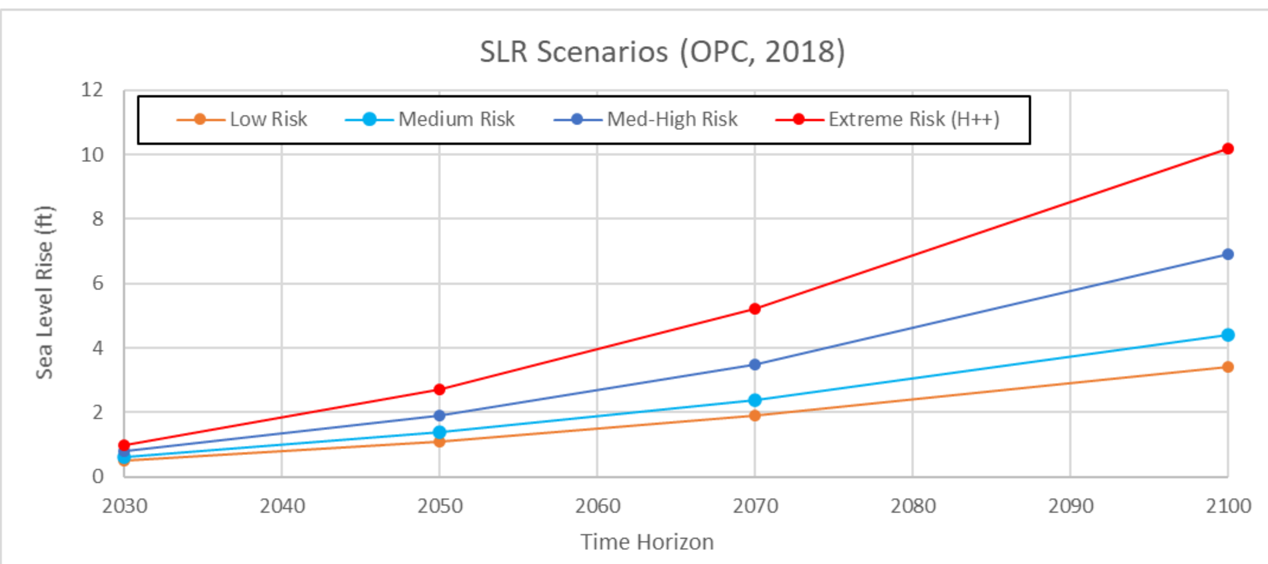


Figure 3-13 SLR projections for San Francisco (OPC, 2018)

The Project has an anticipated design life of 50 years, which generally corresponds to a year 2075 timeframe when assuming a baseline year of 2025. The SLR projections chosen to represent the site are the higher range of the "Low Risk Aversion" scenario, which estimates 0.5, 1.1, 3.9, and 3.4 feet of SLR by 2030, 2050, 2070, and 2100, respectively. The potential timing of these scenarios varies with probability. For example, a 1.9-foot SLR scenario is more likely to occur in 2070 than in 2050. These SLR projections and corresponding scenarios provide a conservative estimate of potential water levels for the Project site over the design life.

It should be noted that the OPC 2018 guidance does not provide input on SLR projections combined with other hazards such as an extreme storm (i.e., waves or rain) or surge event. The combination of SLR and storm events should be further evaluated by the City and stakeholders so that the project design assumptions are in line with the Community's risk tolerance and long-term management strategy.

3.1.2.2.2 Sea Level Rise Vulnerability Assessment

The SLR projections chosen to evaluate the site are the 2018 State of California Sea Level Rise Guidance document (OPC, 2018) using high range of the low risk aversion projections, ranging from 0.5 feet of SLR by 2030 to 3.4 feet of SLR by 2100. The proposed facility has a design life of 50 years, corresponding to the 2075 timeframe (assuming a 2025 baseline year). The project's vulnerability to SLR was evaluated by combining normal high-water levels and extreme water levels with projected SLR. In addition, a design wave height of 2.6 feet was considered in these scenarios, with 70% of the wave height (1.8 feet) added to the scenario.

For the purposes of this analysis, scenarios with wave action were considered to be "Dynamic", whereas scenarios without waves were considered to be "Static", or stillwater, levels. Extreme events are the SLR scenarios coupled with the 100-year storm water level. The range of scenarios are shown in combination with SLR in Table 3-6 and Figure 3-14.

Table 3-6 Sea level rise & extreme water levels

Time Horizon	SLR Projections: Low Risk	Static		Dynamic	
		MHHW + SLR	100-yr Storm + SLR	MHHW + SLR + Waves	100-yr Storm + SLR + Waves
2030	0.5	6.7	10.2	8.5	12.0
2050	1.1	7.3	10.8	9.1	12.6
2070	1.9	8.1	11.6	9.9	13.4
2100	3.4	9.6	13.1	11.4	14.9

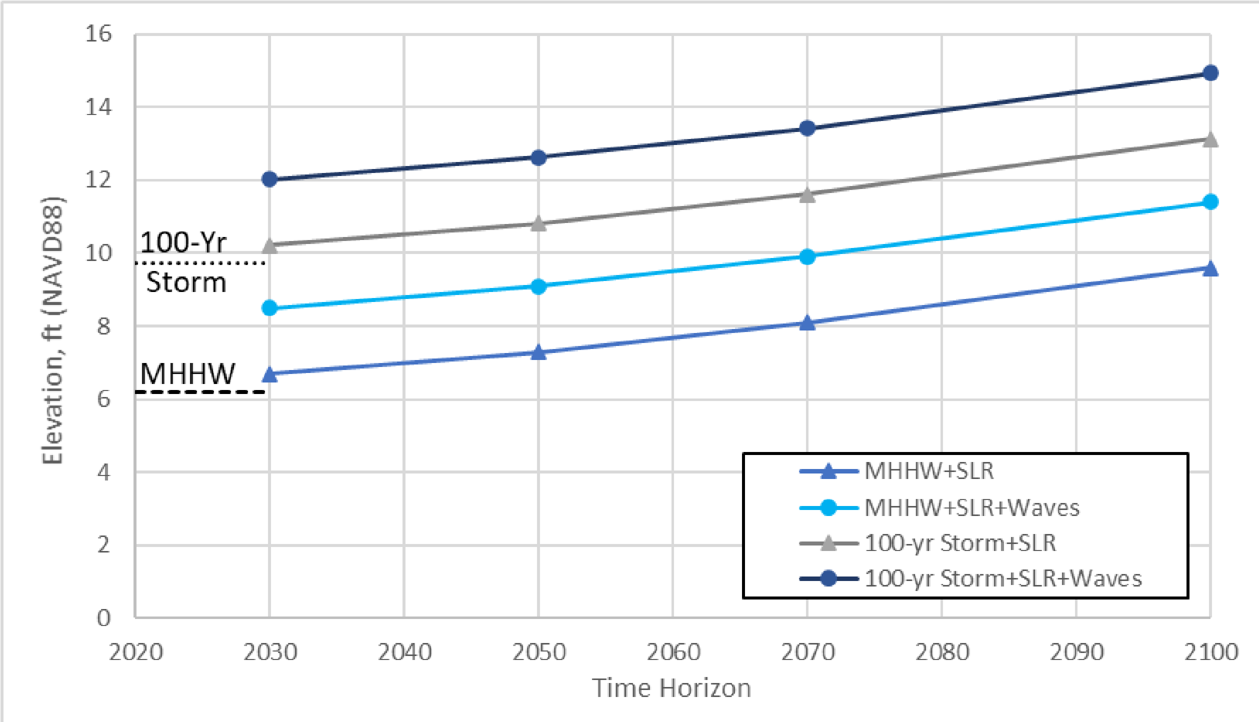


Figure 3-14 **Sea level rise & extreme water level scenarios**

Within the Project's design life, the projected water levels with SLR range from 6.7 feet to 13.1 feet for static water levels and 8.5 feet to 14.9 feet for dynamic water levels. The scenario most representative of regular water levels is MHHW + SLR, which ranges from 6.7 to 9.6 feet. An extreme water level scenario describes an event that is of high intensity, but shorter duration. This is expected for both static and dynamic extreme water level scenarios; however, the presence of waves may slightly extend the overall duration of the event.

In addition to vulnerability, it is important to evaluate the sensitivity of the Project features to these hazards and SLR. The pier structure will generally be able to withstand an extreme-dynamic event without maintaining critical damage. Any flooding or overtopping would likely be a nuisance and may result in temporary closures of the ferry service. In addition, the ferry float and gangway would rise with the water levels, so the sensitivity of these features are relatively low.

Sustained damage would result from regular inundation of the pier underdeck, referring to both the static and dynamic MHHW scenarios. To account for this, the pier elevation will be determined with a 2-foot air gap between the design water level and the soffit of the pier. The soffit of the pier also reduces the long-term damage from sustained high-water levels. Based on the Project's sensitivity, vulnerability, and design life, a design water level of 15 feet is recommended.

The elevation of 15 feet includes 3.4 feet of SLR with an extreme water level and waves. This scenario aligns with California's State goal of 3.5 feet of SLR resiliency by 2050. Based on low-risk aversion SLR projections, the timeframe for this scenario is 2100. However, there is a small chance that 3.4 feet of SLR is exceeded before 2100 based on the OPC 2018 projections (~2.5% chance of exceedance by 2080). Given the uncertainties involved in projecting SLR and the frequently updated science surrounding these projections, monitoring and adaptation are important components of the Project.

3.1.2.2.3 Sea Level Rise Adaptation

Based on the findings of this vulnerability study, the pier should be designed to accommodate water levels of 15 feet. The following design measures can be taken to accommodate for SLR:

– The pier structure can be designed to be adaptable to higher water elevations due to anticipated SLR. For example, the pier deck can avoid periodic flooding at higher water levels by using a metal or fiberglass open grating that allows seawater to pass through, also reducing uplift pressures on the pier.
– The pier can be designed with a higher deck surface elevation to prevent overtopping during most storm events. The plaza and approach to the pier can be raised to match the higher deck elevation by using lightweight fill material and adding a new walking surface with appropriate grades for ADA-accessibility. An airgap of 12 to 24 inches is recommended for the pier soffit (bottom of pier deck) elevation.
– The pier structure can be constructed so that the bents can accommodate the future addition of elevated spacers. This will allow the pier deck to be periodically raised as needed with SLR and extreme water levels.

Project criteria may discuss raising the access pier +1.5 feet after 2050. As SLR science is periodically updated, the vulnerability of the pier to higher water levels should be revaluated at a minimum interval of 10 years.

3.1.3 Wind-Wave Environment

Wind-waves were predicted at the site using a Bay-wide application of the wind-wave growth and transformation model SWAN (Delft University of Technology 2012). Waves were predicted for the entire 2-year period, 2013 and 2014, at hourly intervals using wind speed, wind direction, and tide as inputs. Wind records were taken from NOAA Alameda Station (9414750). Results of the SWAN model included wave characteristics (significant wave height, peak wave direction and peak wave period) along the channel alignment and in the berthing areas. Figure 3-15 shows the results of the SWAN Bay-wide modeling simulation during westerly wind conditions as an example. Figure 3-16 shows time histories of wave and tide conditions that were used for the ferry under keel evaluation, which were extracted at the worst-case location in the navigation channel near the project site.

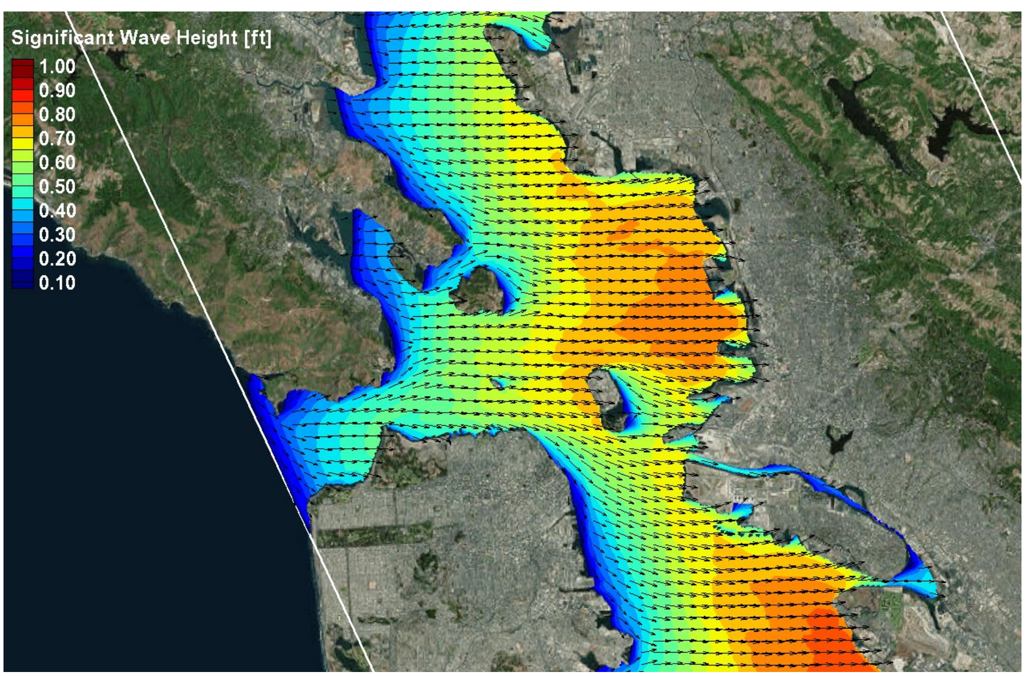


Figure 3-15 **Predicted significant wave heights during 12-mph winds from due west (270 degrees true north), as an example**

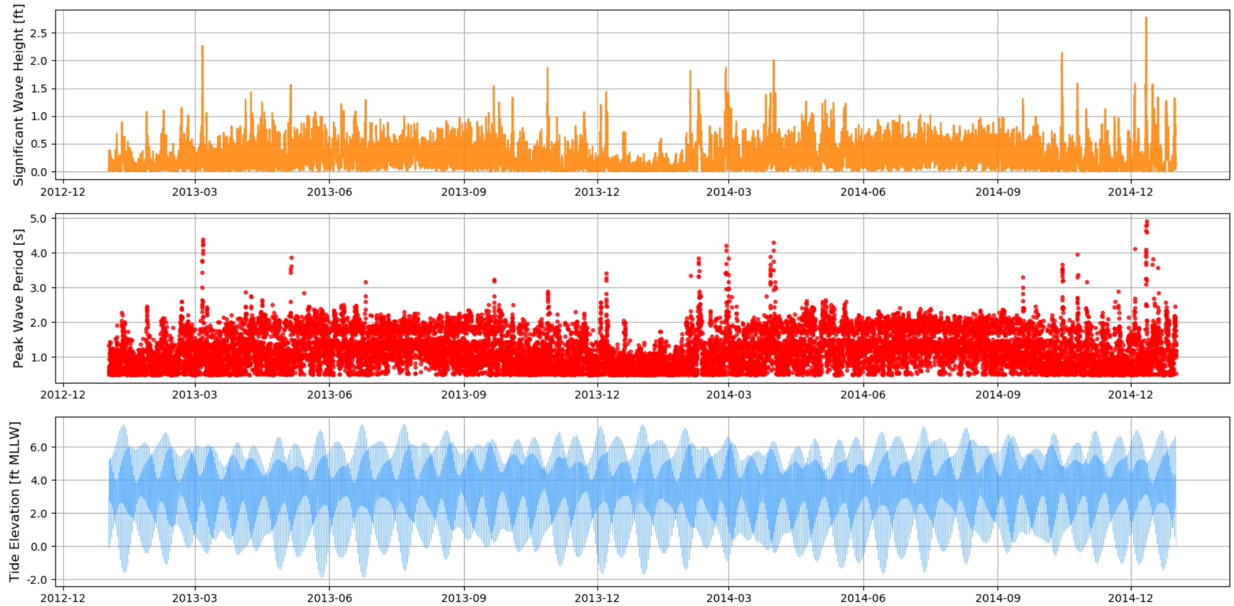


Figure 3-16 **Wave and tide conditions during two-year period (2013 and 2014), extracted at most energetic location along navigation channel**

Coastal conditions data were generated during the study and used to evaluate and select preferred alternative ferry terminal concepts. A refined analysis was performed of local winds, wind-wave growth and nearshore transformation, and relative level of wave protection afforded by each of the facility concepts.

3.1.3.1 Wind Conditions

Local wind analysis was enhanced through evaluation of wind speed data from two local stations immediately adjacent to the terminal area. Figure 3-17 shows locations of Berkeley Reef Light and Berkeley Marina anemometers, which were analyzed for consistency and quality. Berkeley Reef Light station was determined to have the most suitable wind data for wind-wave growth and transformation modeling, as it was less affected by local topography and/or buildings. Figure 3-17 (inset) also shows wind roses for these two stations. Winds at Berkeley Reef Light are most commonly aligned with the existing pier.

3.1.3.2 Wind-Wave Conditions

Additional wind-wave growth and transformation modeling was performed to determine typical wave conditions at the terminal locations to be used in further evaluating wave protection concepts. Figure 3-18 shows an example of wind-wave growth and transformation modeling results for a southwest 20-knot wind generated using the SWAN model (Delft University of Technology 2019). Approximately 6.5 years of waves were predicted at the site using Berkeley Reef Light wind speed and direction (full available record), combined with measured tidal elevation at Alameda (NOAA 9414750). Figure 3-18 (inset) also includes a wave rose taken near the terminus of the existing pier that represents the wave climate during this 6.5-year period.

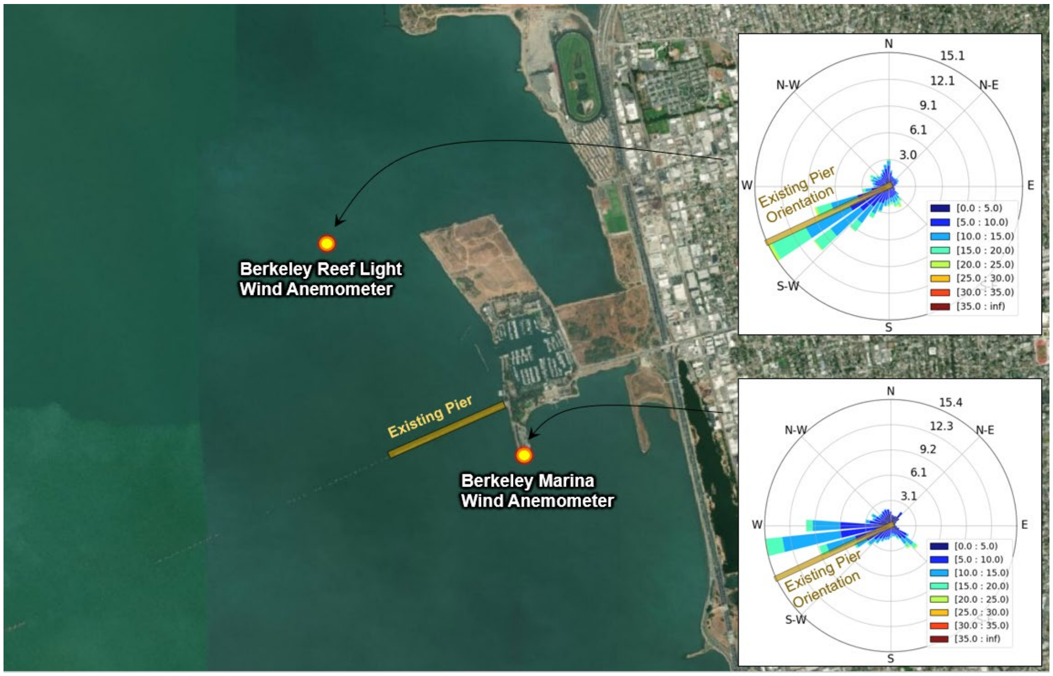


Figure 3-17 Local wind stations evaluated (left) and wind roses for Berkeley Reef Light (inset) and Berkeley Marina (inset) with speeds in knots (2-min average).

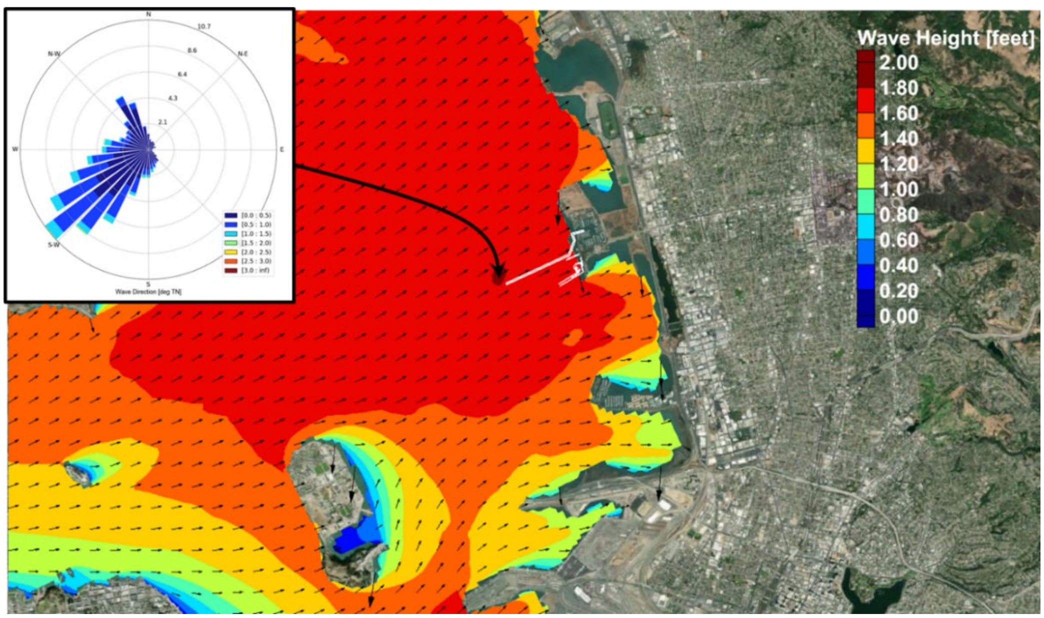


Figure 3-18 Significant wave height and peak wave direction for southwest wind speed 20 knots, and wave rose at the terminus of existing pier (inset).

3.1.3.3 Conceptual Wave Protection Evaluation for Ferry Operations

Additional nearshore wave transformation modeling was performed for the ferry terminal concepts (breakwaters, specifically) using the wind-wave data generated on a Bay-wide scale with the SWAN model. Nearshore modeling was performed using Mike21BW (DHI 2021). Pile-supported pier segments and boarding floats were neglected in the modeling so that only the breakwater (assumed to be a solid sheetpile wall) affected wave transformation was considered in the modeling. A representative wave condition was used for the feasibility-level wave protection assessment: significant wave height 2.62 feet (0.8m), peak period 4.0 seconds, and origin direction 240 degrees true north (southwest). This incident wave condition has a larger peak wave period than daily conditions, which results in more wave penetration and conservative (i.e., larger) wave heights at the float relative to the incident wave heights. The wave protection modeling was intended to be feasibility-level in nature and does not represent a complete evaluation of potential year-round conditions, downtime at the terminal or mooring conditions, all of which should be evaluated during preliminary design.

Feasibility-level nearshore wave modeling showing the level of protection afforded by each breakwater was conducted for each of the ferry facility conceptual alternatives (Concept 1A, 2, 3 and 4). Modeling results are shown in the figures in Section 3.2.5. Wave conditions at the terminal are represented by normalized significant wave heights. Concepts 1A and 2 breakwaters were modeled as shown in the conceptual-level sketches; however, Concepts 3 and 4 were later modified by others (shift in the berthing location) after the wave protection modeling had been performed. Breakwaters were not optimized based on either the original results (Concepts 1A and 2) or recent changes to the alternatives (Concepts 3 and 4). Wave protection should be optimized for the preferred alternative during preliminary design. Based on results of the analysis and previous simulations, it is likely that each of the four concepts reviewed could be optimized to achieve an adequate level of wave protection. Wave protection criteria for optimization of performance should also be further refined during preliminary design.

3.1.4 Terminal Electrification for Electric Ferry Vessel

Based on input provided by PG&E, direct charging at the Pier is not feasible due to peak loading requirements. However, some form of local land-based battery storage could be utilized to reduce the peak loading on the system. See Appendix F for details.

3.1.5 Summary of Design Parameters for Waterside Concepts

The study included a feasibility-level review of utilizing a pile-supported structure as a replacement public pier that also serves as an access point to the ferry facility. The new pier would replace the existing structure and meet current seismic performance requirements per current code. The pier would serve a dual purpose – provide recreational and viewing opportunities for the public and also be used for access to the passenger ferry facility from landside. The facility (access ramp, pier, weather shelters, ferry float and gangway) would be a permanent structure with an anticipated service life of 50 years.

The study also included a description of requirements for a ferry berthing facility. The segment of the dual-purpose pier serving the ferry facility, including the landside abutment, pier approach (access ramp from shore), and ferry float will be designed as an "Essential Facility". An "Essential Facility" level of performance would allow the facility to remain operational following a Design Earthquake (DE) event.

3.2 Waterside Conceptual Alternative Development

3.2.1 Conceptual Dual-Purpose Pier

GHD reviewed the feasibility of utilizing a pile-supported structure as a public pier serving as an access point to the ferry facility. The new pier would replace the existing structure and may include steel and concrete elements. The new structure would meet current seismic performance requirements per the current California Building Code (CBC.) The pier would serve a dual purpose – provide recreational and viewing opportunities for the public and also be used for access to the passenger ferry terminal from landside. The terminal (access ramp, pier, ferry float and gangway) would be a permanent structure with a minimum service life of 50 years.

Concepts for the dual-purpose pier were based on the concepts developed in GHD's 2018 Municipal Pier Structural Assessment report. The new pier could utilize either monopile or dual pile bents, constructed using either steel pipe or precast concrete piles, with cast-in-place concrete pile caps and precast concrete deck panels.

The pier could include a wind shelter and sunshade structure for the ferry passenger waiting area. A security gate would be located at the entrance to the gangway. There would also be a pass-through area for recreational pier users and public access to the remaining areas of the pier.

An approach and ramp would be required at the shore end of the pier to provide secure and safe entry from the land to the recreational pier and ferry terminal access gangway. The new pier would require a higher deck elevation than the existing pier due to anticipated higher water levels in the future. To allow for ADA-access from the landside, it may be necessary to use a fixed steel or concrete ramp with a maximum 8.33% slope. The ramp could be supported on the shore by an abutment at the pier approach. Subsurface investigation is required to see if soil strengthening is needed at this location to mitigate liquefaction or lateral spreading of soft soil layers during a seismic event. The soil improvements could consist of deep soil mixing (DSM), a technique using grout mixed with the in-situ soil to create material that has higher strength and is less vulnerable to vertical or lateral displacement produced by a seismic event.

The ferry float would be located away from the pier alignment at a distance from shore to provide sufficient depth for the ferry vessels and float. The abutment would be located on the shoreline at Seawall Drive and would consist of a concrete abutment supported on steel or concrete piles. The conceptual pier would consist of a precast or cast-in-place concrete structure and supported on 36-inch diameter steel piles or 24-inch square precast piles with a perimeter guardrail.

The finished deck surface would have an elevation of approximately +17 feet MLLW. The pier could be partially covered by a weather canopy for ferry passengers and the public. The pier may have a widened segment to serve as a passenger waiting area and include benches and educational interpretive signs to enhance the waiting area for ferry passengers. It is recommended that these sections of the dual-purpose pier be sufficiently wide to allow for two lines of passengers embarking and room for passengers disembarking. While benches are not necessary on the pier for boarding passengers, they may be required by permitting agencies, which would limit the usable width of the pier, making it difficult to queue people boarding and allow passengers to disembark. The pier would be open to the public at all times (a security gate would be installed at the top of the gangway and closed when the terminal is not in use).

The segment of the dual-purpose pier serving the ferry terminal, including the landside abutment, pier approach and ferry float, should be designed as an "Essential Facility". An "Essential Facility" level of performance will allow the facility to remain operational following a Design Earthquake (DE) event. This is a WETA requirement for their San Francisco Bay Area terminals. The seismic performance requirements for an Essential Facility are increased over those for a recreational pier.

Review of water levels during concept design produced a new pier deck elevation of approximately 17 feet MLLW to accommodate future SLR. The shoreline grade near Seawall Drive is approximately EL +10 feet MLLW. The pile-supported pier may have a 1:12 sloped transfer section to provide a smooth, accessible transition from the shoreline to the pier deck.

3.2.2 Conceptual Ferry Berthing

The ferry float at the conceptual terminal for a double berth configuration was envisioned to be 135 feet in length and 42 feet wide (beam). Float construction is typically steel or concrete. Steel has been a common choice in San

Francisco Bay in the past, as the local shipyards generally favor barge fabrication methods. However, more recently, concrete floats have been used in greater number as local fabrication facilities become available and concrete construction methods familiar.

A steel float is fabricated similar to standard barge construction using welded steel plates, angles and other steel sections. The ferry float may be fabricated with steel using barge construction or as a concrete pontoon. WETA has been using a standardized steel float as there is a spare float that is installed for temporary use during maintenance dredging at the ferry terminals.

The ferry float would serve a number of functions, including providing support for the gangway and platforms that allow passengers access to the ferry vessels. The float would be equipped with marine fenders and provide moorage for vessels. The float would support various utilities that serve the vessels and provide safe access for the passengers.

Internal ballast would be used to trim the float to adjust for vessel freeboards and for off-center loading on the float, such as the platforms and access gangway load reaction. The float compartments would be divided by watertight bulkheads and could be foam–filled to provide buoyancy in case one of the compartments is damaged by vessel or debris impact. The float internal compartments can be designed to accommodate battery storage for the electric ferry vessels. The float stability would be reviewed for additional ballast provided by the batteries.

Vertical fenders and mooring cleats would be located around the perimeter of the float to accommodate vessel berthing. The float would be held in position with a preliminary arrangement of four steel pipe guide piles and an addition two steel fender piles, totaling six piles. The guide piles would be attached to the float by collars that allow the float to move up and down with the tide. Ultra-high molecular weight (UHMW) pads would allow the collars to move along the pile surface without binding.

The fender piles would serve as protection to both the float and the vessel should the ferry lose navigation nearing the float. “Donut fenders” (fenders that move up and down on the vertical fender piles) would be located near the float for additional protection against vessel impact.

Stability analysis would be conducted where the rectangular float prism is reviewed, and the metacenter (GM) calculated to determine if the floating body is stable. The difference in height between the float’s center of gravity and GM is a measure of stability of a floating body. High GM values are more stable than low values.

A gangway would provide access from the widened pier section to the ferry float. The float end of the gangway would have wheels or guides to allow backward and forward movement of the float with varying tide levels and wave motions. The pier end of the gangway would be designed to allow movement of the float in the lateral direction. The gangway would be hinged at the pier connection to allow rotation with tide levels.

3.2.2.1 Float Design

Steel floats are typically fabricated in a similar manner to material and equipment barges, with bulkhead frames used along with stiffened keel, hull and deck plates. Steel floats are generally simple to modify and attach elements to (fenders, mooring cleats, platform supports, etc.) by welding. The floats can also be reconfigured easily. However, steel floats are susceptible to corrosion in the marine environment and must be coated with a high-build marine epoxy and have a passive cathodic protection system consisting of anodes attached to the steel hull. A steel float will need to be removed from the water approximately every ten years for cleaning, recoating and replacement of anodes. Dive inspections could be conducted to determine the condition of the float and when dry dock service would be required. A means to temporarily suspend the gangway may also need to be provided. This operation requires that service be disrupted and that a temporary float be available to continue ferry service.

Preliminary analysis shows that the draft of a steel float at the Berkeley Ferry Terminal site would be approximately 6 feet. With 3 feet of freeboard, this produces a total float depth of 9 to 10 feet.

Steel float hull construction offers the following advantages:

– Expected to be lower cost than concrete for moderate to smaller size floats and limited order quantities
– Easier to modify
– Conventional shipyard methods for construction and maintenance apply (bulk cargo barges, etc.)
– Damage to hull is easier to repair
– Longer track record of steel floats and barges being fabricated locally

3.2.2.2 Recommended Float Option

Because of the relative ease of barge construction, a steel superstructure on a low-freeboard (approximately 3 foot) steel float is the preferred configuration. The superstructure could be modified in the future as vessels and boarding freeboards change over time and the steel float structure could accommodate modifications (adding mooring cleats and fenders). A long service life would be provided, assuming periodic inspection and dry dock maintenance (marine growth removal, anode replacement and recoating.) Removal of the float from the terminal for dry docking would cause ferry schedule disruptions if a temporary float were not available. WETA's ability to use their spare float would reduce disruption to the schedule.

Future maintenance costs would include towing the steel float from the terminal, dry-docking, coating removal, recoating and anode replacement. It is estimated that a steel float would require this service at approximately ten-year intervals.

For construction of the ferry terminal, fabrication of the steel float and gangway are typically completed off-site. The pile-supported pier, abutment and ramp would be completed before the arrival of the float and gangway. With the pier completed, the float would be brought in and located in position. This would involve installing the guide piles for the float, possibly using the collars as pile guides and the dolphin fender piles at the end of the float, as the crane barge and equipment would be at the site. Once the float is in position, the gangway would then be placed using the crane. Utilities would then be connected. The in-water work (float installation with piles and gangway) would be completed within one environmental work season (typically June 1st to November 30th). Other work on the pier or float deck could be completed outside of the work window.

3.2.3 Conceptual Ferry Facility Gangway

Concerns regarding the impact of SLR require that new fixed piers be constructed at increasingly higher elevations. This requires longer gangways to allow vessel boarding at very low tidal conditions to remain within the 1:12 slope limits required for conformance with Section 4.8 (Ramps) of the Americans with Disabilities Act Design Guidelines (ADADG) and CBC Chapter 11.

While the ADADG and CBC Section 11V-1003 provide guidance for recreational boating facilities, they do not specifically cover passenger vessels. The United States Access Board has developed proposed accessibility guidelines for passenger vessels.

Section 4.10 of the proposed guidelines covers gangways but does not include exceptions for allowable exceedance of the 1:12 gangway slope limit at extreme tidal conditions. The proposed guidelines do have an exception for gangways exceeding 120 feet. The scoping requirements in Section 208.1 indicate that accessible boarding systems need to be installed when required by the Department of Transportation (DOT) or the Department of Justice.

3.2.3.1 Water Elevations

Water level elevations in the design are based on the tidal information for Berkeley, CA (NOAA Station ID 9414816), for the tidal epoch 1983-2001, as shown in the Table 3-7 below, excerpted from the Berkeley Pier Structural Assessment Study. The project datum is MLLW.

Table 3-7 Water level elevations

Water Level	MLLW Elevation (feet)
Highest Astronomical Tide (HAT)	7.6
Mean Higher High Water (MHHW)	6.1
Mean Lower Low Water (MLLW)	0.0
Lowest Astronomical Tide (LAT)	-2.1

3.2.3.2 Pier Deck Elevation and Float Freeboard

Fixed Pier Elevation: Base flood elevation and SLR projections for the Berkeley Pier were reviewed to determine that the +17'-0" MLLW pier deck elevation would accommodate escalating SLR predictions.

Float Freeboard: Passenger loading onto ferries occurs via a passenger float that maintains a constant freeboard (height above the adjacent water level). WETA is working to standardize the size and layout of their passenger floats. The standard WETA steel float, passenger float will most likely be used for the Berkeley Ferry Terminal. The float would accommodate two ferry vessels and is 135 feet long by 42 feet wide and is a minimum of 6'-4" deep. The float itself has a freeboard of 3 feet and a raised ramping walkway system that accommodates freeboards of a variety of vessels. The freeboard of the walkway at the bottom of the gangway is typically 8'- 5" (101 inches) above the waterline.

3.2.3.3 Gangway Length at Low Water Levels

Table 3-8 shows the gangway lengths required to achieve a 1:12 maximum slope at low water levels for both MLLW and Lowest Astronomical Tide (LAT) conditions. The chart indicates that while an 82-foot-long gangway is ADA compliant at most low water conditions, a 128-foot gangway would remain ADA compliant at the lowest water condition.

Table 3-8 Gangway lengths required to achieve a 1:12 maximum slope at low water levels

Tide Condition	Elevation Top of Gangway	Waterline	Freeboard at Bottom of Gangway	Height Difference	ADA Gangway Length to Achieve 1:12 Slope
	(feet)	(feet)	(feet)	(feet)	(feet)
Mean Lower Low Water (MLLW)	17.0	0.0	8.416	8.58	103.0
Lowest Astronomical Tide (LAT)	17.0	-2.1	6.316	10.68	128.2

3.2.3.4 Gangway Length Evaluation

In the absence of clear federal guidelines allowing the installation of a gangway with a slope exceeding the 1:12 maximum slope requirement at extreme low water levels, the installation of a 130-foot-long gangway for the Berkeley Ferry Terminal appears to be appropriate. A more detailed analysis could compare the occurrence of extreme low tides with the anticipated ferry service schedule and determine the frequency that a reduced length gangway would be out of the 1:12 slope compliance. Also, if the draft guidelines are adopted as proposed in 2018, the proposed exemption would allow a 120-foot gangway.

Table 3-9 indicates that the slope of the gangway would be essentially flat at high water conditions.

Table 3-9 Gangway slopes

Tide Conditions	Elevation-Top of Gangway (feet)	Waterline (feet)	Freeboard at bottom of Gangway (feet)	Height Difference (feet)	Gangway Slope with 130' Long Gangway (feet)
Mean Higher-High Water (MHHW)	17.0	6.1	14.516	2.48	1.9% Downwards
Highest Astronomical Tide (HAT)	17.0	7.6	16.016	0.98	0.8% Downwards

3.2.3.5 Security Gate

A security gate for the ferry facility could be provided at the top of access gangway. This will be reviewed with WETA and refined during preliminary design. The gate could be located to allow a portion of the pier to provide cover for queuing passengers while maintaining public access to all of the pier area. The ferry facility would be unmanned, and the gate would be opened and closed by the ferry boat crew. A security alarm and camera may be provided at the gate.

3.2.4 Waterside Concepts

3.2.4.1 2018 Option A – Ferry Facility on Existing Pier Alignment

The feasibility study started in 2018 and included the review and development of two alternatives for the dual-purpose pier and ferry facility. Option A shows a terminal location positioned on the south side of the existing pier and orients the ferry terminal parallel with the existing pier, which has an orientation of 246 degrees (true north).

Option A (2018), as initially sketched, requires removal of approximately 400 feet of the existing pier. A “spur pier”, or dogleg in the pier, is recommended in order to provide adequate space between the float and the pier for safe maneuvering during energetic winds and waves. The length of the spur segment and the gangway could both be modified as long as the distance between the pier and the float remains sufficient.

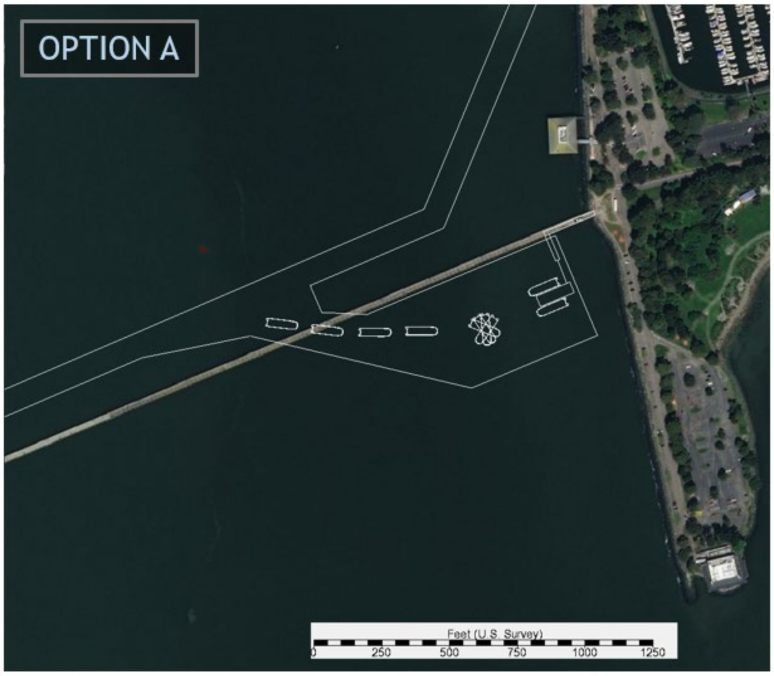


Figure 3-19 **2018 Option A ferry terminal concept, located on south side of existing pier alignment**

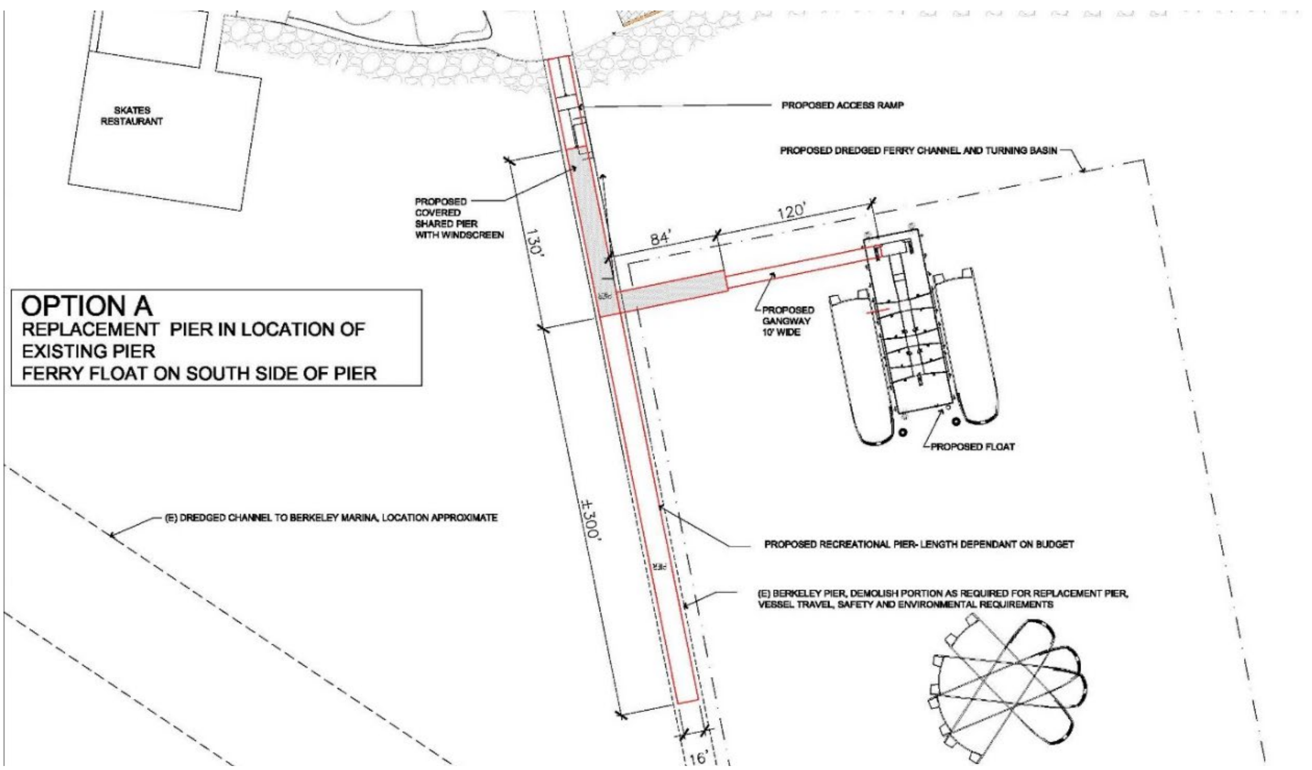


Figure 3-20 **2018 Option A ferry terminal at existing Pier alignment**

3.2.4.2 2018 Option B – Ferry Facility at South Pier Location

The 2018 study also included an Option B, with the dual-purpose pier positioned south of the existing pier, along a new pier alignment, allowing the ferries to easily turn off the Marina entrance channel and minimize small craft conflicts in this area.

Option B (2018) also requires removal of approximately 400 feet of the existing pier, and has a very similar “spur pier”, or dogleg in the pier, for safe maneuvering during energetic winds and waves. As with Option A, the length of the spur segment and the gangway could both be modified as long as the distance between the pier and the float remains sufficient.

Figure 3-21 **2018 Option B ferry terminal at new South Pier location**

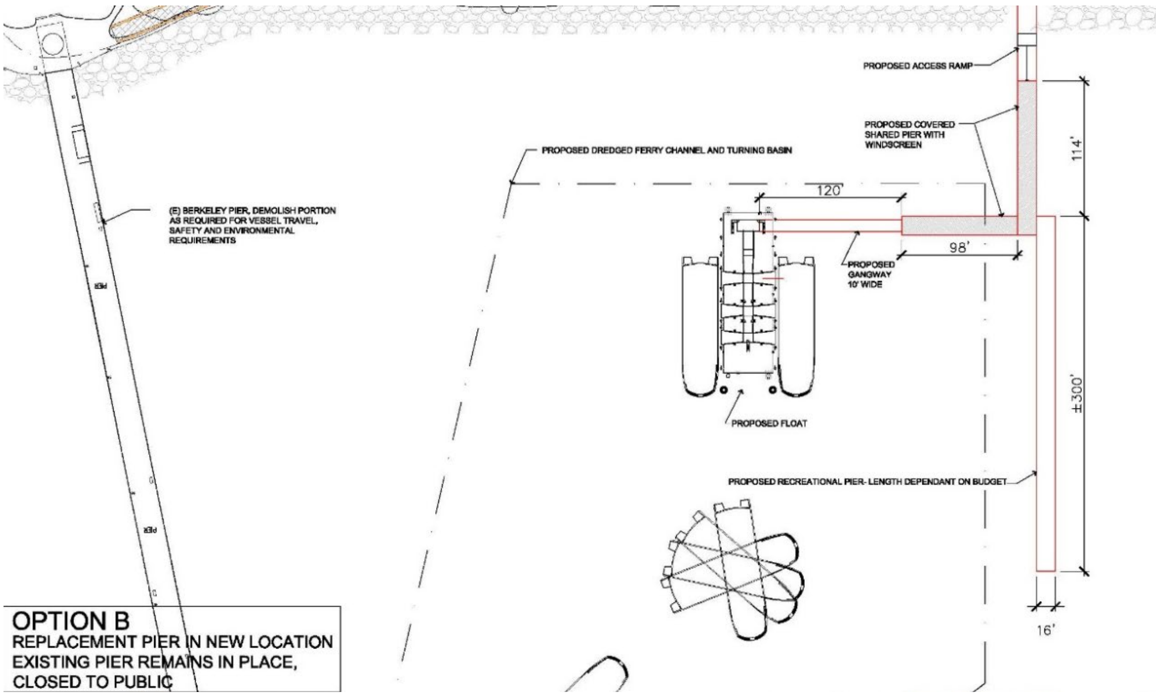


Figure 3-22 **2018 Option B Ferry terminal at new South Pier location**

3.2.5 Refined Pier and Ferry Facility Concepts

In 2020 and 2021, Options A and B were further refined using public feedback from the Community Workshops and meetings with the City and WETA. The refined options and additional conceptual options, shown in Figure 3-23 below, were developed based on the input received. The concept configurations were further refined to the Concepts shown in Figure 3-24 as the study progressed using feedback received; the refined concept configurations were renumbered to avoid confusion with the previously presented concepts. The configurations presented illustrate the pier location and geometric shape at a conceptual level. We note that the actual elements of the dual-purpose pier will be developed during design development during the next stage of the project.

Figure 3-23 **Dual-purpose pier and ferry configuration concepts**

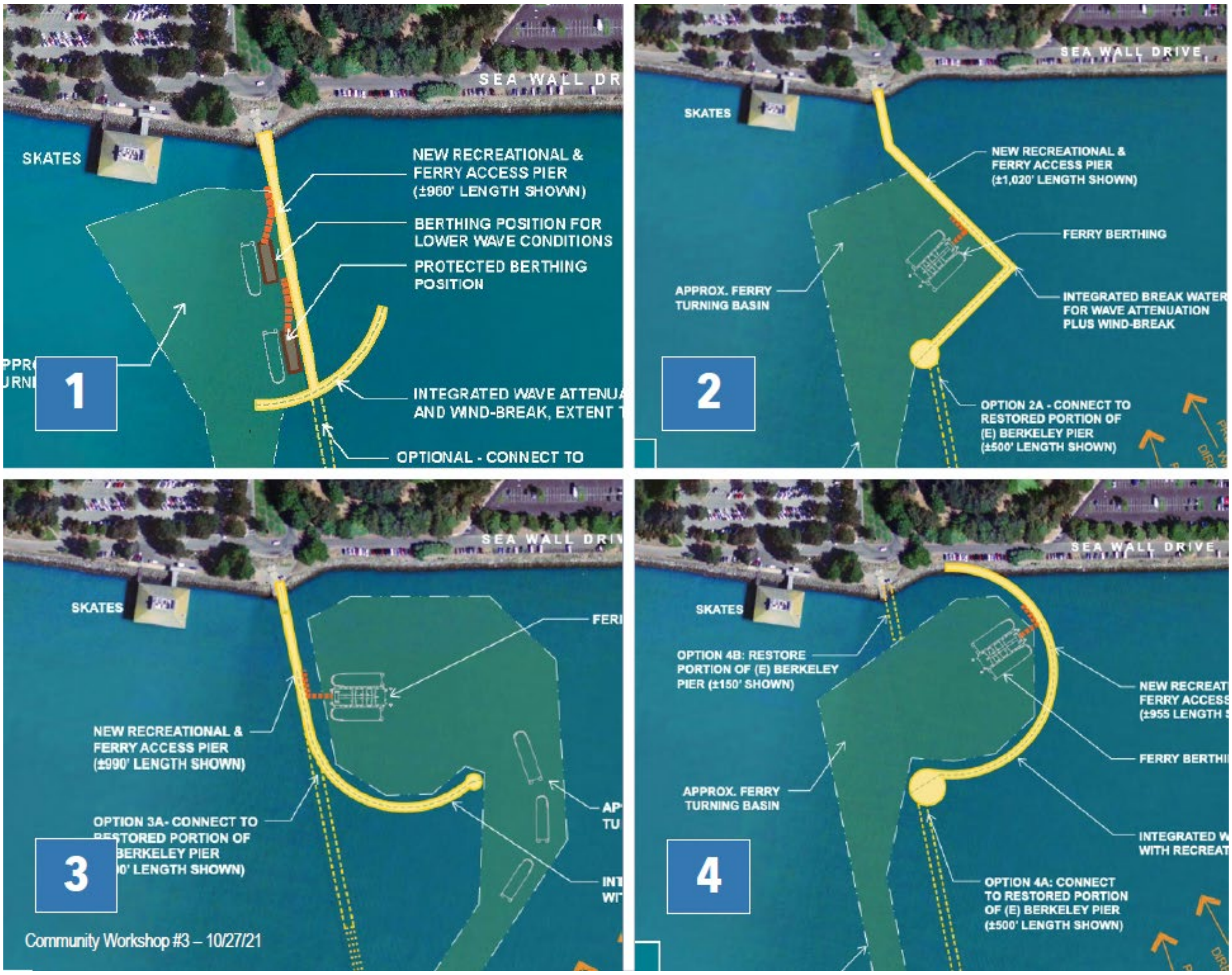


Figure 3-24 **Dual-purpose pier and ferry configuration concepts – refined**

3.2.5.1 Concept 1: “Sword” Configuration

Concept 1 “Sword” option replaces a segment of the ‘red-tagged’ Berkeley pier with a new pier structure. As shown in Figure 3-25, two options were considered: Concept 1A retains the existing pier alignment, while Concept 1B moves the pier alignment south, which would allow for restoration of a portion of the existing pier. An ADA-compliant ramp leads from a shoreside plaza to the new pier deck, which will be elevated to accommodate future SLR. The linear pier segment comprising the dual-purpose segment provide passenger access to the security gates for the ferry facilities. The public may also continue to the wave attenuation (breakwater) walkway or to the recreational pier segment beyond the breakwater. The vertical breakwater creates a calm harbor for berthing and mooring of the ferry vessels. Fishing and other recreational uses are accommodated on the southside of the dual-purpose pier, along the breakwater walkway or along the recreational pier.

If desired, a section of the original pier beyond the dual-purpose segment area could be restored for public use and accessed via a ramp sloping down from the replacement pier deck.

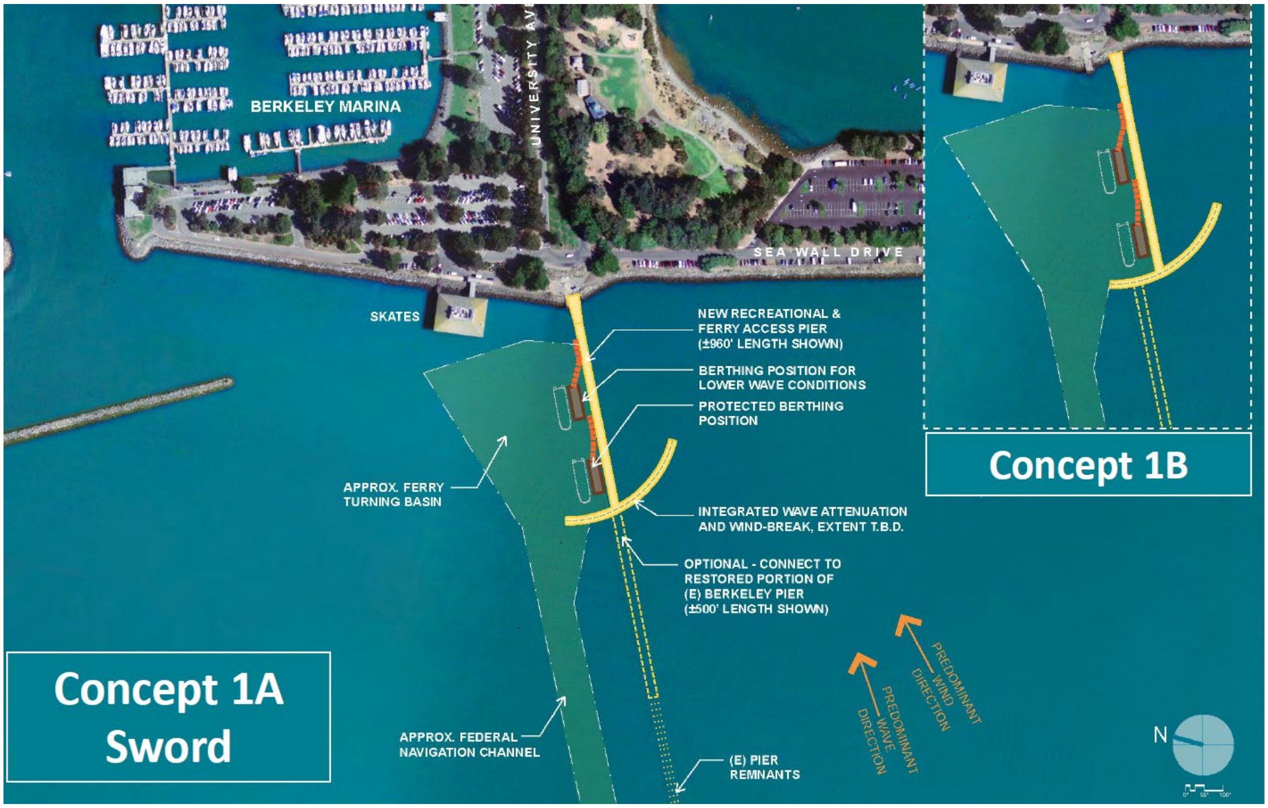


Figure 3-25 **Concept 1A/1B – Sword Configuration**

3.2.5.1.1 Wave Protection

Wave protection analysis was conducted for Concept 1A, see Figure 3-26 below. The analysis served to develop the wave barrier configuration shown in the figure. The barrier may consist of a solid vertical breakwater using steel or concrete sheet piles.

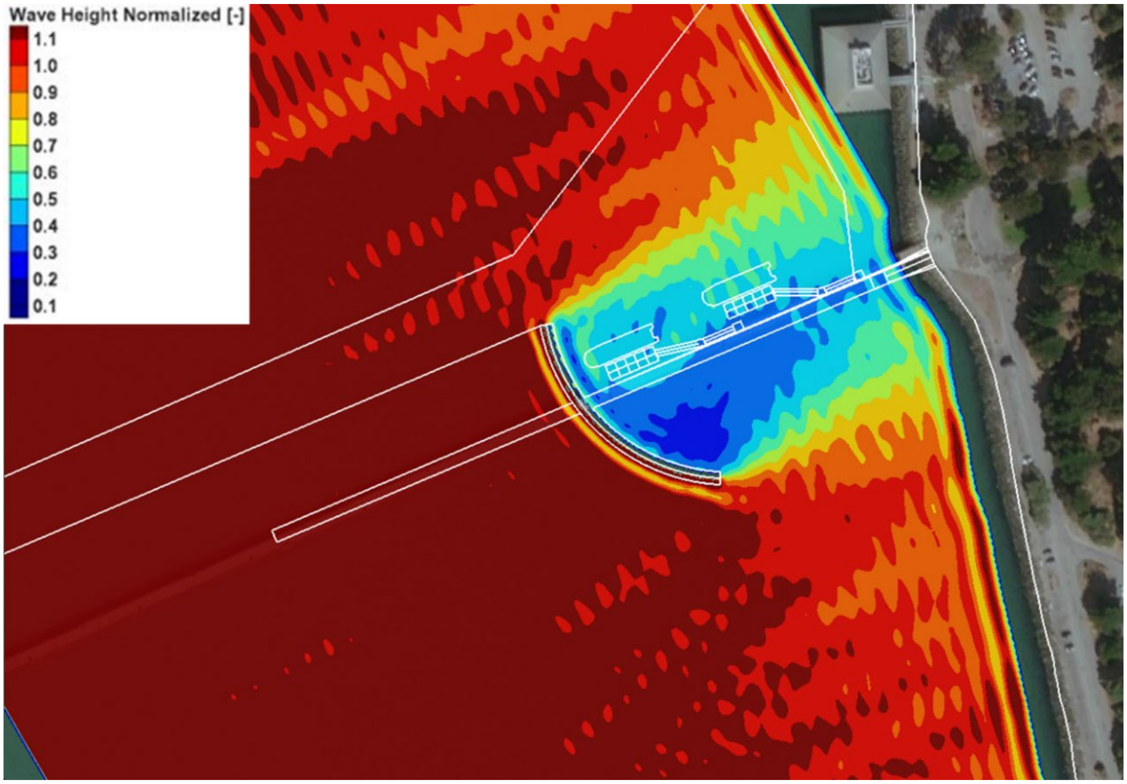


Figure 3-26 **Concept sketch for Concept 1A relative wave protection (normalized significant wave height) for 4-second southwest waves**

3.2.5.1.2 Concept 1A/1B Waterside ROM Cost Estimate

The planning-level cost estimate for Concept 1A/1B waterside improvements is approximately $70M.

3.2.5.2 Concept 2: "Dog Leg" Configuration

The "Replacement Pier" replaces a segment of the 'red-tagged' Berkeley pier with a new pier structure (see Figure 3-27). An ADA-compliant ramp would lead from land to the new raised pier deck, which will be elevated to accommodate future SLR. After the straight section, the pier turns to the west at a right angle. A vertical breakwater located below the pier sections creates a calm harbor for ferry vessels. Fishing and other recreational uses are accommodated on the north and west sides, for the entire length of the pier.

If desired, a section of the original timber pier beyond the replacement area could be restored or replaced with a new pier section for public use and accessed via a ramp sloping down from the replacement pier deck.

Figure 3-27 **Concept 2 – Dog Leg Configuration**

3.2.5.2.1 Wave Protection

Wave protection analysis was conducted for Concept 2, see Figure 3-28 below. The analysis served to develop the wave barrier configuration shown in the figure. The barrier may consist of a solid vertical breakwater using steel or concrete sheet piles.

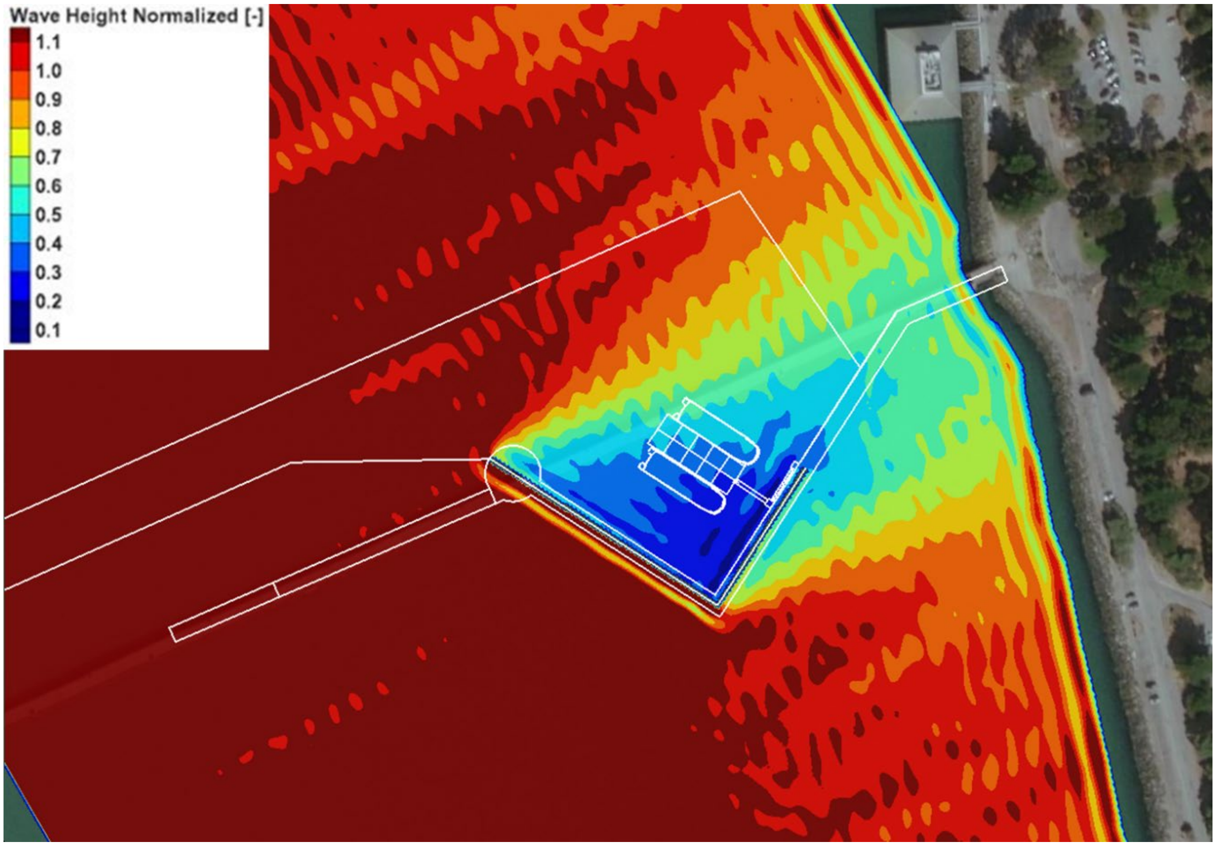


Figure 3-28 Concept sketch for Concept 2 relative wave protection (normalized significant wave height) for 4-second southwest waves

3.2.5.2.2 Concept 2 Waterside ROM Cost Estimate

The planning-level cost estimate for Concept 2 waterside improvements is approximately $82M.

3.2.5.3 Concept 3: "Fish Hook" Configuration

The "Replacement Pier" replaces a segment of the 'red-tagged' Berkeley pier with a new pier structure (see Figure 3-29). An ADA accessible sloping ramp would lead from land to the new raised pier deck, which will be elevated to accommodate future SLR. After the 400-foot-long straight section, the pier curves southward. A vertical breakwater located below the curving pier section creates a calm harbor for ferry vessels. Fishing and other recreational uses are accommodated on the north and west sides for the entire length of the pier.

If desired, a section of the original timber pier beyond the replacement area could be restored for public use and accessed via a ramp sloping down from the replacement pier deck.

Figure 3-29 **Concept 3 – Fish Hook Configuration**

3.2.5.3.1 Wave Protection

Wave protection analysis was conducted for Concept 3, see Figure 3-30 below. The analysis served to develop the wave barrier configuration shown in the figure. The barrier may consist of a solid vertical breakwater using steel or concrete sheet piles.

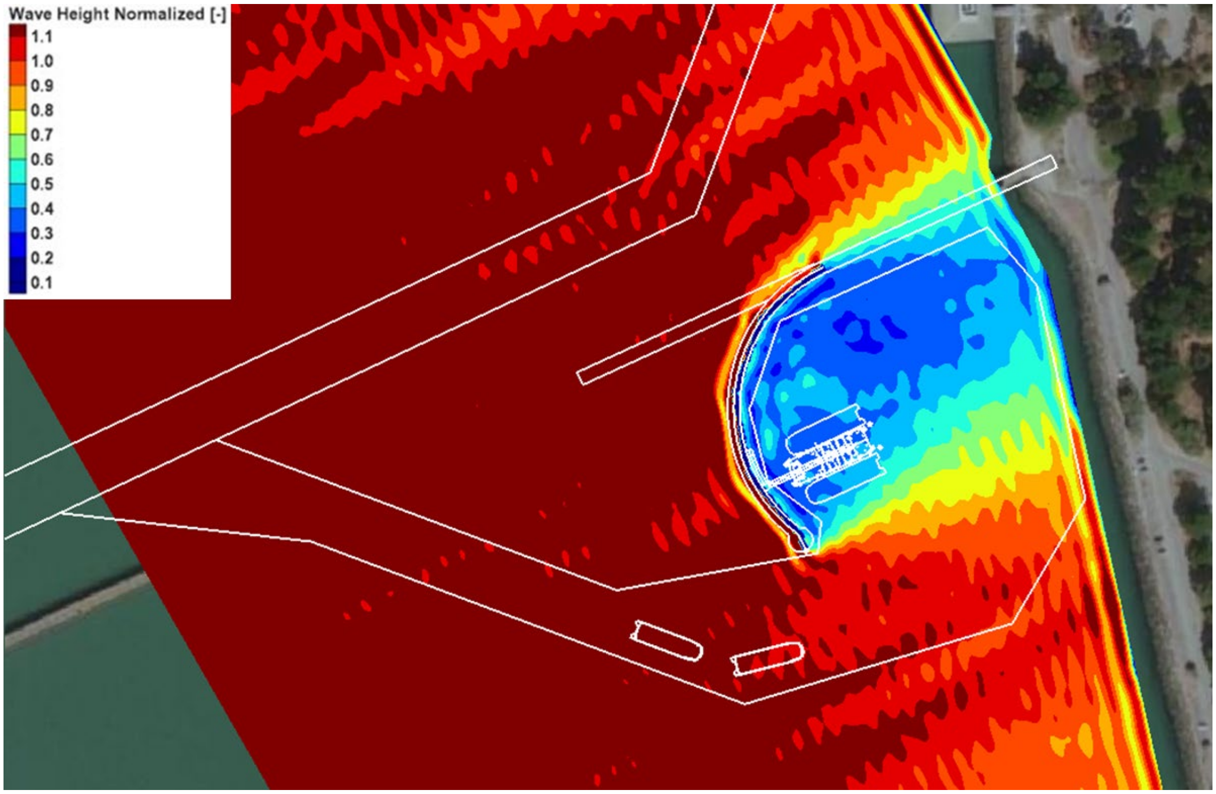


Figure 3-30 Concept sketch for Concept 3 relative wave protection (normalized significant wave height) for 4-second southwest waves

Note: the float location was moved in the most recent iteration of Concept 3 but is not shown in the modeling results above.

3.2.5.3.2 Concept 3 ROM Waterside Cost Estimate

The planning-level cost estimate for Concept 3 waterside improvements is approximately $89M.

3.2.5.4 Concept 4: "Circle" Configuration

The "New Circular Pier" alternative is comprised of a 915-foot-long arc curving to the south to provide optimum views of the Bay Bridge and the San Francisco skyline beyond. A breakwater located below the pier provides a calm harbor inside the circle for ferry vessels. The entire outside of the circle provides space where fishing or other recreational activities can occur without potential interference with ferry vessels. Ferry vessels enter the circular 'harbor' directly from the Berkeley Marina Channel, minimizing dredging of undisturbed bay floor.

If desired, a 100 to 200 foot long section of the original Berkeley Pier can be restored and integrated as part of this alternative.

Figure 3-31 **Concept 4 – Circle Configuration**

3.2.5.4.1 Wave Protection

Wave protection analysis was conducted for Concept 4, see Figure 3-32 below. The analysis served to develop the wave barrier configuration shown in the figure. The barrier may consist of a solid vertical breakwater using steel or concrete sheet piles.

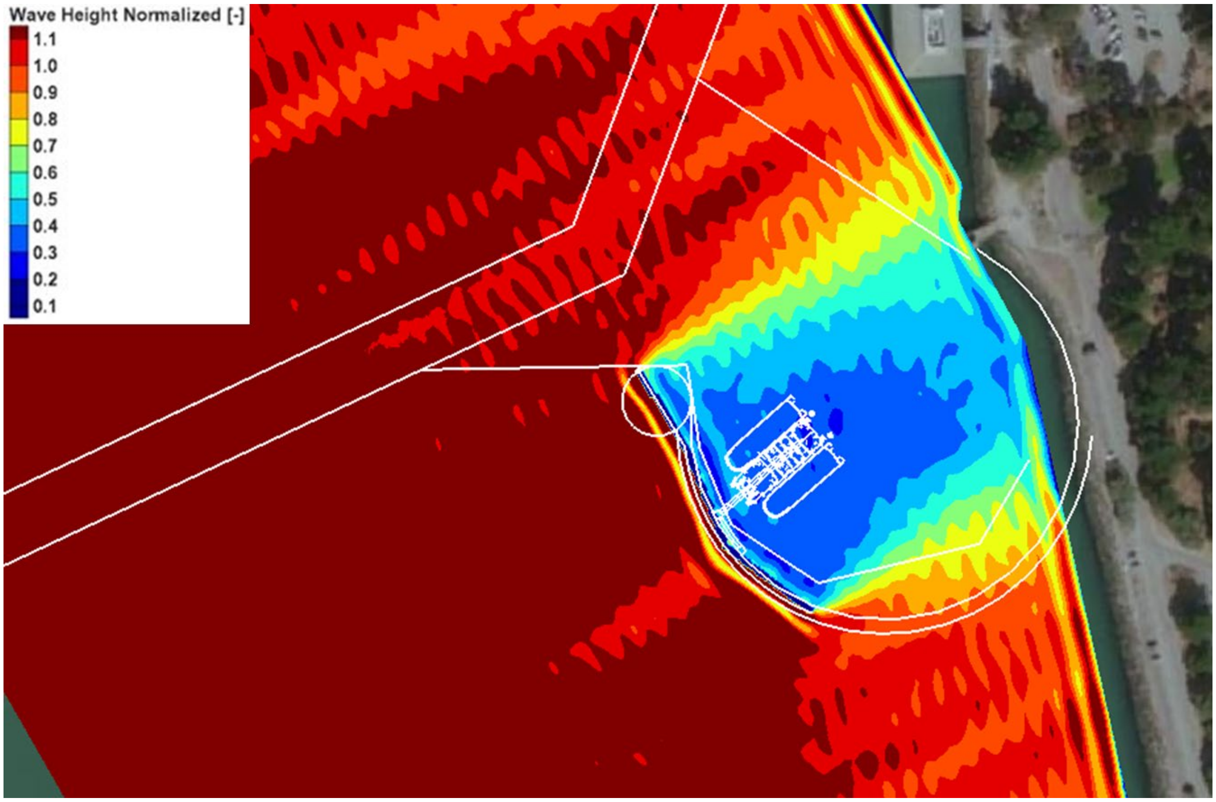


Figure 3-32 Concept sketch for Concept 4 relative wave protection (normalized significant wave height) for 4-second southwest waves

Note: the float location was moved in the most recent iteration of Concept 3 but not shown in the modeling results. If Concept 4 is selected, the under-pier breakwater in Concept 4 should be extended to provide better protection in the new berthing area

3.2.5.4.2 Concept 4 ROM Waterside Cost Estimate

The planning-level cost estimate for Concept 4 waterside improvements is approximately $91M.

3.3 Preferred Waterside Conceptual Design Evaluation Considerations

The following criteria, based on community feedback, capture the qualities of and activities available at the waterfront that the Berkeley community value. These criteria provide a helpful planning tool to guide selection and refinement of a dual-purpose pier and ferry facility that is responsive to the community's values.

3.3.1 Evaluation Considerations

3.3.1.1 Implementation

1. Limits dredging requirements.
   - Requires reduced bay floor material to be removed for a navigation channel for ferry access.
2. Allows for cost-effective, time-efficient construction.
   - Optimizes location, shape, configuration, size and footprint for cost-effective construction.

3. Incorporates green infrastructure technology.
    - Opportunity to use photovoltaic panels within pier deck or on wind shelter roof.

3.3.1.2 Ferry Operations

1. Allows for efficient electric vessel operation.
    - Minimizes maneuvering effort and time for docking and loading.
2. Maximizes vessel maneuverability.
    - Provides safe conditions for the public, passengers and ferry personnel.
3. Maximizes protection from wind and waves.
    - Provides shelter from waves and allows vessel mooring with bow facing prevailing winds.

3.3.1.3 Visual & Placemaking

1. Provides for a positive overall pier experience.
    - Provides observation points of Golden Gate, San Francisco, Angel Island and Marin.
    - Creates a comfortable, safe, attractive environment for ferry, recreational and passive uses.
2. Relates to and is reminiscent of the former pier.
    - Retains an historical link to the former pier for one or more qualities related to the former pier: siting/location, geometry/proportions, experience, or reuses a portion of the old pier.
3. Harmonizes with the existing waterfront aesthetics and experience.
    - Creates a landmark and destination for the community and visitors without disrupting existing use patterns or the community's historical relationship with the waterfront.

3.3.1.4 Recreation: On-Pier & In-Water

1. Allows for unimpeded access for recreational users.
    - Design offers sufficient width to accommodate passengers queuing-up and boarding the ferry while not impacting recreational users.
2. Offers sufficient space for multiple active and passive recreation uses.
    - Pier length – beyond ferry-queuing area offers sufficient space for active and passive uses.
3. Limits potential ferry conflicts with marina boating.
    - Limits potential ferry conflicts with boats leaving the inner harbor to the north.
4. Limits potential ferry conflicts with watersports activities.
    - Limits potential conflicts with recreational watercraft and watersports at the southern end of peninsula.

3.3.2 Outcome of Evaluation & Community Feedback

Table 3-10 Summary and ranking of evaluation criteria

		1	2	3	4
		Sword	Dog Leg	Fish-Hook	Circle
Implementation	– Amount of dredging – Constructability – Green infrastructure	More Preferable	Less Preferable	Less Preferable	Less Preferable
Ferry Operations	– Wind/wave protection – Vessel maneuverability – Avoid potential conflicts with recreation watercraft	More Preferable	Less Preferable	Less Preferable	Less Preferable
Visual & Placemaking	– Overall pier experience – Harmony with former pier – Consistency with waterfront culture/experience	More Preferable	Less Preferable	Less Preferable	Less Preferable
Recreation: On-Pier	– Unimpeded access for fishing, walking, recreation – Length of pier for fishing, walking, recreation – Bay views and experience	More Preferable	Less Preferable	Less Preferable	Less Preferable
Recreation: In-Water	– Reduced conflicts with marina boating – Reduced conflicts with watersports – Reduced pier and ferry operation footprint	More Preferable	Less Preferable	Less Preferable	Less Preferable

3.4 Preferred Waterside Concept

Reviewing the results of the ranking summarized above, Concept 1 is shown to be the preferred waterside alternative with a ROM construction cost of $70M. Concept 1 provides the following pier attributes:

- Concentrated ferry parking to one location and utilizes the TDM method to reduce the number of vehicles driving to and parking in the waterfront specifically for ferry access
- Preserves prime seawall parking for public use
- Preserves parking for existing users
- Re-uses the existing parking lot at 199 Seawall drive
- Incorporates new recreational facilities
- The ferry terminal components of Concept 1 would include ferry berthing floats, float piles, ADA gangways, and security gates.

4 Conceptual Design Development Process: Landside

4.1 Basis of Design Considerations for Landside Concepts

The landside project component is defined as the shoreside improvements that complement and enhance the dual-purpose pier and ferry facility. These conceptual improvements include parking, ferry passenger drop-off area, bike lockers, restroom, fish cleaning tables, public plaza and events space, and non-powered watercraft launch.

The feasibility study reviewed how people access and circulate through University Avenue and the Berkeley Marina area and considered modes of travel to the pier and ferry facility including pedestrian, bicycle, cars, mass transit, service and delivery vehicles, and emergency vehicles. It addressed TDM measures and identified concepts to address how ferry and visitor parking needs could be accommodated.

New ferry service at the Berkeley Marina would be a valuable travel option between San Francisco and the East Bay but attracting and retaining ferry riders requires convenient and effective transportation options for accessing the service.

Future ferry riders who drive and park at the marina may increase traffic congestion to and from the marina. Alternatively, well-designed bicycle and pedestrian networks and programs that encourage transit use and carpooling are effective non-driving options that bring ferry users to the marina, without generating additional traffic or requiring more parking spaces to be built.

The feasibility study identified TDM strategies that support new ferry service at the Berkeley Marina while minimizing parking demand and the negative impacts of vehicle traffic. Three scenarios were developed to demonstrate different levels of ferry ridership that could be supported based on varying levels of TDM investment and availability of shared parking opportunities. The Ferry Facility Parking and TDM Strategy memorandum can be found in Appendix D. Further study has been performed on parking and ridership as part of the Berkeley Ferry Business Service Plan prepared by WETA.

4.1.1 Parking Demand Evaluation

The GHD team analyzed existing conditions and transportation resources near the proposed ferry facility location and identified preliminary TDM and shared parking opportunities. Based on these conditions and opportunities, the project team developed a baseline mode share and a TDM-supported mode share for future ferry riders traveling to and from the marina. To demonstrate the potential for TDM and shared parking strategies to support increased ferry ridership, the project team analyzed three parking and TDM scenarios.

4.1.1.1 Ridership Forecast

Operational assumptions about future ferry service, including ferry size and schedule, were based on WETA's expected service plan as of January 2020. Ridership estimates were based on prior ridership modeling and analysis completed in 2012. No new ridership modeling or market analysis was conducted as part of this study. Ferry ridership estimates for each scenario and mode share summary are provided in Table 4-1 and Table 4-2 below. Three scenarios were reviewed: baseline, TDM-supported and TDM with additional shared parking.

A. Scenario 1 – Baseline: This scenario includes the baseline mode share (without TDM support) and 250 available parking spaces. The ridership estimate for this scenario is approximately 950 weekday riders.

B. Scenario 2 – TDM-supported: This scenario includes the TDM-supported mode share and 250 available parking spaces. The ridership estimate for this scenario is approximately 1,208 weekday riders.

C. Scenario 3 – TDM-supported with additional shared parking: This scenario includes the TDM-supported mode share and 300 available parking spaces. The ridership estimate for this scenario is approximately 1,449 weekday riders.

4.1.1.2 Ferry Access Mode Split Analysis

The baseline and TDM-supported scenarios were reviewed with different ferry access modes to estimate ridership percentage. The modes included walk, drive alone, bike, carpool, public transit, drop off, employer shuttle, Transportation Network Companies (TNCs) and other.

4.1.2 Key Study Findings

The study identified a range of TDM opportunities that could result in a decrease of 14% in drive-alone rates by incentivizing biking, carpooling, public transit and employer-operated shuttle programs. As a result, the study estimated that TDM strategies could support a 27% increase in weekday ferry ridership relative to the baseline scenario.

– Additional ferry parking, which could be achieved through shared parking agreements with other marina uses, could support an additional 25% increase in weekday ferry ridership.

Table 4-1 Ridership and scenario summary

Scenario	Parking Spaces	Mode Share	Est. Weekday Ferry Riders
Scenario 1: Baseline	250	Baseline	950
Scenario 2: TDM-Supported	250	TDM-Supported	1,208
Scenario 3: TDM and additional parking	300	TDM-Supported	1,449

Table 4-2 Mode share summary

Travel Mode	Baseline Mode Share	TDM-Supported Mode Share	
		Mode Share	Change from Baseline
Walk	3%	3%	0%
Drive Alone	54%	40%	-14%
Bike	18%	22%	4%
Carpool	9%	12%	3%
Public Transit	4%	7%	3%
Drop Off	8%	8%	0%
Employer Shuttle	0%	3%	3%
TNCs	3%	4%	1%
Other	1%	1%	0%

4.1.3 Parking Management and Transportation Demand Reduction Strategies

Currently there are approximately 1,800 parking spaces located throughout the Berkeley Marina. While some of these spaces are restricted for specific marina users or are located far from the proposed terminal location, others are well-suited for shared parking arrangements with weekday ferry riders. The City has previously studied several conceptual parking options near the proposed ferry facility site, including an option that would add on-street parking on University Avenue and Seawall Drive.

The City completed a study of parking supply, demand and management strategies in the Berkeley waterfront in 2018. That study identified a number of recommendations for managing parking more efficiently and balancing the needs of all the different uses and activities in the waterfront. Many of the recommendations could be used to help manage ferry parking, including:

Priced parking, which could help manage parking demand in the most centrally located lots and encourage people to use underutilized lots for longer-term parking. A pricing structure could be designed to allow short-term and medium-term parking free of charge (for example, up to 4 hours) while requiring an hourly or flat rate for all-day parking (including ferry riders).

Expanded parking permit program, which could facilitate shared parking in facilities used by both frequent users (including slip holders and regular ferry riders) and less frequent visitors (including recreational visitors).

Increased enforcement, which could make more efficient use of available supply by preventing long-term parking in violation of posted time limits. Enforcement could be funded in part by revenue from priced parking.

Improved information, which is essential for helping waterfront visitors and ferry riders find available parking and adhere to posted time limits and restrictions.

Ferry parking regulations and management tools should be fully integrated into a waterfront-wide strategy that supports shared parking, minimizes complexity and balances the needs of the many different users and activities.

4.2 Landside Conceptual Alternative Development

The feasibility study included review of two landside options for the preferred Concept 1, Option A – Clustered Parking and Option B – Dispersed Parking. Both options involved the development of an improved area along the southern side of University Avenue for bus stops, shuttle stops, a drop-off zone for rideshare and family vehicles, a restroom, fish cleaning stations and trash cans, improved pedestrian trails and lighting, public plaza and events space, a new access point for no-motorized watercraft, and the shift of the Seawall Drive vista parking zone from the west side to the east side of the road.

4.2.1 Option A – Clustered Parking

Option A consists of ferry parking located along Seawall Drive and the parking lot located south of University Avenue and Seawall Drive near the former HS Lordships Restaurant. Approximately 250 parking spaces would be provided in this lot with an additional 71 spaces along Seawall Drive. ROM construction cost is $14.0M.

Figure 4-1 **Option A – Clustered Parking**

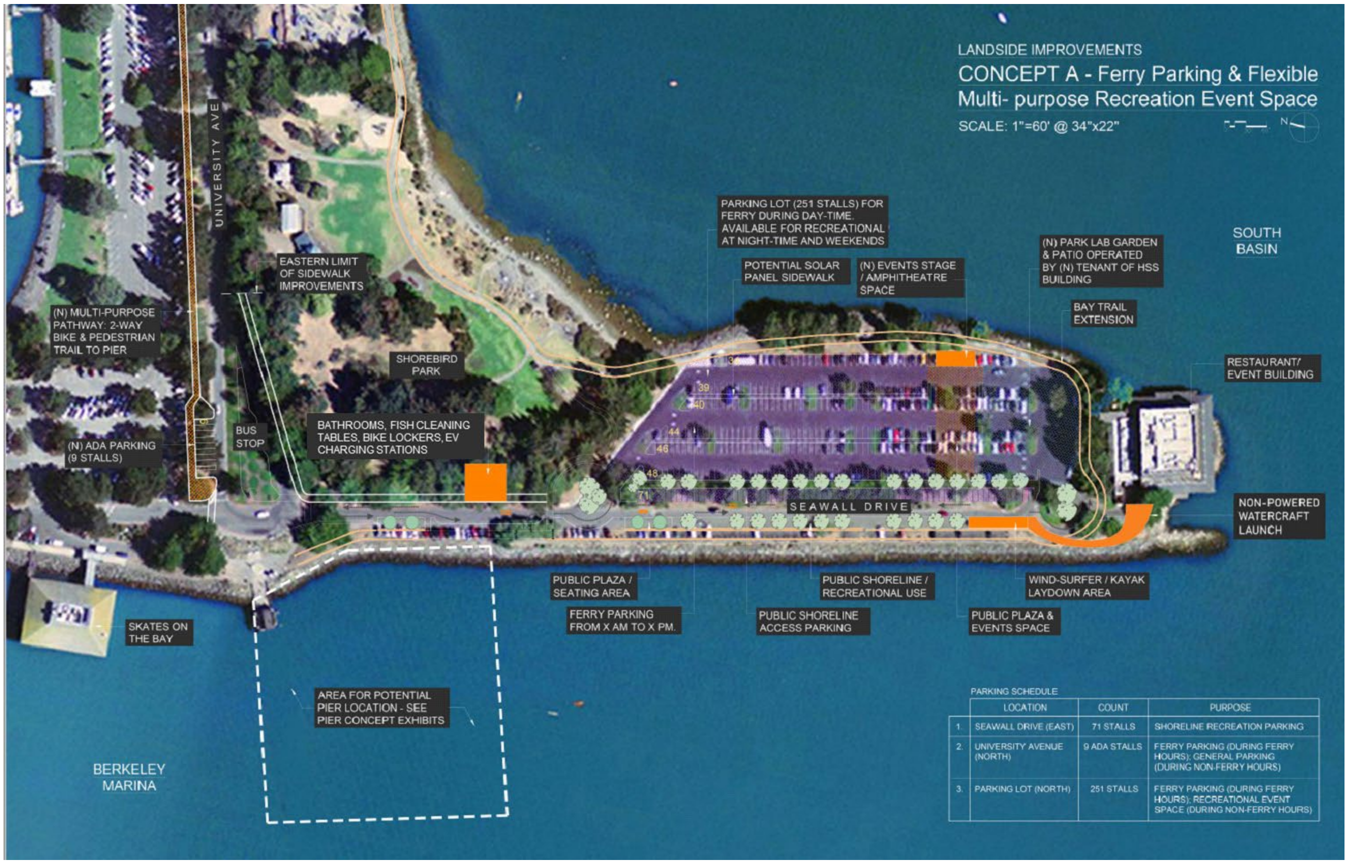


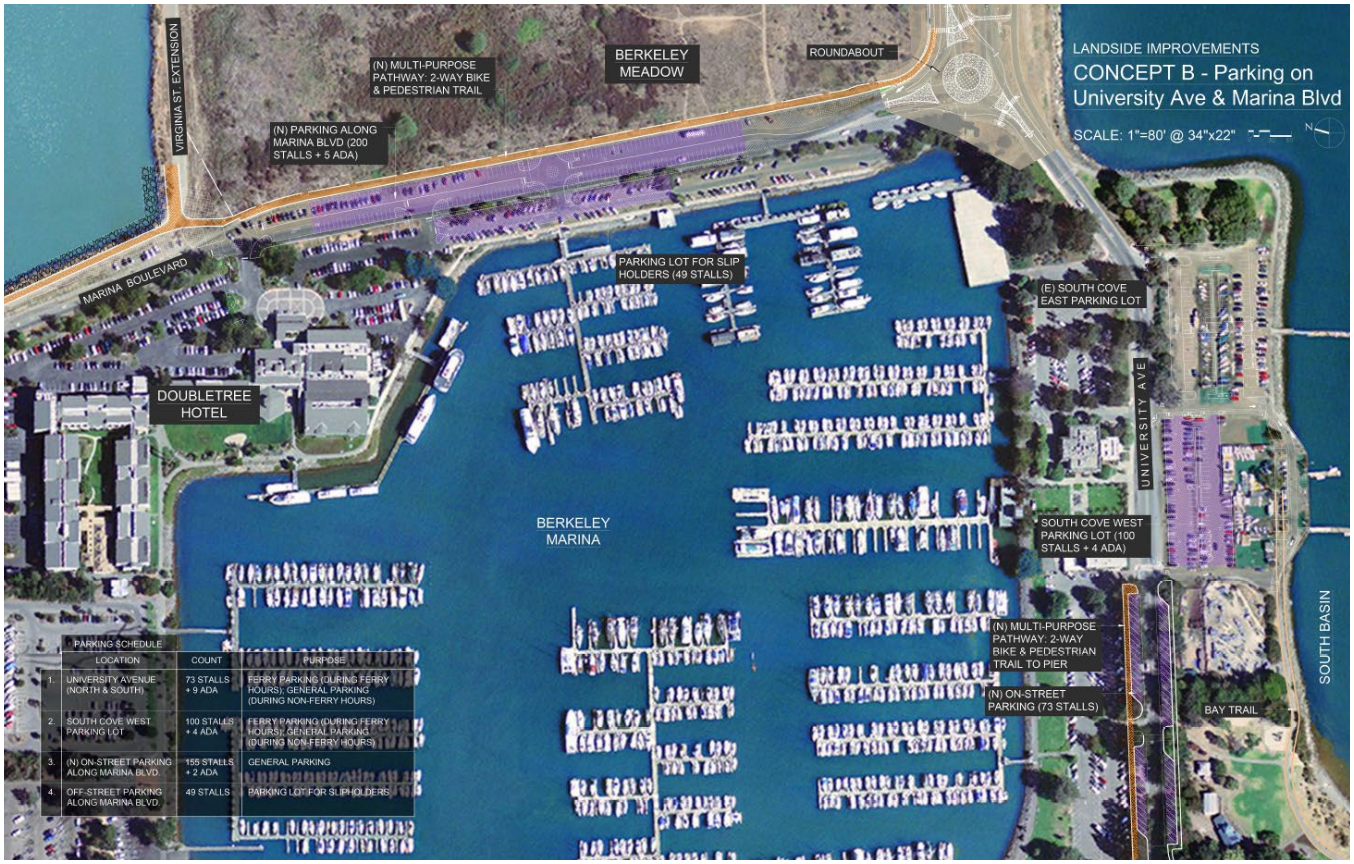
Figure 4-2 **Option A – Clustered Parking**

4.2.2 Option B – Dispersed Parking

Option B consists of ferry parking located along Seawall Drive and along both sides of University Avenue. Approximately 73 stalls for on-street parking would be provided on University Avenue with another 71 spaces along Seawall Drive and approximately 200 spaces along Marina Boulevard. ROM construction cost is $19.5M.

Figure 4-3 **Option B - Dispersed Parking**

Figure 4-4 **Option B - Dispersed Parking**



	LOCATION	COUNT	PURPOSE
1.	UNIVERSITY AVENUE (NORTH & SOUTH)	73 STALLS + 9 ADA	FERRY PARKING (DURING FERRY HOURS); GENERAL PARKING (DURING NON-FERRY HOURS)
2.	SOUTH COVE WEST PARKING LOT	100 STALLS + 4 ADA	FERRY PARKING (DURING FERRY HOURS); GENERAL PARKING (DURING NON-FERRY HOURS)
3.	(N) ON-STREET PARKING ALONG MARINA BLVD.	155 STALLS + 2 ADA	GENERAL PARKING
4.	OFF-STREET PARKING ALONG MARINA BLVD.	49 STALLS	PARKING LOT FOR SLIPHOLDERS

Figure 4-5 Option B – Dispersed Parking

4.3 Preferred Landside Conceptual Design Evaluations Considerations

Criteria based on community feedback were established to capture the qualities of and activities available at the waterfront that the Berkeley community value. These criteria provide a helpful planning tool to guide selection and refinement of a landside plan that is responsive to the community's values and complements the pier and ferry facility.

4.3.1 Evaluation Considerations

4.3.1.1 Implementation

1. Allows for cost-effective construction.
   - Location of amenities and circulation support cost-effective construction.
2. Provides for centralized EV charging & green infrastructure.
   - Provides efficiencies for installing EV chargers and related improvements.
3. Supports a flexible configuration for future development.

4.3.1.2 Mobility

1. Supports safe, convenient access for ferry users via bike/pedestrian/transit.
   - Location and access to shuttle/transit/rideshare stop limits potential conflicts with non-ferry visitors.

- Transit stop is a comfortable walking distance to ferry boarding area.

2. Supports safe ferry parking access.
   - Path of vehicle travel to ferry parking area limits congestion with non-ferry visitors.
3. Supports convenient, safe wayfinding.
   - Car, transit, bicycle/pedestrian circulation is safe, efficient and easy to navigate.

4.3.1.3 Visual and Placemaking

1. Harmonizes with and enhances existing waterfront experience.
   - Enhances the current waterfront experience as destination for the community and visitors to gather and recreate without altering nor impacting existing use patterns and programs.
2. Enhances public safety.
   - Design features and amenities enhance personal safety.
3. Minimizes parking footprint.
   - Parking area for ferry use is bounded and harmonizes with the larger waterfront.

4.3.1.4 Recreation

1. Provides sufficient space for diverse recreational uses.
   - Avoids impacts to the safe operations of existing recreational programs and amenities.
2. Offers flexible space for recreation/events.
   - Parking area is a welcoming space and flexible to hold events or activities when demand is low.
3. Leverages existing parking supply to support waterfront uses.
   - Existing parking is preserved for non-ferry visitors and recreation uses.

4.3.2 Outcome of Evaluation & Community Feedback

The two options were compared to the evaluation criteria, with the following advantages and disadvantages noted in Table 4-3.

Table 4-3 Summary and ranking of evaluation criteria

		Concept 1A	Concept 1B
		Clustered	Dispersed
Implementation	– Constructability – Centralized EV charging & green infrastructure – Flexible configuration for future development	More Preferable	Less Preferable
Mobility	– Supports biking, walking, transit access – Supports convenient parking access and management – Effective wayfinding and user-friendly	More Preferable	Less Preferable

		Concept 1A	Concept 1B
		Clustered	Dispersed
Visual & Placemaking	– Harmony with and enhancement of the waterfront – Enhances public safety – Minimizes parking footprint to allow for more greenspace	More Preferable	Less Preferable
Recreation	– Provides space for diversified recreation uses – Flexible space for recreation/events during low parking demand – Leverage existing parking supply to support waterfront uses	More Preferable	Less Preferable

4.4 Preferred Landside Conceptual Alternative

Reviewing the results of the ranking summarized above, Option A "Clustered Parking" is shown to be the preferred landside alternative with an ROM construction cost of $14M. Option A provides the following waterside attributes:

– Leveraged multi-use breakwater to protect the ferry terminal from wind and waves with surface decking for public access

– Positioning of the ferry float to accommodate the following:

  - Access for recreational vessels to travel into and out of the marina harbor
  - Access for windsurfers, swimmers, and other watersports users along the southern area
  - Improved permitting process for dredging, if necessary

– No additional filling of the Bay

5 Conclusions and Next Steps

The feasibility study included the development of conceptual pier layouts that were developed using two alternative locations and several configurations based on the 2018 Structural Assessment Report. The feasibility study focused on the landside and waterside improvements needed to support a public ferry terminal for each concept.

– The landside studies included public transportation facilities (e.g., pathways, bus terminal, rideshare), site amenities (e.g., restrooms, bicycle facilities), transportation and parking demand analysis (e.g., parking demand forecast, ferry ridership forecast, ferry access mode split analysis), and parking transportation demand reduction strategies. Landside studies also included electrification of the facility for use by electric ferry vessels. The waterside studies included the pile-supported pier segment starting at the shoreline, ferry facility (gangway, berthing float, passenger shelter, wave protection, etc.) and other project elements located in the water. Both waterside and landside studies included mitigation measures to minimize potential impacts to recreation users at the marina.

– All concepts reviewed were determined to be feasible in terms of ferry facility access, landside improvements, coastal processes, dredging, and ferry facility design/operations and a rough order of magnitude (ROM) cost estimate was developed for each concept, see Appendix E.

- GHD finds that a ferry facility is feasible with the dual-purpose pier configurations reviewed in the study. The conclusions drawn rely on use of low-draft ferry vessels and dredging required for safe vessel navigation over the tidal range. Dredging would be required given under-keel clearance requirements for ferry vessels.
- The following conclusions are provided as a result of the ferry facility feasibility study:
  - Rehabilitation and retrofit of the existing pier structure is not recommended due to the extensive work and cost to provide the enhanced seismic performance required and to provide an appropriate service life prior to when future repairs would be needed.
  - A new pile-supported pier located on the alignment of the existing Municipal Pier is suitable to serve both public recreational use and as access for a passenger ferry facility.
  - Sedimentation at the proposed ferry facility location is expected to be minimal. Over-dredging would be recommended due to high cost per cubic yard for maintenance dredging.
  - The wave environment at the project site and wave protection at the terminal were evaluated as part of the study. The terminal is subject to a strong wave environment and a wave barrier would provide improved ferry operating conditions and safety over an unprotected berth.
  - Vessel under-keel clearance requirements necessitate discussion with WETA; however, at >30 knots with 250 pax on board, 2-foot under-keel clearance is likely near the minimum.
  - The Marina entrance channel likely requires deepening and may require widening for improved safe navigation.
  - The proposed ferry facility could accommodate zero emission passenger ferry vessels. Based on review and findings during the study, construction and operation of electric ferry vessels including the ferry charging infrastructure, is feasible, see Appendix F.

Following review and comparison of the relative merits of each pier/ferry facility option, input from WETA and feedback and comments received from the public during three community meetings conducted, Concept 1A is preferred. ROM construction cost for Concept 1A, including pier approach, dual purpose pier, ferry facility, wave barrier, and dredging required for navigation is $69.5M. ROM construction cost of landside improvements for Concept 1A is $14.0M. A summary of the estimate and assumptions are provided in Appendix E. Waterside and landside improvements for Concept 1A are discussed below.

5.1 Preferred Waterside Concept

Concept 1, the "Sword" (Figure 5-1), which would provide approximately 1,480 feet of public access, was identified as the preferred waterside concept. Details of Concept 1 include the following:

- A new, 22-foot-wide pier (same width as the existing Berkeley Municipal Pier) to accommodate both ferry foot traffic, recreational activities, and emergency and maintenance vehicles.
- A new breakwater creating a safe harbor from the predominantly southwesterly winds and waves for ferry boarding on the north side of the new pier (approximately 400 feet long).
  - The breakwater would provide surface decking to allow public access for recreational activities.
- An extension of the new pier westward into the Bay for recreational use (approximately 500 feet long).
- A ferry terminal including ferry berthing floats, float piles, ADA gangways, and security gates.
  - A ferry boarding pier from the shoreline at Seawall Drive westward to a new breakwater (approximately 580 feet long).

Attributes of Concept 1 that are superior to the other three concepts include:

– Utilization of the same location of the existing Berkeley Municipal Pier, which would greatly minimize potential impacts to existing water-based recreation users to both the south (windsurfers, kayakers, and swimmers) and the north (sailboats using the main harbor channel).
  - Concept 1 would also eliminate the need for a second structure (new pier) to be constructed adjacent to the existing pier and associated fill within the Bay.
– Utilization of a linear design (similar to the existing pier), which would have a lower construction cost compared to a curved pier.
– The necessary north-south breakwater to create a safe harbor for ferry boarding on the north side of the new pier would also provide additional pedestrian surface for public recreation.
– Extension of the recreation pier to the west of the breakwater would provide unimpeded recreational use.

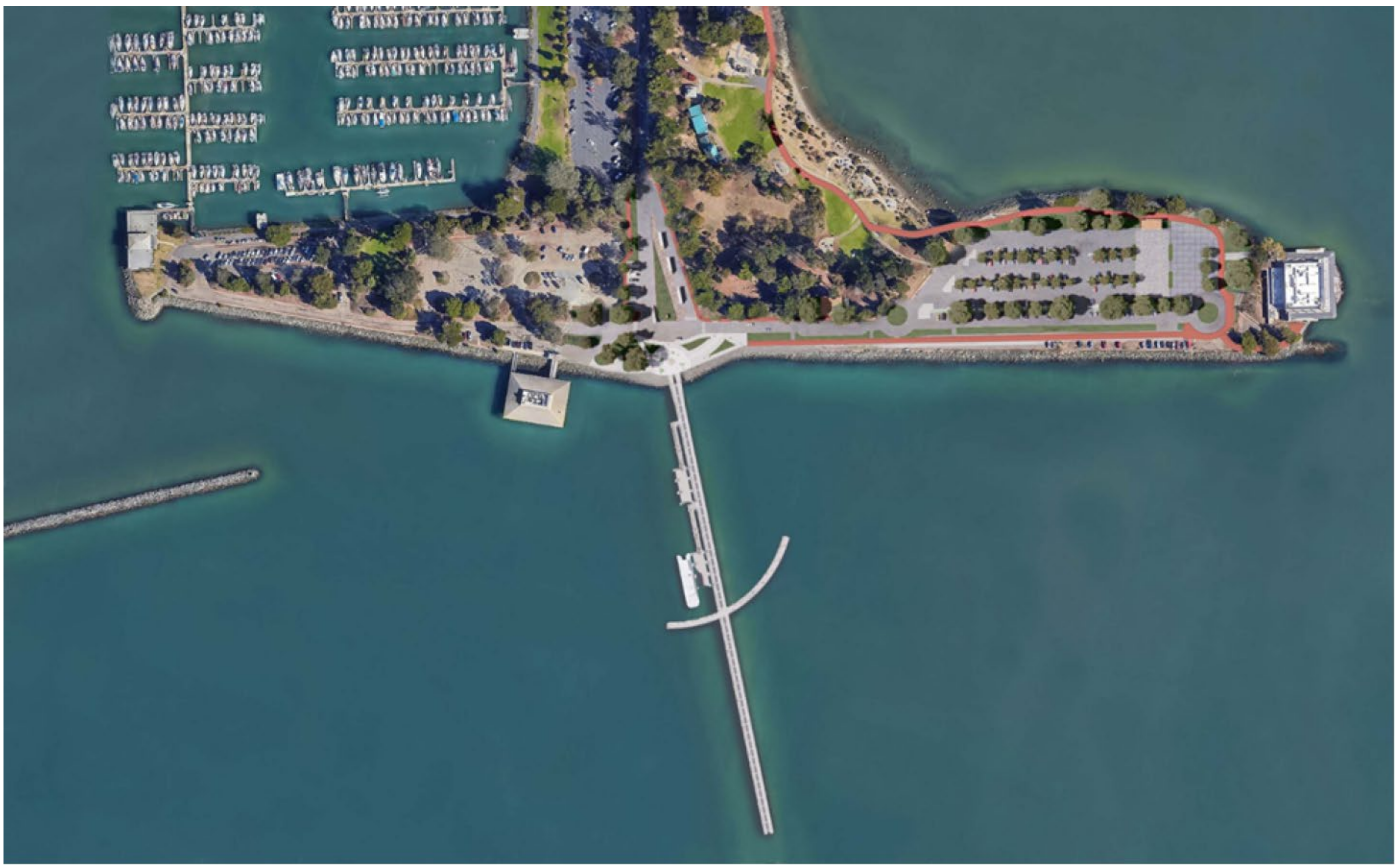


Figure 5-1 Preferred Waterside Concept 1

5.2 Preferred Landside Concept

Two landside options, Concept 1A: Dispersed Parking and Concept 1B: Clustered Parking, were developed for evaluation and community discussion. Concept 1A received general support from the community, with an emphasis placed on the mitigation of potential impacts related to parking and traffic, environmental impacts, and preservation of the existing beauty and recreational activities at the marina.

Concept 1A would allocate 250 parking spots in the lot located at 199 Seawall Drive for ferry users. Concept 1A would also provide several supportive elements and amenities (Figure 5-2).

Features of Concept 1A include the following:

- Renovation of the parking lot located at 199 Seawall Drive, which would include new pavement surfacing, new striping, and new stormwater bioswales to treat stormwater.
- Improvement of an area along the southwestern side of University Avenue would provide for public buses, shuttles, and a drop-off zone for rideshare and family vehicles.
- Renovation of pedestrian pathways and safety lighting.
- Shifting the Seawall Drive vista parking zone from the west side to the east side of the road
- A new water access point at the small peninsula located at the southwest corner of Seawall Drive.
- Amenities would include:
  - A new restroom
  - A new fish cleaning area
  - A public plaza and events space
  - Other (e.g., trash cans, drinking fountains, potential area for food trucks)

To minimize potential impacts to existing pier usage and the environment, the City would implement Transportation Demand Management (TDM) methods to improve circulation at the Berkeley waterfront for pedestrians, bicycles, cars, mass transit, service and delivery vehicles, and emergency vehicles.

Figure 5-2 Preferred Landside Concept 1A

5.3 Planning-Level Combined Waterside and Landside Preferred Concept Plan Estimated Cost

Planning-level cost estimates were developed for the conceptual dual-purpose pier and ferry facility concepts as part of the feasibility study. Many assumptions were made for the planning level estimates, including the following:

- Dual-purpose and recreational pier segment widths are both 22 feet.

- Pier construction costs include steel piles, steel or concrete beam cap and concrete deck, wind shelter structure(s), benches, railing, fishing amenities and lighting.
- Ferry berthing float consists of steel fabrication.
- Cost of two dedicated electric ferry vessels is included.
- Project contingency of 25% is included in total ROM cost.
- Design phase costs (preliminary/final design, permitting, environmental clearance and investigations) are 12% of construction cost.
- Construction phase cost (management and inspection services) is 8% of construction cost.

The estimates presented reflect the concept design developed for the feasibility study and reflect essentially a zero percent level of design and Q4-2021 prices to the extent possible. Due to supply chain disruptions and other factors currently impacting the market, pricing for construction materials is increasing more rapidly at the current time than in recent years. An escalation factor of 3% per annum to the assumed start of construction in June 2025 has been included.

Detailed cost estimates will be updated as additional data for preliminary and final design, such as site-specific geotechnical information, bathymetric survey and sediment sampling and testing are identified at future stages of the project.

The planning-level ROM cost estimates for the options reviewed are summarized in Table 5-1, see Appendix E for details.

Table 5-1 Summary of planning level ROM cost estimates for reviewed options

Option	ROM Total Project Cost
Concept 1A	$119.5M
Concept 1B	$120.0M
Concept 2*	$131.7M
Concept 3*	$138.9M
Concept 4*	$140.4M

*Not a preferred alternative, ROM estimate for waterside improvements only.

Differences in pier construction costs include amenities such as wind shelter structures located on the dual-purpose segment compared to the recreation segment. The curved pier configurations considered a higher unit cost due to more complex formwork and construction.

As presented in Section 4, Option 1A is the preferred configuration for the multi-use pier and ferry terminal. The ROM cost estimates developed account for the dual-purpose pier permitting, design and construction, fixed breakwater for wave attenuation, dredging (to estimated required water depth for ferry operation), ferry float parameters, fenders, two electric ferry vessels, gangway and boarding ramps, access area and wind shelters, utilities, and landside components (e.g., parking, bus stops, ride share pick-up/drop-off, bike/scooter facilities, weather shelters for passenger queuing, etc.). The ROM cost estimates for the preferred option for the pier and ferry facility is $105.5M and $14M for the preferred landside concept, for a total ROM project cost of $119.5M. In addition, preliminary estimates indicate annual maintenance costs of approximately $200,000. The estimated annual costs include ongoing maintenance such as landscaping, general maintenance, electricity, water and trash service.

5.4 Anticipated Regulatory Agency Permits, and Level of Environmental Review

Resource agency review and permitting for a dual-purpose replacement pier and ferry facility, regardless of the alternative, is expected to include the City of Berkeley, San Francisco Bay Regional Water Quality Control Board, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, National Marine Fisheries Service, California Department of Fish and Wildlife, San Francisco Bay Conservation and Development Commission (BCDC) and Dredge Material Management Office (DMMO).

To provide safe navigational approaches and maneuvering to the terminal locations, the project will require a one-time dredge of the Bay mudline. All material proposed to be dredged will need to be characterized and disposed at permitted disposal sites, pursuant to applicable regulations and the DMMO determination of suitability for dredge material disposal for the project.

Because of the one-time navigational dredge, it is anticipated the project will receive approval for both the dredge activity as well as the placement of fill (from facility piles, etc.) through the DMMO. Typically, when a project has both dredge and fill components, the application is processed as one action.

The project will be designed to address sea level rise (SLR) based on a design life span of approximately 50 years. BCDC will require an analysis of future SLR on the facility and how it will be designed to adapt to SLR.

The environmental review and evaluation process for the project includes the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA). Both require evaluation of major projects for their impacts on the environment. CEQA is the California law that requires state and local agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible. For the project, CEQA will likely require completion of an Environmental Impact Report (EIR). An EIR informs public agency decision–makers and the public of the significant environmental impacts of the proposed project and its alternatives. NEPA includes similar federal requirements that are reported in an Environmental Assessment (EA), which is also likely to be required.

Anticipated consultations, approvals and permits are listed in Table 5-2 below.

Table 5-2 Anticipated consultations, approvals, and permits

Agency	Project Activity	Type of Permit/Review
Local		
City of Berkeley	Construction of replacement recreational pier and new ferry terminal	Demolition Permit, Design Review, Use Permit, and Building Permits Long-term lease for construction and operation of new facilities
State and Federal (Trigger)		
San Francisco Bay Conservation and Development Commission (McAteer-Petris Act)	Development within 100 feet of San Francisco Bay shoreline (mean high tide) and placement of fill within Bay	Administrative or Major Permit, including Design Review Federal Consistency Determination
Regional Water Quality Control Board, San Francisco Bay Region	Discharge of fill material within wetlands or waters of the U.S. or state	Water Quality Certification

Agency	Project Activity	Type of Permit/Review
(Clean Water Act; Porter-Cologne Water Quality Control Act)		
Dredged Material Management Office	Long Term Management Strategy	Dredge and Disposal Authorization
U.S. Army Corps of Engineers (Clean Water Act; Rivers and Harbors Act)	Discharge of dredged or fill material into wetlands or other waters of the U.S. and placement of structures in navigable waters	Nationwide Permit (NW25) or Letter of Permission
U.S. Fish and Wildlife Service (Federal Endangered Species Act Section 7)	Potential impacts on federally listed species	Not Likely to Adversely Affect or Biological Opinion
National Marine Fisheries Service (Federal Endangered Species Act Section 7; Magnuson-Stevens Fishery Conservation and Management Act; Marine Mammal Protection Act	Potential impacts on federally listed marine species and essential fish habitat	Not Likely to Adversely Affect or Biological Opinion Marine Mammal Incidental Harassment Authorization
State and Federal (Trigger)		
California Department of Fish & Wildlife (Fish & Game Code Section 2081)	Potential impacts to State threatened or endangered species (excludes fully protected species)	Incidental Take Permit

5.5 Next Steps:

The City and WETA will identify and apply for potential funding opportunities from various sources (local, state, federal and other) for the next phases of the project, including:

- Advancing the design phase of Concept 1A from preliminary through final design to include the following features:
  - Waterside
    - A new dual-purpose pier in the same location as the existing municipal pier extending from the shoreline at Seawall Drive westward to a new breakwater (580 ft long).
    - A new breakwater creating a safe harbor from the predominant southwesterly wind and waves for ferry boarding on the north side of the new pier (400 ft long)
      - The breakwater will have surface decking to allow public access for recreation.
    - An extension of the new pier westward from the new breakwater providing 500 ft of additional pier for recreational use. All together, these elements will provide approximately 1,480 feet of pier available for public access.
  - Landside
    - Renovation of the existing 320 car parking lot at 199 Seawall Drive, including pavement surfacing, striping, and new stormwater bioswales to treat stormwater
      - 250 parking spots will be allocated for weekday ferry users.
    - Renovation of the southwestern side of University Ave and portions of Seawall Drive to provide new spaces for public buses, shuttles, rideshares, and family vehicles.
    - Renovation of the existing pedestrian pathways to include safety lighting, a new restroom, a new fish cleaning area, trash cans, a new public plaza and events space, and other amenities (e.g., drinking fountain, area for potential food trucks, etc.).

    - Shifting the existing Seawall Drive vista parking zone from the west side to the east side of the road
        - A new Bay Trail pathway will be installed on the west side.
    - A new water access point at the small peninsula at the southwest corner of Seawall Drive for windsurfing, etc.
- Preparing Design Development Phase Cost Estimate(s)
- Preparing required CEQA and NEPA documentation
- Performing supporting Environmental Technical Studies
- Initiating agency coordination and entitlements review
- Resource and regulatory agency coordination and permitting (DMMO, USFWS, BCDC, etc.)

Appendices

Appendix A

Conceptual Drawings

1 DRIVE-IN MOVIES & CONCERTS
1 EVENTS, PARTIES, FOOD TRUCKS/FESTS
1 FARMER'S MARKET
2 PERFORMANCES/SHOWS
3 BAY TRAIL EXTENSION
2 (N) EVENTS STAGE/ AMPHITHEATRE AREA
RESTAURANT/ EVENTS BUILDING
SHORELINE RECREATION PARKING STALLS
1 PARKING LOT (WITH EV CHARGING STATIONS) FOR FERRY DURING DAY-TIME. AVAILABLE FOR RECREATIONAL USE AT NIGHT-TIME AND WEEKENDS.
SEAWALL DRIVE
4 NON-POWERED WATERCRAFT LAUNCH
(N) PARK LAB GARDEN & PATIO OPERATED BY (N) TENANT OF HSS BUILDING
SHOREBIRD PARK
2 PUBLIC PLAZA & EVENTS SPACE
5 PUBLIC SHORELINE / RECREATIONAL USE WITH SEATING
6 BATHROOMS, FISH CLEANING TABLES & BIKE LOCKERS
3 EXTENDED BAY TRAIL
San Francisco Bay Trail
4 KAYAK LAUNCH
6 FISH CLEANING TABLES
5 PUBLIC SHORELINE

PARKING SCHEDULE

	LOCATION	COUNT	PURPOSE
1.	SEAWALL DRIVE (EAST)	71 STALLS	SHORELINE RECREATION PARKING
2.	UNIVERSITY AVENUE (NORTH)	9 ADA STALLS	FERRY PARKING (DURING FERRY HOURS); GENERAL PARKING (DURING NON-FERRY HOURS)
3.	PARKING LOT (NORTH)	251 STALLS	FERRY PARKING (DURING FERRY HOURS); RECREATIONAL EVENT SPACE (DURING NON-FERRY HOURS)

LANDSIDE IMPROVEMENTS
CONCEPT-B OVERALL KEY PLAN
SCALE: 1"=120' @ 34"x22"
"DISPERSED PARKING"
NEW PARKING ALONG MARINA BLVD
MARINA BLVD
(E) SOUTH COVE EAST PARKING LOT
SOUTH COVE WEST PARKING LOT
SOUTH BASIN
NEW ON-STREET PARKING ALONG UNIVERSITY AVE
UNIVERSITY AVE
POTENTIAL HOTEL / RESTAURANT AREA
SHOREBIRD PARK
RESTAURANT/ EVENTS BUILDING
SEAWALL DRIVE
BERKELEY MARINA
SKATES ON THE BAY
NEW BUS TERMINUS AND RIDE SHARE DROP OFF

PARKING SCHEDULE

	LOCATION	COUNT	PURPOSE
1.	SEAWALL DRIVE (EAST)	71 STALLS	SHORELINE RECREATION PARKING
2.	UNIVERSITY AVENUE (NORTH & SOUTH)	73 STALLS + 9 ADA	FERRY PARKING (DURING FERRY HOURS); GENERAL PARKING (DURING NON-FERRY HOURS)

LANDSIDE IMPROVEMENTS

CONCEPT B - Parking on University Ave & Marina Blvd

SCALE: 1"=80' @ 34"x22"

"DISPERSED PARKING"

PARKING SCHEDULE

	LOCATION	COUNT	PURPOSE
1.	UNIVERSITY AVENUE (NORTH & SOUTH)	73 STALLS + 9 ADA	FERRY PARKING (DURING FERRY HOURS); GENERAL PARKING (DURING NON-FERRY HOURS)
2.	SOUTH COVE WEST PARKING LOT	100 STALLS + 4 ADA	FERRY PARKING (DURING FERRY HOURS); GENERAL PARKING (DURING NON-FERRY HOURS)
3.	(N) ON-STREET PARKING ALONG MARINA BLVD.	155 STALLS + 2 ADA	GENERAL PARKING
4.	OFF-STREET PARKING ALONG MARINA BLVD.	49 STALLS	PARKING LOT FOR SLIPHOLDERS


Preferred Option 1A

Preferred Option 1A


Preferred Option 1A


Preferred Option 1A

Preferred Option 1A


Preferred Option 1A


Preferred Option 1A

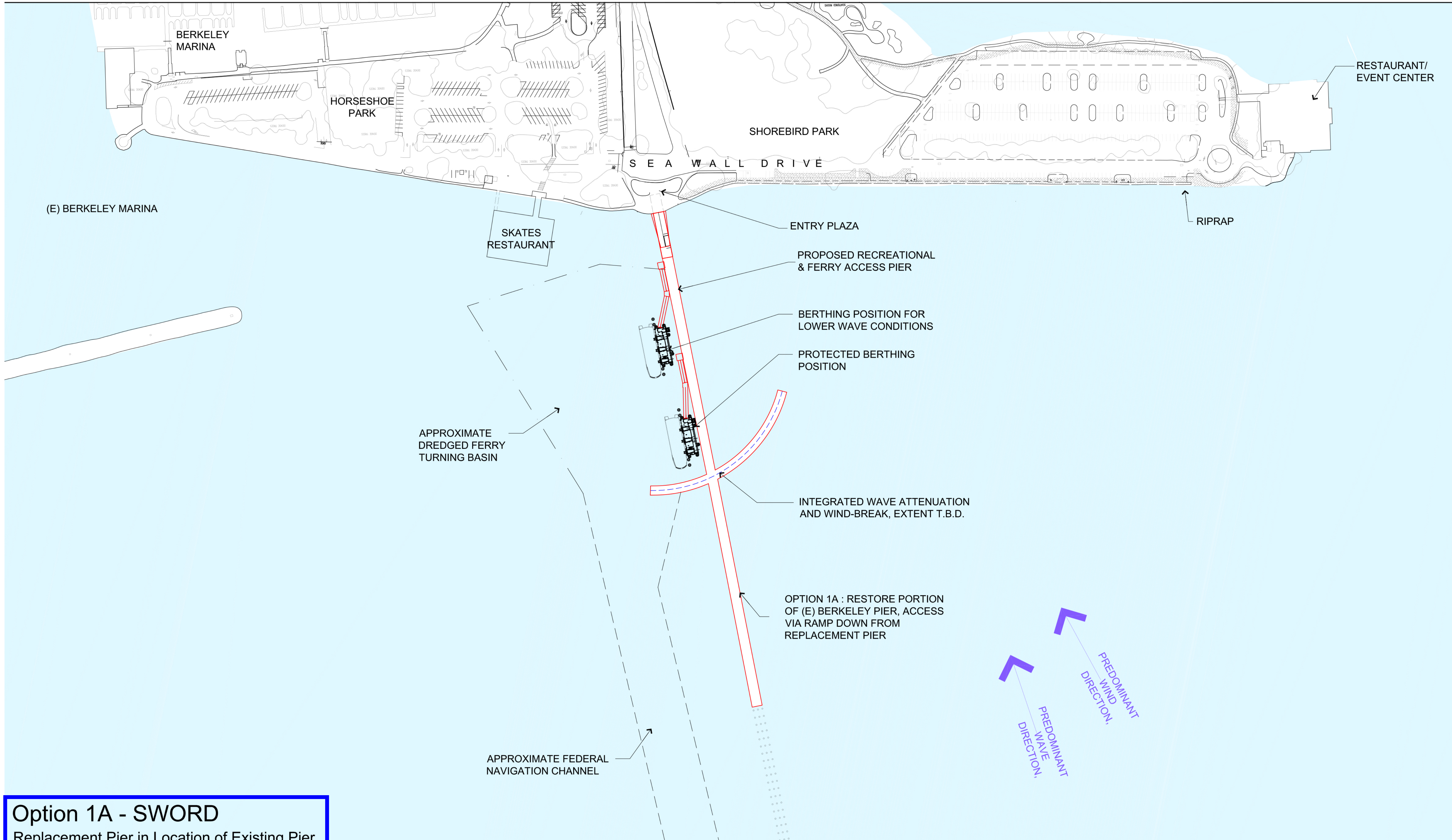

Preferred Option 1A

Preferred Option 1A

Preferred Option 1A

Preferred Option 1A


Preferred Option 1A



Option 1A - SWORD

Replacement Pier in Location of Existing Pier

DSGN	DL
DRWN	KS, JT, EG
CHKD	MW
SCALE	AS NOTED

BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

GHD
655 Montgomery Street, Suite 1010.
San Francisco, CA 94111
T 415-283-4970
W www.ghd.com

MARCY WONG DONN LOGAN
ARCHITECTS
800 bancroft way #200 berkeley, ca 94710
tel. 510. 843.0916

MOTT MACDONALD

Berkeley Pier Ferry Terminal
Expanded Feasibility Study

Seawall Drive, Berkeley, CA 94710

CITY OF BERKELEY

DATE: OCT 20, 2021

PHASE: Feasibility Study

WATER EMERGENCY TRANSPORTATION AUTHORITY

OPTION 1A
SCALE: 1"=100' @ 34"x22"

PROJECT NO. 1807A

DRAWING NO. 1A

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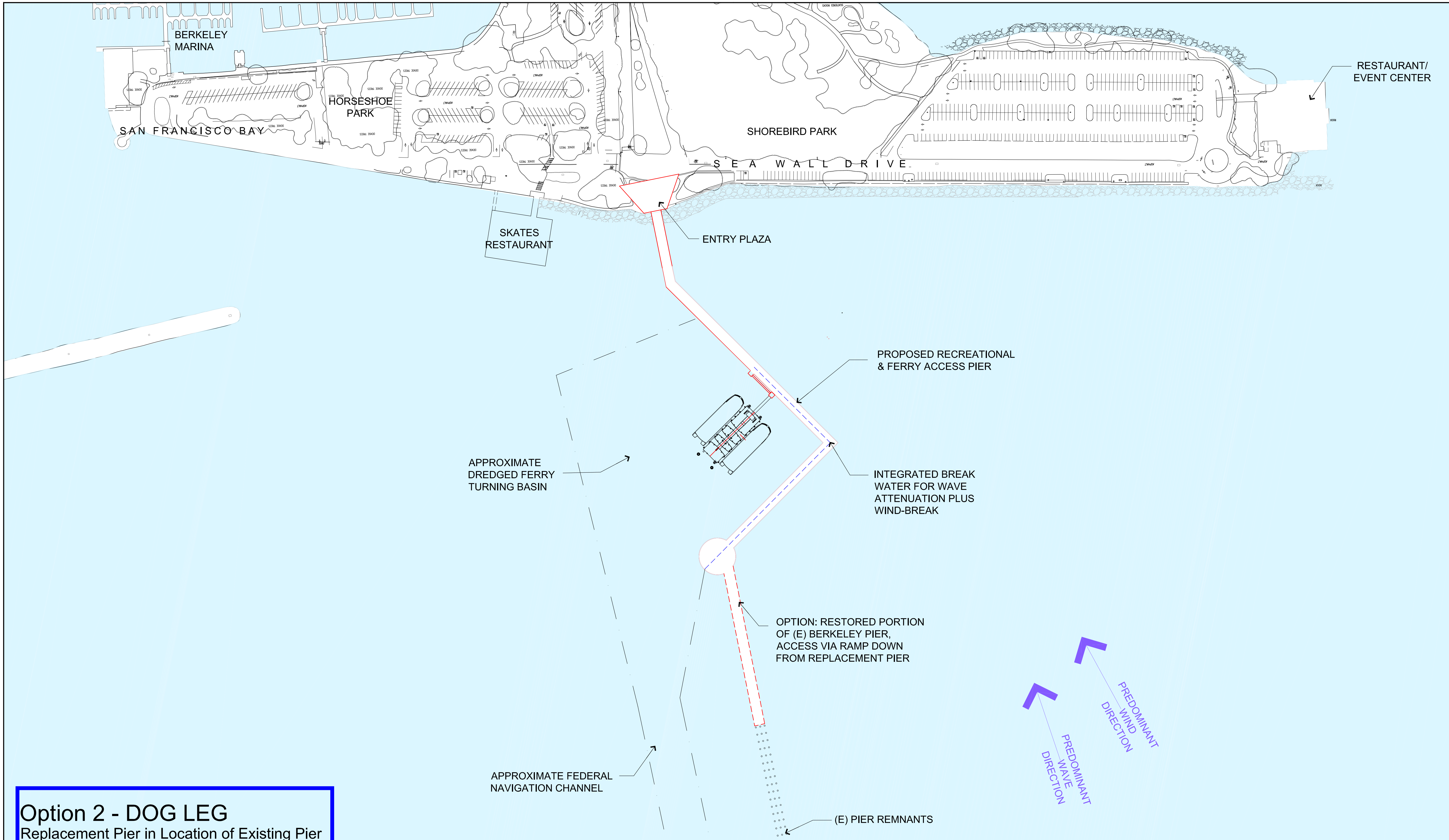

Option 2 - DOG LEG

Replacement Pier in Location of Existing Pier

DSGN	DL
DRWN	KS, JT, EG
CHKD	MW
SCALE	AS NOTED

BAR IS ONE INCH ON ORIGINAL DRAWING
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

GHD Inc.
655 Montgomery Street, Suite 1010.
San Francisco, CA 94111
T 415-283-4970
W www.ghd.com

MARCY WONG DONN LOGAN ARCHITECTS
800 bancroft way #200 berkeley, ca 94710
tel. 510. 843.0916

MOTT MACDONALD
Mott MacDonald
155 Montgomery Street
Suite 1400
San Francisco CA 94104
T +1 (415) 968 3495
mottmac.com

Berkeley Pier Ferry Terminal Expanded Feasibility Study

Seawall Drive, Berkeley, CA 94710

CITY OF BERKELEY

DATE: OCT 20, 2021

PHASE: Feasibility Study

WATER EMERGENCY TRANSPORTATION AUTHORITY

OPTION 2
SCALE: 1"=100' @ 34"x22"
0' 50' 100'
N

PROJECT NO. 1807A

DRAWING NO. 2

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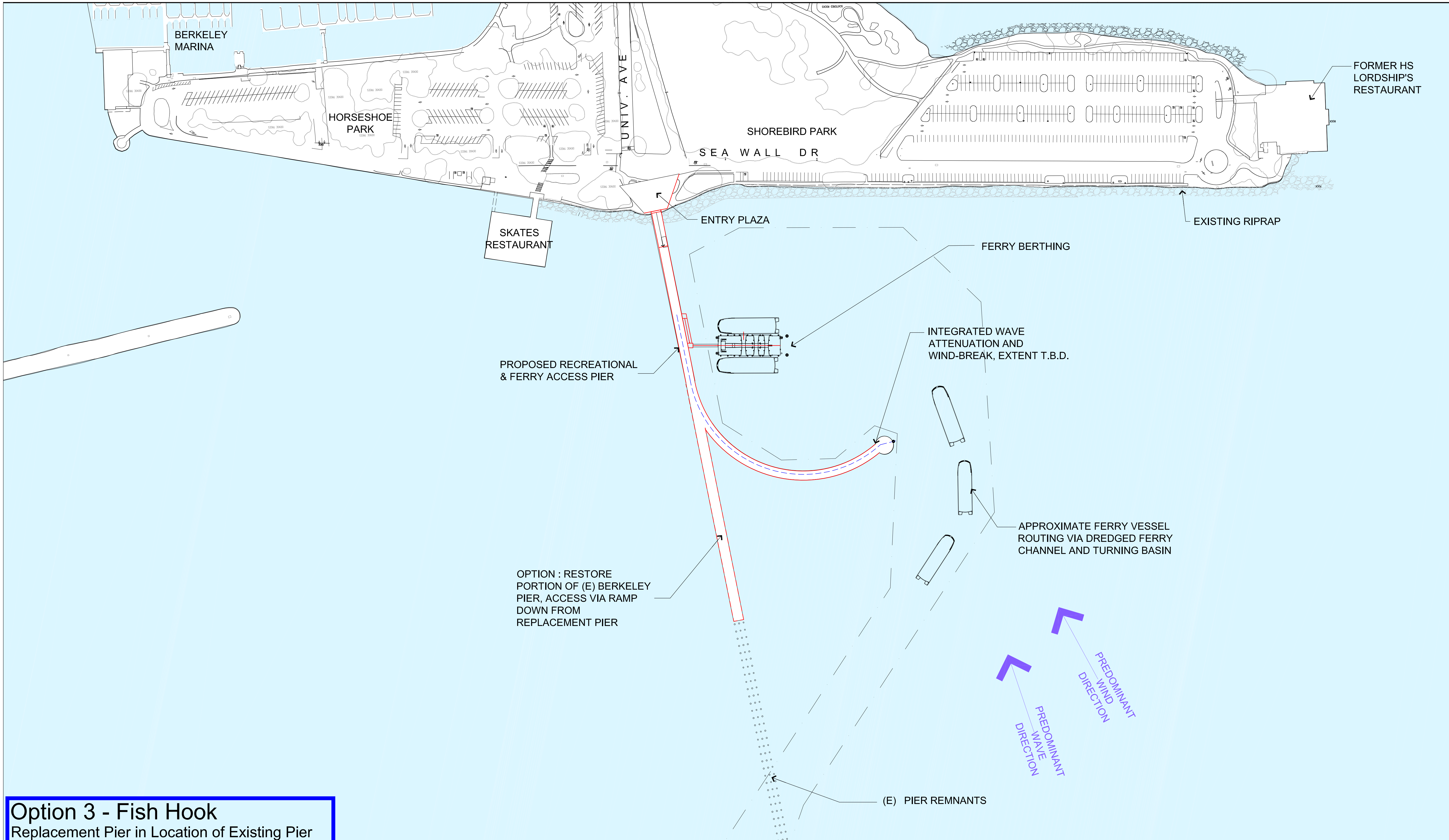

Option 3 - Fish Hook

Replacement Pier in Location of Existing Pier

DSGN	DL
DRWN	KS, JT, EG
CHKD	MW
SCALE	AS NOTED

BAR IS ONE INCH ON ORIGINAL DRAWING

0 1"

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GHD Inc.
655 Montgomery Street, Suite 1010.
San Francisco, CA 94111
T 415-283-4970
W www.ghd.com

MARCY WONG DONN LOGAN ARCHITECTS
800 bancroft way #200 berkeley. ca 94710
tel. 510. 843.0916

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Berkeley Pier Ferry Terminal Expanded Feasibility Study

Seawall Drive, Berkeley, CA 94710

CITY OF BERKELEY

DATE: OCT 20, 2021

PHASE: Feasibility Study

WATER EMERGENCY TRANSPORTATION AUTHORITY

OPTION 3
SCALE: 1"=100' @ 34"x22"

0' 50' 100'

N

PROJECT NO. 1807A

DRAWING NO. 3

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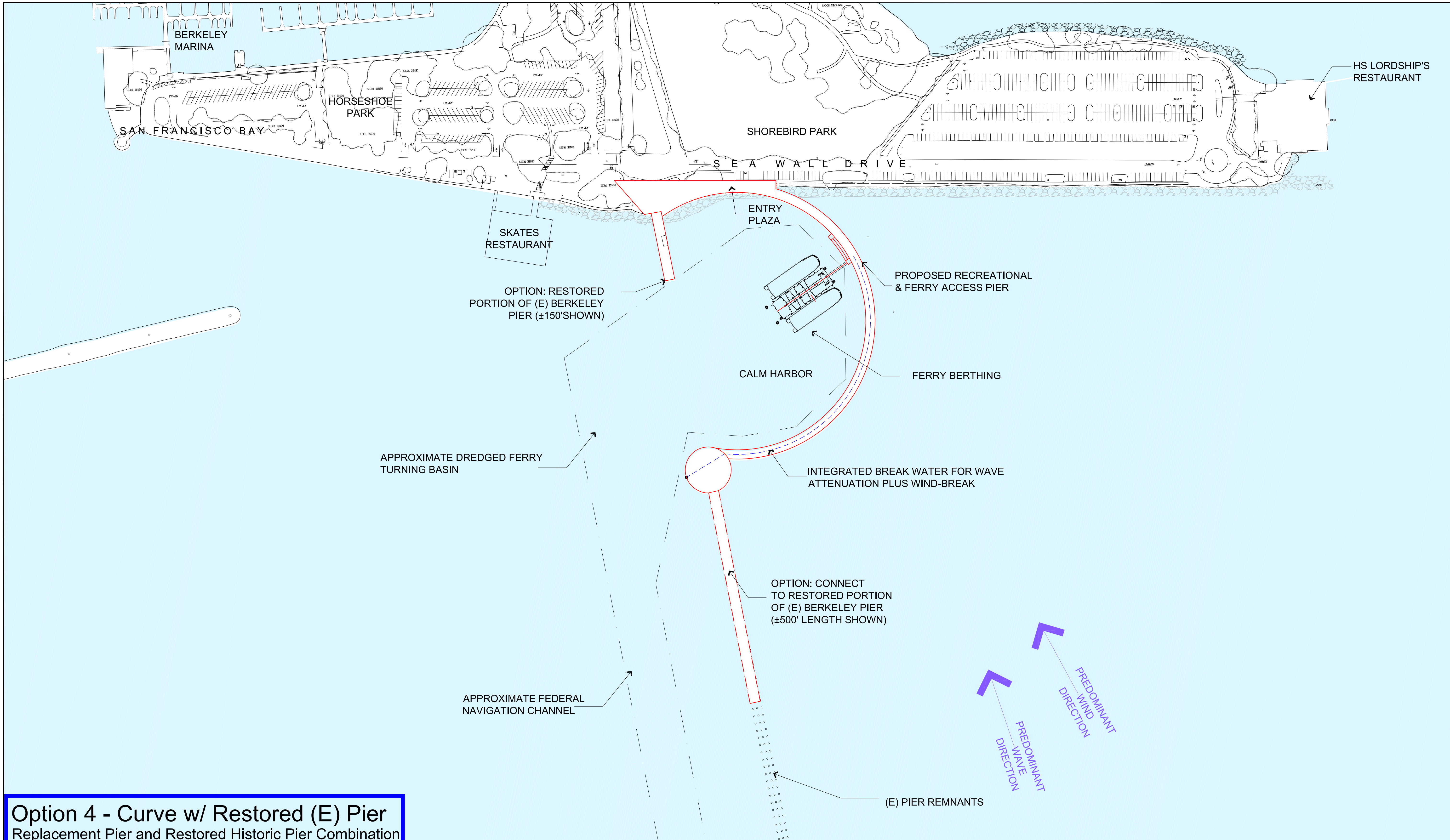


Option 4 - Curve w/ Restored (E) Pier

Replacement Pier and Restored Historic Pier Combination

DSGN	DL
DRWN	KS, JT, EG
CHKD	MW
SCALE	AS NOTED

BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

GHD Inc.
655 Montgomery Street, Suite 1010.
San Francisco, CA 94111
T 415-283-4970
W www.ghd.com

MARCY WONG DONN LOGAN ARCHITECTS
800 bancroft way #200 berkeley. ca 94710
tel. 510. 843.0916

MOTT MACDONALD
Mott MacDonald
155 Montgomery Street
Suite 1400
San Francisco CA 94104
T +1 (415) 968 3495
mottmac.com

Berkeley Pier Ferry Terminal Expanded Feasibility Study

Seawall Drive, Berkeley, CA 94710

CITY OF BERKELEY

DATE: OCT 20, 2021

PHASE: Feasibility Study

WATER EMERGENCY TRANSPORTATION AUTHORITY

OPTION 4
SCALE: 1"=100' @ 34"x22"
0' 50' 100'
N

PROJECT NO. 1807A

DRAWING NO. 4

SHT OF

Appendix B

Wave Protection Modeling Figures

DRAFT Technical Memo

Project:	**Berkeley Pier Ferry Terminal Feasibility Study**		
Our reference:	507381291	**Your reference:**	N/A
Prepared by:	Scott Fenical, PE, D.CE, D.PE	**Date:**	October 7, 2021
Approved by:	Scott Fenical, PE, D.CE, D.PE	**Checked by:**	Andrew Cairns, PE. D.PE
Subject:	**Coastal Conditions Update**		

1. Introduction

The City of Berkeley and the Water Emergency Transportation Authority (WETA) are evaluating alternatives for a mixed public access pier and ferry terminal adjacent to the existing Berkeley Municipal Pier. Wave protection is proposed to ensure safe conditions for maneuvering, berthing, mooring, and loading/unloading at the terminal. This memo supplements previous analysis by Mott MacDonald described in *Small Scale Ferry Terminal Feasibility Study at Berkeley Municipal Pier* (GHD/Mott MacDonald/MWDL Architects 2018) and within the appendix to that document entitled *Berkeley Pier Ferry Terminal Feasibility Study Coastal Engineering Analysis and Concept Design* (Mott MacDonald 2018). The intent of this memo is to provide the City of Berkeley and WETA updated coastal conditions data that were generated during the project that will be used to evaluate and select preferred alternative ferry terminal concepts. This memo presents a refined analysis of local winds, wind-wave growth and nearshore transformation, and relative level of wave protection afforded by each of four (4) recently modified terminal concepts.

2. Wind Conditions Update

Local wind analysis was enhanced through purchase and evaluation of winds from two local stations immediately adjacent to the terminal area. Figure 1 shows locations of Berkeley Reef Light and Berkeley Marina anemometers, which were analyzed for consistency and quality. Berkeley Reef Light station was determined to have the most suitable wind data for wind-wave growth and transformation modeling, as it was less affected by local topography and/or buildings. Figure 1 (inset) also shows wind roses for these two stations. Winds at Berkeley Reef Light are most commonly aligned with the existing pier.

3. Wind-Wave Conditions Update

Mott MacDonald performed additional wind-wave growth and transformation modeling to determine typical wave conditions at the terminal locations, to be used further in evaluating wave protection concepts. Figure 2 shows example wind-wave growth and transformation modeling results for a southwest 20-knot wind, generated using the SWAN model (Delft University of Technology 2019). Approximately 6.5 years of waves were predicted at the site using Berkeley Reef Light wind speed and direction (full available record), combined with measured tidal elevation at Alameda (NOAA 9414750). Figure 2 (inset) also includes a wave rose taken near the terminus of the existing pier that represents the wave climate during this 6.5-year period.

Figure 1. Local Wind Stations Evaluated (left) and Wind Roses for Berkeley Reef Light (inset) and Berkeley Marina (inset) with Speeds in Knots (2-min average).

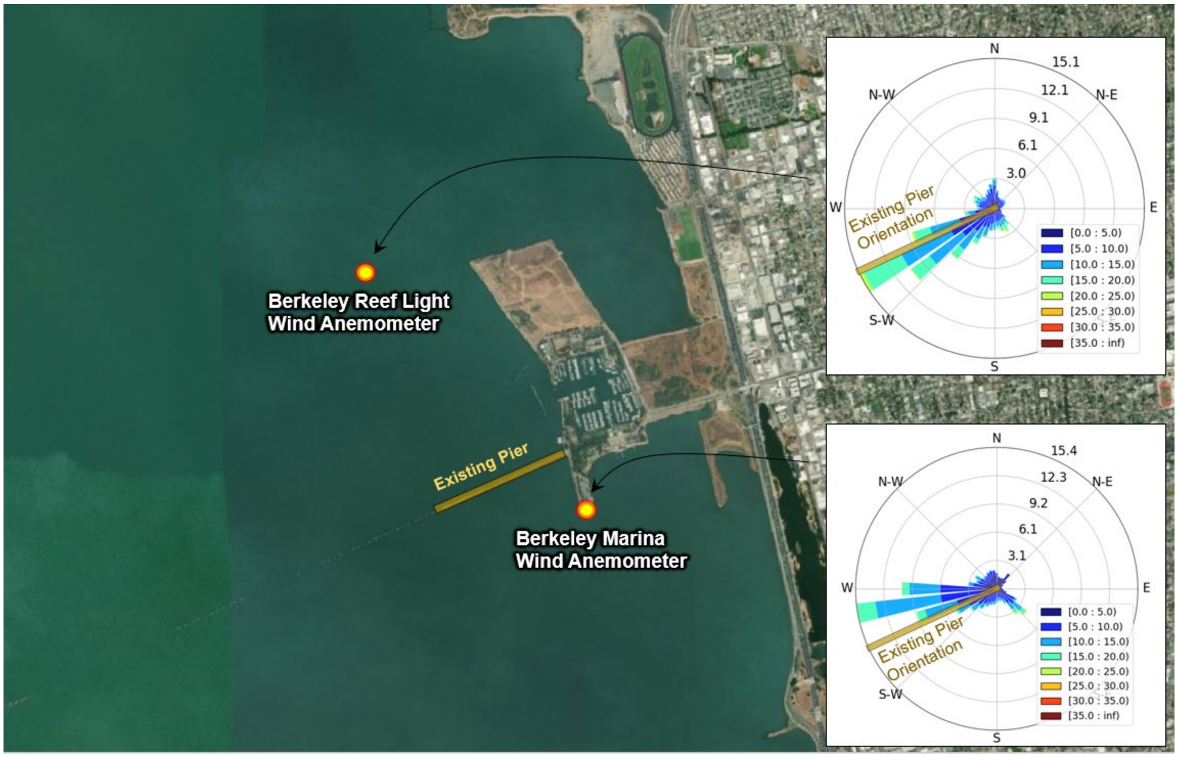
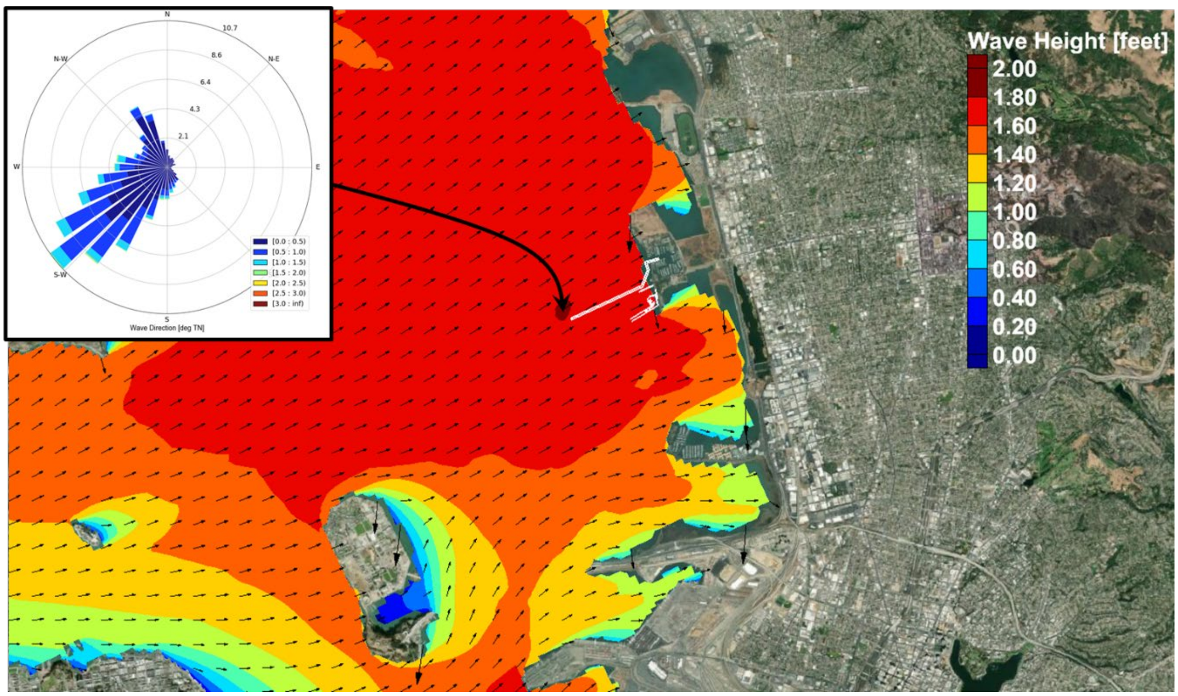


Figure 2. Significant Wave Height and Peak Wave Direction for Southwest Wind Speed 20 knots, and Wave Rose at the Terminus of Existing Pier (inset).



4. Feasibility-Level Wave Protection Evaluation for Updated Concepts

Mott MacDonald performed additional nearshore wave transformation modeling for terminal Concepts (breakwaters, specifically) using the wind-wave data generated on a Bay-wide scale with the SWAN model. Nearshore modeling was performed using Mike21BW (DHI 2021). Pile-supported pier segments and boarding floats were neglected in the modeling, so that only the breakwater (assumed to be a solid sheetpile wall) affected wave transformation in the modeling. A representative wave condition was used for the feasibility-level wave protection assessment: significant wave height 2.62 feet (0.8m), peak period 4.0 seconds, and origin direction 240 degrees True North (Southwest). This incident wave condition has a larger peak wave period than daily conditions, which results in more wave penetration and conservative (i.e. larger) wave heights at the float relative to the incident wave heights. The wave protection modeling was intended to be feasibility-level in nature and does not represent a complete evaluation of potential year-round conditions, downtime at the terminal, or mooring conditions, all of which should be evaluated during preliminary design.

Figures 3-6 show each recent ferry terminal conceptual alternative (Concept 1A, 2, 3 and 4), and feasibility-level nearshore wave modeling results showing the level of protection afforded by each breakwater. Wave conditions at the terminal are represented by normalized significant wave heights. Options 1A and 2 breakwaters were modeled as shown in the conceptual-level sketches; however, Concepts 3 and 4 were later modified by others (shift in the berthing location), after the wave protection modeling had been performed. Breakwaters were not optimized based on either the original results (Concepts 1A and 2) or recent changes to the alternatives (Concepts 3 and 4). Wave protection should be optimized for the preferred alternative during preliminary design. Based on results of the analysis and previous simulations, it is likely that each of the four (4) Concepts presented here could be optimized to achieve an adequate level of wave protection. Wave protection criteria for optimization of performance should also be further refined during preliminary design.

5. References

Delft University of Technology. 2019. SWAN – User Manual, Version 41.31AB, May 2019.

DHI. 2021. MIKE 21 Boussinesq Wave Module.

GHD, Mott MacDonald and Marcy Wong Donn Logan Architects. 2018. *Small Scale Ferry Terminal Feasibility Study at Berkeley Municipal Pier.*

Mott MacDonald. 2018. *Berkeley Pier Ferry Terminal Feasibility Study Coastal Engineering Analysis and Concept Design*.

National Oceanic and Atmospheric Administration, 2019, National Tide Information System data available on the World Wide Web (Center for Operational Oceanographic Products and Services), accessed November 2019, at URL https://tidesandcurrents.noaa.gov/.

Figure 3. Concept Sketch for Concept 1A (top) and Relative Wave Protection (Normalized Significant Wave Height) for 4-second Southwest Waves (bottom).

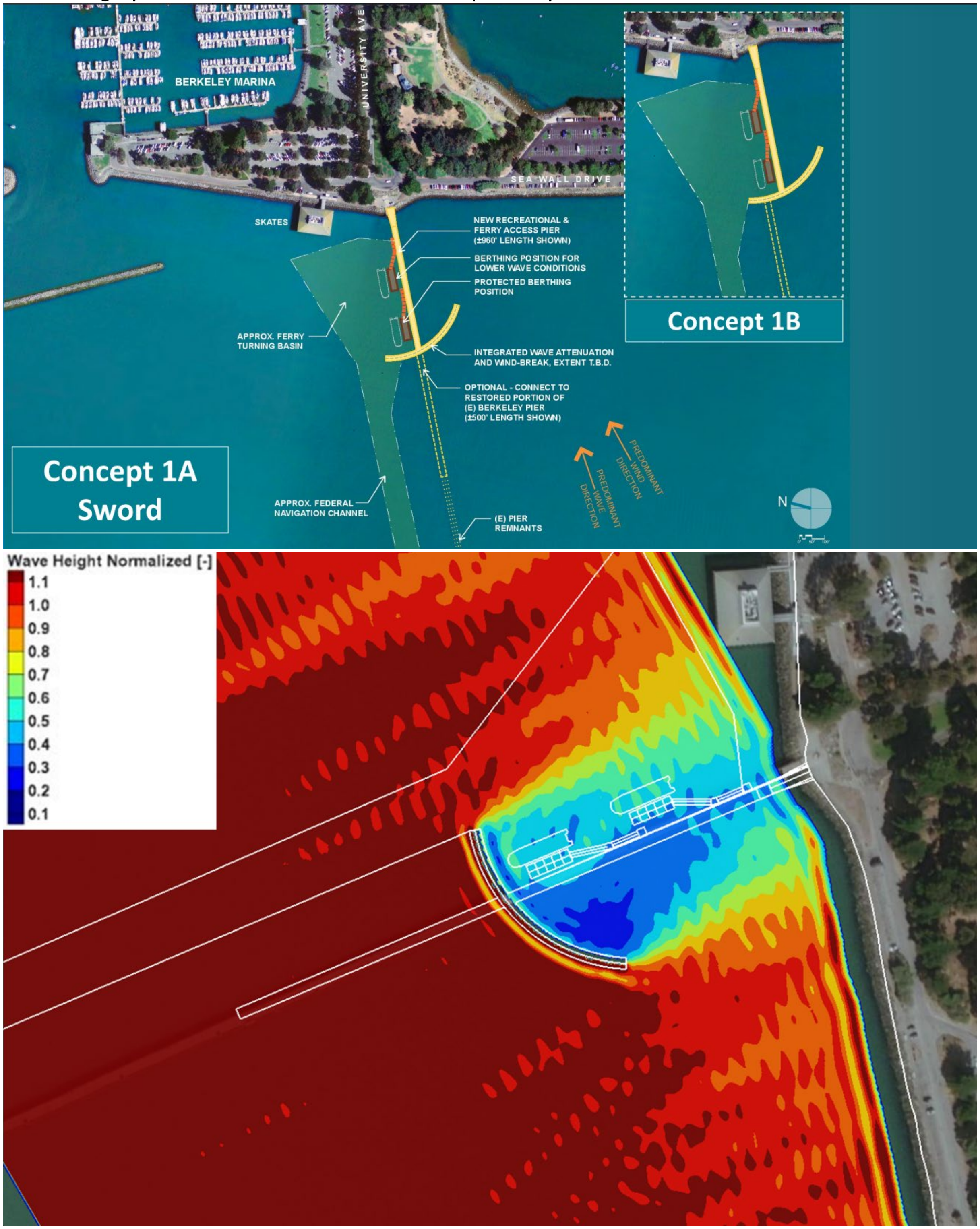


Figure 4. Concept Sketch for Concept 2 (top) and Relative Wave Protection (Normalized Significant Wave Height) for 4-second Southwest Waves (bottom).

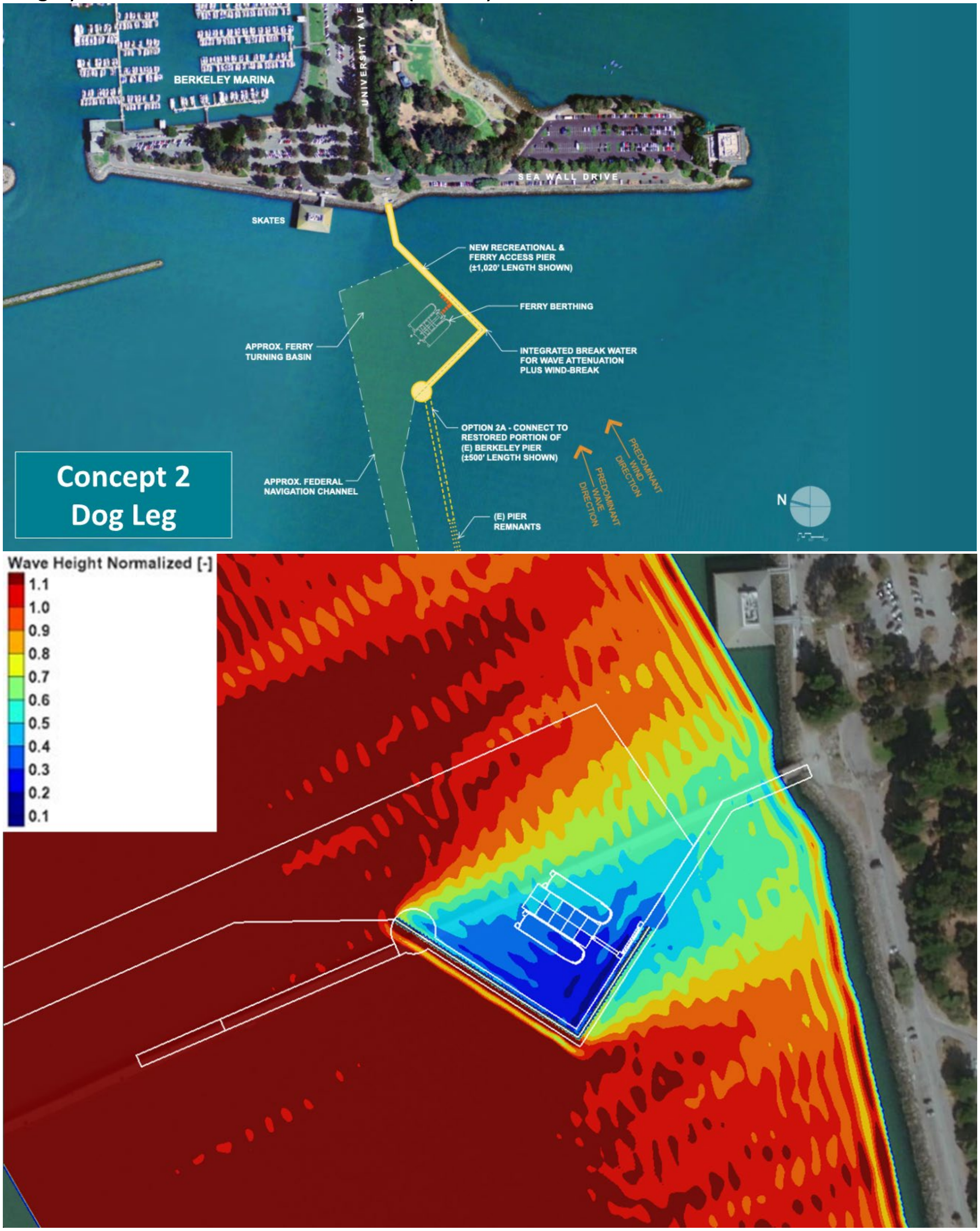


Figure 5. Concept Sketch for Concept 3 (top) and Relative Wave Protection (Normalized Significant Wave Height) for 4-second Southwest Waves (bottom). Note: the float location was moved in the most recent iteration of Concept 3 but not shown in the modeling results.

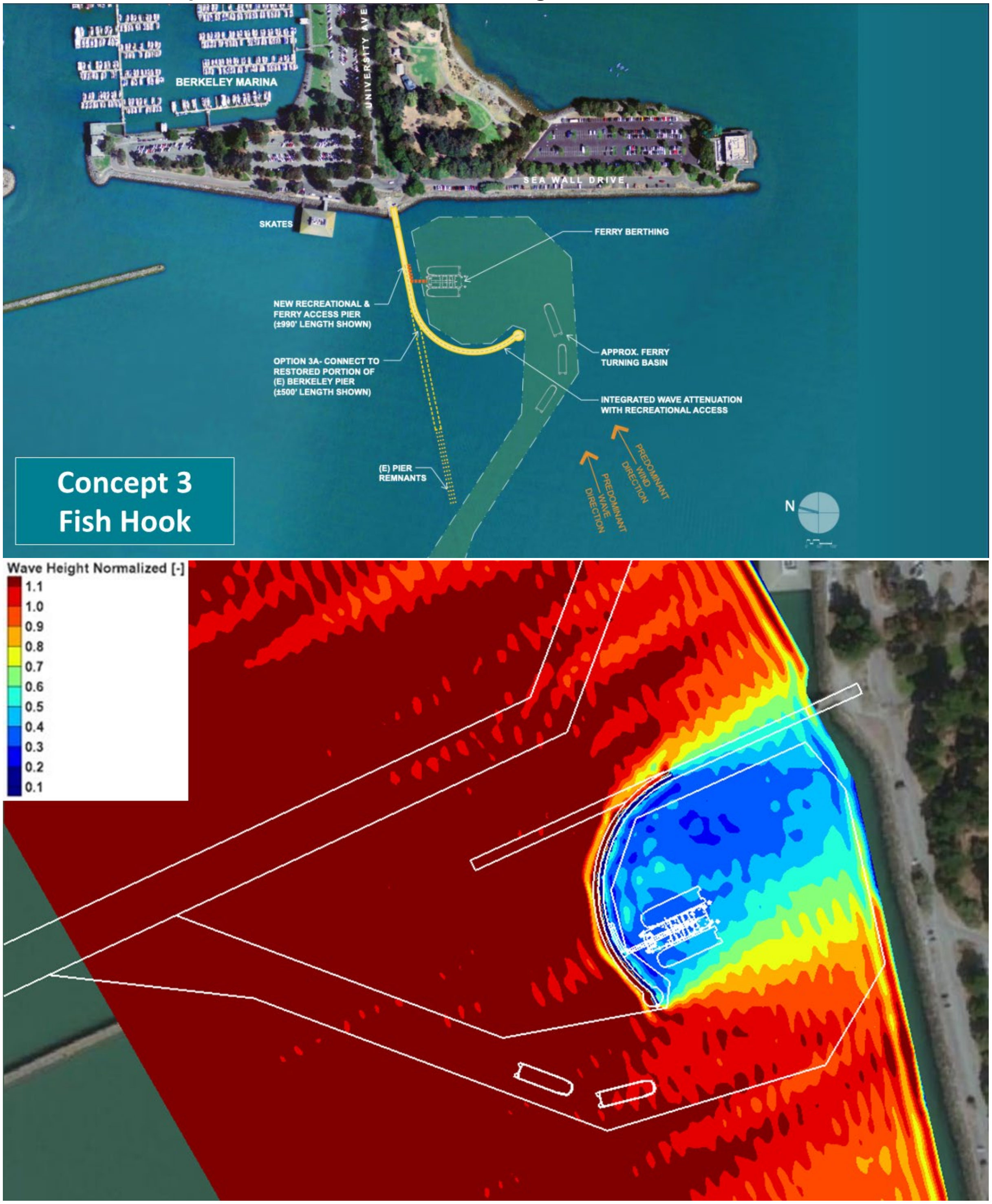
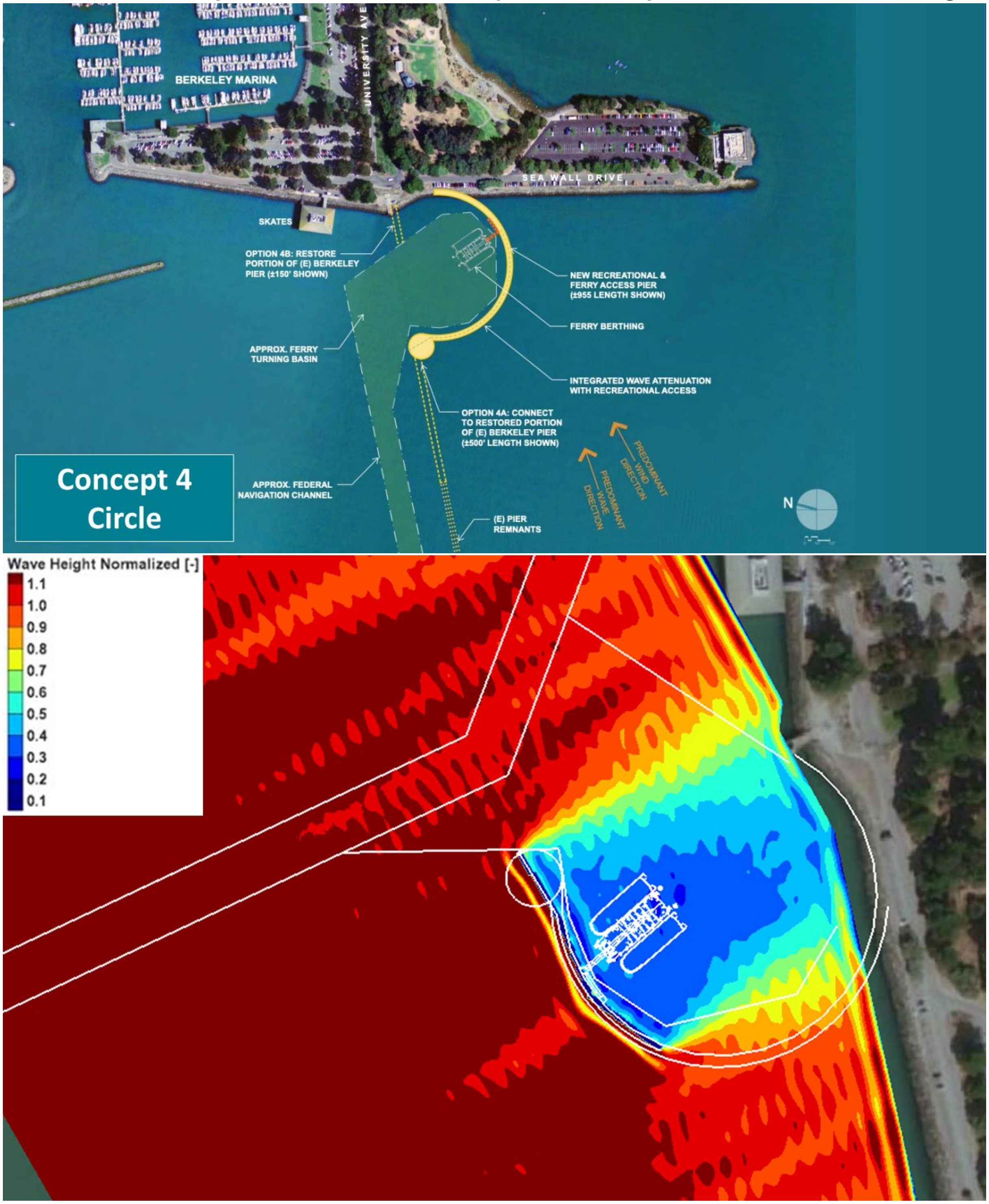


Figure 6. Concept Sketch for Concept 4 (top) and Relative Wave Protection (Normalized Significant Wave Height) for 4-second Southwest Waves (bottom). Note: the float location was moved in the most recent iteration of Concept 3 but not shown in the modeling results. If Concept 4 is selected, the under-pier breakwater in Concept 4 should be extended to provide better protection in the new berthing area.



Appendix C

Preliminary Design Criteria Memorandum

City of Berkeley – Ferry Terminal Expanded Scope Feasibility Study

Preliminary Design Criteria – Updated May 4, 2021

A. INTRODUCTION

This document describes the preliminary design criteria for the conceptual Berkeley Ferry Terminal to be located near the existing Municipal Pier in Berkeley, CA. This document is intended to provide and document the preliminary design assumptions, operational criteria, safety and other requirements for the ferry terminal.

B. DESIGN CODES, REFERENCES AND STANDARDS

The design requirements of the following design codes and standards will be incorporated into conceptual design of the Berkeley Ferry Terminal study:

1. American Bureau of Shipping (ABS), Rules for Building and Classifying Steel Barges, 2019.
2. American Concrete Institute, "Building Code Requirements for Structural Concrete," ACI 318-14 and Commentary (ACI 318R-14.)
3. American Institute of Steel Construction (AISC), "Specification for Structural Steel Buildings," AISC 360-16, 2016.
4. American Institute of Steel Construction (AISC) Steel Construction Manual, 15th Edition, 2017
5. American Society of Civil Engineers, "Minimum Design Loads for Buildings and Other Structures," ASCE/SEI 7-10, 2010.
6. American Society of Civil Engineers, "Seismic Design of Piers and Wharves," ASCE/COPRI 61-14.
7. American Society for Testing and Materials (ASTM), latest standards.
8. American Welding Society (AWS) – D1.1, Structural Welding Code, 2015.
9. American Welding Society (AWS) D1.5, Bridge Welding Code, 2015.
10. California Building Standards Commission, "2019 California Building Code (CBC)," California Code of Regulations, Title 24, Parts 1 and 2, 2019.
11. International Code Council, "2018 International Building Code (IBC)," 2018.
12. PIANC, "Guidelines to Design of Fender Systems," 2002.
13. United States Access Board, Passenger Vessels, Chapter V4
14. US Department of Justice 2010 ADA standards for accessible design Title II (28 CFR part 35) and Title III (28 CFR part 36).

The project elements shall follow the codes and standards below for design:

1. MOTEMS, Chapter 31F 2019 CBC for ferry terminal vessel fender and mooring design.
2. ASCE 61-14 for seismic design of any pile-supported structures.
3. ABS standard for design and fabrication of steel float(s).

C. FUNCTIONAL AND OPERATIONAL CRITERIA

The ferry terminal will be designed to Essential Facility standards per 2019 California Building Code (Title 24.)

General:

The terminal will be used by WETA vessels for passenger loading and unloading. Two vessels shall be accommodated at the facility. Terminal configuration may consist of double berths at a single float or single berths at two separate floats. Routine maintenance and overnight berthing of ferry vessels is not anticipated to be required.

1. Steel Float Size: TBD
2. Design Life: 50 years
3. Design Float Freeboard: 3 feet (+/- 1 inch)

Vessels:

1. Float(s) shall accommodate WETA 250-325 Passenger Ferry vessels loading / unloading and temporary mooring port and starboard. *WETA to provide controlling dimension(s) for different class vessels (including electric-powered) to be used at terminal (all dimensions including freeboard, port and starboard, etc.)*

Float Superstructure:

1. Float shall have an elevated superstructure consisting of fixed and adjustable ramps, landings, gates and guardrailing/handrails.
2. Float superstructure shall meet applicable state and federal regulations and comply with ADA requirements. Range of motion (TOM) for adjustable ramps:
   - Forward adjustable ramp – TBD
   - Aft adjustable ramp – TBD
3. Adjustable ramps shall be capable of completing a full up and down range of motion in 60 seconds.

Ramps and Gangways:

1. Movable gangways shall be hinged to allow pivoting at the top with bottom free to move on platform.
2. Walkways and gangways shall be designed to accommodate passenger foot traffic, bicycles and small equipment carts.
3. Gangways and walkways shall be uncovered.
4. Brow ramps shall be adjustable using electric or hydraulic motors and controls.
5. Light transmitting materials such as grating shall be considered for walking surfaces on platforms and gangways.

Vessel Mooring:

1. Mooring accessories shall accommodate all float and ferry vessel dimensional and performance requirements.
2. Mooring fitting arrangement shall not impact passenger access areas.
3. Arrangements shall protect ferry vessels from reasonably expected emergency situations
4. Desirable mooring orientation is bow into predominant SW winds
5. Terminal (float, pier, or other structures) to consider inclusion of shore-powered mooring winches, alternate mooring line arrangements, and/or higher-modulus mooring line types to reduce vessel motions, i.e. eliminate the need for running engines while moored to reduce motions.

Utilities:

1. Electrical: two power receptacles shall be located on the float. Electrical power demand to be reviewed for use with zero emission vessels.
2. Lighting: gangway and float navigational lighting shall be provide that meets applicable state, US Coast Guard, safety and ADA requirements.
3. Emergency Power: An emergency generator is not required. Emergency power for egress lighting and operational needs to allow operation during loss of permanent power (clipper card, access control, security, ramp adjustment, etc.) shall be provided via batteries or a combination of batteries and solar power.
4. Water: potable water system on float.
5. Electronic Card Reader System: Clipper card reader system shall be provided and installed. System shall include communications and power infrastructure.
6. Signage: electronic signage for vessel tracking system shall be installed on gate.

7. Fire Suppression: Per the California Building Code and California Fire Code, the terminal float is classified as an Assembly Group A-3. Consultation with the local authorities having jurisdiction (AHJ) will be required to determine fire protection requirements. A standpipe system may be required on the float, and possibly the fixed pier. Fire sprinklers may be required depending on the final configuration of an enclosed passenger shelter on the pier.
8. Sewage / Bilge: sanitary sewer connection or provisions for sewage / bilge pump out is not required.

Float Ballast System:
1. Float(s) shall utilize a freshwater ballast system. The potable water system will be used to add water to the ballast tanks for adjusting trim and freeboard of the float(s). Battery storage for electric vessels may be used as float ballast.
2. The ballast system will use hoses to fill tanks through ports in each ballast hatch cover.

D. DESIGN LOADS AND LOADING COMBINATIONS

Design loading combinations for the conceptual Berkeley Ferry Terminal are presented below. Design load combinations are summarized at the end of this section.

The terminal float and access gangway will be designed for governing design load combinations per the requirements of the 2019 California Building Code. A summary of the recommended Design Criteria for the conceptual Berkeley Ferry Terminal Project follows:

1. Gravity Loading

   pcf = pounds per cubic foot
   psf = pounds per square foot
   plf = pounds per linear foot
   kips – 1 kip = 1,000 pounds

   Dead Loads – self weight of all structures and fixed equipment, including permanent elements such as fenders, pile collars, mooring hardware, ramps and platforms, gangways and supports, utilities, permanent ballast and hydrostatic pressure.

   Unit Weights:
   Reinforced Concrete..150 pcf
   Steel ....490 pcf
   Aluminum ....165 pcf
   Fiber Reinforced Polymer...115 pcf
   Seawater ....64 pcf
   Miscellaneous Utilities ....20 plf
   Marine Growth on Submerged Surfaces ....5 psf

2. Live Loads – transient loading.
   On float access ramps and gangways..100 psf
   On float decks (uniform) ....40 psf
   On float decks (concentrated) ....650 pounds

3. Gangway and Gangway Platform
   Uniform Live Load ....100 psf
   Concentrated Live Load ....500 psf
   Maximum Gangway Live Load Deflection L/180
   Handrail
   Uniform Live Load .... 50 plf applied at the top in any direction
   Concentrated Live Load ....250 lbs applied at the top in any direction

4. Buoyancy Loads
Buoyancy forces shall consist of uplift forces applied at the rate of 64 psf of plan area for every foot of submergence below water level.

5. Mooring Loads
Mooring bitts and attachments on the float shall be designed to resist design vessel line loads. Winches or other mechanical mooring system may be used to limit vessel motions while at berth.

6. Float Tow Attachments
Attachments for float tow shall be designed for a TBD minimum breaking strength to be applied in any direction.

7. Vessel Berthing Loads
The berthing loads for the fenders shall be determined using the kinetic energy method in accordance with PIANC Guidelines for Design of Fender Systems (2002), for vessel displacement under 10,000 MT, berthed during moderate conditions.

Berthing Velocity:	1.5 feet per second
Incidence Angle:	10 degrees
Mass:	Added mass of water
Impact:	Applied at centerline of single fender

8. Float Stability Analysis
Stability analysis will be performed for the float structure consisting of hydrostatic properties, intact stability, damage stability and ballast assessment.

9. Seismic Loading

Seismic Design Category:	D
Site Class:	E
S_S:	1.733 g
S_1:	0.687 g
S_{DS}:	1.040 g
S_{D1}:	1.100 g

10. Load Combinations per 2019 CBC:

Loading	D	D+L	D+L+W	D+L+EQ	D-W	D+IM
D, Dead	1.4	1.2	1.2	1.2	0.9	1.2
L, Live		1.6	1.0	1.0		
E, Environmental						
W, Wind			1.0		1.0	
EQ, Earthquake				1.0		
IM, Accidental Impact						1.3

11. Environmental Loading:

Loading	Value
Wind (ASCE 7 3-sec gust, mph)	110
Exposure Category (ASCE 7)	D
Current (knots)	1.0
Significant Wave Height (H_S, feet)	4.9
Significant Wave Peak Period (seconds)	4.9

E. MATERIAL PROPERTIES

The following structural material and properties are anticipated to be use for the project:

Concrete

All concrete shall be reinforced and utilize a mixture design suitable for the marine environment to meet the facility service life requirement.

Structural Steel

Plates and Bars	ASTM A 131 or ASTM A 36
Wide Flange Shapes	ASTM A 992
Pipe	ASTM A 53, Grade B
Tubes: Round or Rectangular HSS	ASTM A 500, Grade B
Angles and Channels	ASTM A 36
All Other Plates	ASTM A 992
Bolts	ASTM A 325
Welding Electrodes	ASTM E 70xx
Nuts	ASTM A 194 / ASTM A 563, Grade A
Washers	ASTM F 436 / F 844

Stainless Steel

All shapes and plate	ASTM A 276 Type 316

Aluminum

Aluminum used for access gangway and walkway fabrication and other components shall be 6061-T6, 6063-T6, or per manufacturer's specification.

Bolts for use with structural aluminum shall be Type 316 stainless steel or per manufacturer's specification and approved by Engineer.

Corrosion Protection

Passive cathodic protection system shall be used on steel float and piles consisting of zinc anodes.

F. GEOTECHNICAL CRITERIA

Geotechnical criteria and parameters for preliminary and final design of the ferry berthing float guide piles and other piles will be based on site investigations and engineering studies conducted.

G. ACCESSIBILITY REQUIREMENTS

Gangway and ramps shall meet requirements of ADA-ADAAG and Draft Passenger Vessel Accessibility Guidelines. Minor deviations from accessibility standards are possible at the most extreme tides which may occur approximately several hours per year.

H. DESIGN VESSEL DATA

Parameter	Design Vessel
Vessel	WETA 200-325 Passenger Ferry
Length Overall, L	135 feet
Beam, B	35 feet
Max Displacement	166.1 LT, 168.8 tonnes
Draft, T (Hull + Appendages)	4.75 ft
Freeboard	TBD
PAX Boarding Locations	Dual Entrances, XX feet between centerline Potential Bow Loading
Max Hull Pressure	5.5 psi

Note: Terminal shall be designed to accommodate other vessels.

Table 1 – Vessel Data

Design tide elevations are based on the tidal information for Berkeley, CA NOAA Station ID 9414847 for the tidal epoch 1983-2001. Project Datum is Mean Lower Low Water (MLLW.)

Level	Elevation (feet, MLLW)
Highest Astronomical Tide (HAT)	7.6
Mean Higher High Water (MHHW)	6.1
Mean Lower Low Water (MLLW)	0.0
Lowest Astronomical Tide	-2.1

Table 2 – Preliminary Tidal Data

Climate Change Adaptation:

- Facility shall be designed to be adaptable to accommodate sea level rise induced by climate change. The assessment will consider sea level rise based on BCDC's Adapting to Rising Tides (ART) Bay Area Sea Level Rise and Mapping project.
- The estimated increase in water level represents the 50 year service life of the facility, target of year 2075 based on start of construction in 2025. The water level is interpolated in accordance with Guidance for Incorporating Sea Level Rise into Capital Planning in San Francisco: Assessing Vulnerability and Risk to Support Adaptation (2015).

Time Horizon	SLR Projections: Low Risk	Static		Dynamic	
		MHHW + SLR	100-yr Storm + SLR	MHHW + SLR + Waves	100-yr Storm + SLR + Waves
2030	0.5	6.7	10.2	8.5	12.0
2050	1.1	7.3	10.8	9.1	12.6
2070	1.9	8.1	11.6	9.9	13.4
2100	3.4	9.6	13.1	11.4	14.9

Time Horizon	Sea Level Rise (feet)		
	SLR Projections: Low Risk	Low (mean of the B1 scenario)	High (mean of the A1F1 scenario)
2030	5.6 (+/- 1.9)	2	12
2050	11.0 (+/- 3.6)	5	24
2100	36.1 (+/- 10.0)	17	66
2075	***24***	***11***	***45***

Table 3 – Sea Level Rise Estimate

Facility Security:

- Security gates will be located at the entry to the passenger shelter and to control access to the float from the gangway. A gate and security structure at the passenger shelter entrance shall include signage and notice area.

Facility Performance Requirements:

- Survive a 50 year storm event with minimal damage to facility.
- Float at extreme low tide.
- Float(s) shall be moored using steel pipe guide piles founded in competent subsurface strata.

DREDGING/NAVIGATON CHANNEL DESIGN CRITERIA

1. Channel depth
   a) Authorized channel depth should provide 4.5-ft draft ferry at least 1 foot underkeel clearance at all times during a typical year *(this clearance requires authorized depth of 8 feet (MLLW.)*
   b) Advanced maintenance dredging allowance 6".
   c) Construction tolerance 6".

d) Dredging volumes to be computed assuming depth 9 feet (MLLW), based on a-c above, using the May 2018 hydrographic survey.

2. Channel width
   a) No requirements exist for WETA ferry terminal channel width. Width to be minimized based on discussion with WETA and computed dredging volumes. *Using existing marina channel, width is fixed at 100 feet.*
   b) Dredging volumes to be computed based on May 2018 hydrographic survey and assumed width and 2H:1V side slopes.

3. Channel location
   a) Authorized channel to be private, located directly in front of terminal, running roughly parallel to existing pier on north side. *Assumption made that existing channel is also considered new work dredging. If not, existing channel may be used to reduce costs.*
   b) Channel to terminate at native channel depth equal to authorized depth.

Appendix D

Berkeley Marina Ferry Parking and Transportation Demand Management Strategy Memorandum

City of Berkeley | WETA

Berkeley Marina Ferry Parking and Transportation Demand Management Strategy

Living Draft – Last Updated October 2021

Contents

EXECUTIVE SUMMARY

The City of Berkeley and WETA are conducting a study to evaluate the feasibility of implementing new ferry service between the Berkeley Marina and San Francisco. As part of this study, the project team developed a parking and Transportation Demand Management (TDM) Strategy to support the needs of future ferry riders traveling to and from the Berkeley Marina.

This parking and TDM strategy is a living document, which will continue to be updated as the vision for ferry service evolves and parking and TDM opportunities are refined.

Study Overview

The project team analyzed existing conditions and transportation resources near the proposed ferry terminal location and identified preliminary TDM and shared parking opportunities. Based on these conditions and opportunities, the project team developed a baseline mode share and a TDM-supported mode share for future ferry riders traveling to and from the marina. To demonstrate the potential for TDM and shared parking strategies to support increased ferry ridership, the project team analyzed three parking and TDM scenarios:

Scenario 1 – Baseline: This scenario includes the baseline mode share (without TDM support) and 250 available parking spaces.

Scenario 2 – TDM-supported: This scenario includes the TDM-supported mode share and 250 available parking spaces.

Scenario 3 – TDM-supported with additional shared parking: This scenario includes the TDM-supported mode share and 300 available parking spaces.

Operational assumptions about future ferry service, including ferry size and schedule, are based on WETA's expected service plan as of January 2020. Ridership estimates are based on prior ridership modeling and analysis completed in 2012. No new ridership modeling or market analysis was conducted as part of this study.

Key Findings

- The study identified a range of TDM opportunities that could result in a decrease of 14% in drive-alone rates by incentivizing biking, carpooling, public transit, and employer-operated shuttle programs.
- As a result, the study estimates that TDM strategies could support a 27% increase in weekday ferry ridership relative to the baseline scenario.
- Additional ferry parking, which could be achieved through shared parking agreements with other marina uses, could support an additional 25% increase in weekday ferry ridership.

Figure 1 Ridership and Scenario Summary

Scenario	Parking Spaces	Mode Share	Est. Weekday Ferry Riders
Scenario 1: Baseline	250	Baseline	950
Scenario 2: TDM-Supported	250	TDM-Supported	1,208
Scenario 3: TDM and additional parking	300	TDM-Supported	1,449

Figure 2 Mode Share Summary

Travel Mode	Baseline Mode Share	TDM-Supported Mode Share	
		Mode Share	Change from Baseline
Walk	3%	3%	0%
Drive Alone	54%	40%	-14%
Bike	18%	22%	4%
Carpool	9%	12%	3%
Public Transit	4%	7%	3%
Drop Off	8%	8%	0%
Employer Shuttle	0%	3%	3%
TNCs	3%	4%	1%
Other	1%	1%	0%

PROJECT CONTEXT

New ferry service at the Berkeley Marina would be a valuable travel option between San Francisco and the East Bay, but attracting and retaining ferry riders will require convenient and effective transportation options for accessing the service.

Future ferry riders who drive and park at the Marina may increase traffic congestion to and from the marina. Alternatively, well-designed bicycle and pedestrian networks, and programs that encourage transit use and carpooling, are effective non-driving options that bring ferry users to the marina, without generating additional traffic or requiring more parking spaces to be built.

This document identifies TDM strategies that support new ferry service at the Berkeley Marina while minimizing parking demand and the negative impacts of vehicle traffic. Three scenarios were developed to demonstrate different levels of ferry ridership that could be supported based on varying levels of TDM investment, and availability of shared parking opportunities.

Figure 3 Berkeley Marina and Proposed Ferry Terminal Location

EXISTING CONDITIONS

Parking Supply

Today, there are nearly 1,800 parking spaces located throughout the Berkeley Marina. While some of these spaces are restricted for specific marina users or are located far from the proposed terminal location, others are well-suited for shared parking arrangements with weekday ferry riders. As part of the Berkeley Waterfront Parking Study, the city has studied several conceptual parking options near the proposed ferry terminal site, including an option which would add on-street parking on University Ave and Seawall Drive.

Additional information about parking supplies and regulations can be found in the Berkeley Waterfront Parking Study.[1]

Transit Services

DIRECT BUS SERVICE

The only transit route that serves the Berkley Marina is AC Transit's 51B line. This bus route connects between Rockridge BART and Seawall Drive via College Avenue, Downtown Berkeley BART, and University Avenue. Only one out of every three scheduled trips between 7AM and 9PM provides service to the Marina—all other trips terminate at the Berkeley Amtrak station. This schedule equates to 30-minute headways.

AMTRAK SERVICE

Amtrak Capitol Corridor services the Berkeley Station on University Avenue, which is approximately 1.3 miles from the proposed ferry terminal location at the Berkeley Marina. Eleven trips run during the weekday and nine trips on the weekends. The route's main hubs are San Jose and Sacramento.[2]

Figure 4 Transit Access to Berkeley Marina within 2 miles

Route	Operator	Distance from Proposed Ferry Terminal Location
Bus 51B	AC Transit	0 miles (University Avenue & Seawall Drive)
Capitol Corridor	Amtrak	1.3 miles (Berkeley Station)
Bus FS	AC Transit	1.4 miles (University Avenue & 6th Street)
Bus G	AC Transit	1.4 miles (University Avenue & 6th Street)
Bus 72/72R/72M	AC Transit	1.7 miles (University Avenue & San Pablo Avenue)

[1] Revised Short-Term Recommendations for Waterfront Parking Management – DRAFT Memorandum, Dated 9/11/18. Nelson/Nygaard. See Appendix A.

[2] Amtrak (2012) Capitol Corridor Route Map. *Retrieved from* https://www.capitolcorridor.org/route-map/

Bicycle Facilities

The Bay Trail is a walking and bicycling path encircling San Francisco Bay that is currently being constructed in segments. As of August 2020, 350 out of the planned 500 miles of the trail have been completed including a continuous segment along the I-80 frontage road from Emeryville to Albany. This portion of the trail provides high-quality bike and pedestrian access to the vicinity of the marina from residential areas, job centers, and regional attractions throughout the East Bay.

The Bay Trail Bicycle and Pedestrian Bridge across I-80 connects the main line of the Bay Trail to existing and planned Bay Trail extensions within the Marina itself. As of August 2020, completed segments of the Berkeley Bay Trail Extension connect the South Cove East Lot and the Adventure Playground. When completed, the Bay Trail Extension will provide continuous trail access between the Bicycle and Pedestrian Bridge and the proposed Marina site.

Other existing bicycle facilities within the marina include a mix of paved and unpaved bicycle trails, paths and routes. Eight bike racks are currently available throughout the Berkeley Marina, five of which are close enough to the proposed ferry terminal location to serve ferry commuters. By May 2021, the City of Berkeley will install 20 bicycle e-lockers near the current location of the Hana Japan restaurant. WETA ferries can currently accommodate a maximum of 30-50 bicycles on board, depending on the class of vessel.

Figure 5 Existing Berkeley Bicycle Network (Berkeley Bicycle Plan 2017)

Bikeshare Services

Bay Wheels is the regional bikeshare operator in the City of Berkeley as well as Oakland, Emeryville, San Francisco and San Jose. Today, the closest Bay Wheels bike station is located near Addison and 4th Street, which is over a mile from the proposed ferry terminal location. While Bay Wheels does not currently offer dockless bikes in the East Bay, an evaluation of the network design is underway and will likely result in modifications to the system in the future.

Carsharing services

GIG is a carsharing company that operates a fleet of free-floating cars in Berkeley, Oakland, and San Francisco. Users pay by the minute, hour, or by day and can travel freely. While users to do not have to pay for meters, a vehicle must be parked in the 'home zone' at the end of a trip. The boundary of the home zone runs along Second Street, 1.5 miles from the marina.

Ridehailing and Transportation Network Companies

Transportation Network Companies (TNCs) such as Uber and Lyft offer shared or personal rides in private vehicles using smartphone-based dispatching apps. TNC services provide flexible first- and last-mile connections that do not require parking.

Shuttle services

While there are no shuttle services that connect to the Berkeley Marina, there are opportunities for the City to coordinate with existing shuttle operators, Transportation Management Associations (TMAs), and employment sites to add or expand routes.

WEST BERKELEY SHUTTLE

The West Berkeley Shuttle is a free first-mile/last-mile connector from Ashby BART to West Berkeley corridors. The Berkeley Gateway Transportation Management Association sponsors the route, which primarily serves West Berkeley's employers. As an employment-focused shuttle, it operates during peak commute hours. The nearest stop is 1.5 miles from the Berkeley Marina at Dwight Way and 7th Street.

SENIOR CENTER SHUTTLE PROGRAM

Berkeley sponsors shuttle trips for older Berkeley residents who are registered with the senior center. Shuttle service includes trips to local groceries stores, personal errands, and trips to points of interest and essential services. Trips are published in the monthly newsletter and senior center members sign up to participate.

BEAR TRANSIT

The University of California, Berkeley operates Bear Transit shuttle service. This fixed-route shuttle provides all residents access to the city's downtown district. The public is eligible to ride for $1.00 per trip, although the provision of service for the public is not well advertised. UC Berkeley affiliates may ride the service free of charge. Currently, Bear Transit does not have stops near the marina.

Paratransit Services

EAST BAY PARATRANSIT

East Bay Paratransit is the ADA-mandated program that provides curb-to-curb service for people with disabilities in Berkeley. It operates within ¾ mile of AC Transit bus routes and BART stations. A person is eligible if they qualify under the American Disabilities Act (ADA) guidelines. To apply for eligibility, Berkeley residents must fill out an application and arrange for an in-person interview.[3]

[3] https://www.eastbayparatransit.org/eligibility.htm

TDM STRATEGIES AND OPPORTUNITIES

Bicycle Strategies

Estimated Mode Share Increase: 4%

Bicycle Network Improvements

The San Francisco Bay Trail is a planned walking and cycling path around the entire San Francisco Bay. Plans for the Bay Trail include the completion of a spur that runs along the perimeter of the Berkeley Marina and connects to the existing bicycle/pedestrian bridge over I-80. The completion of this spur will provide a high-quality circulation and access route for bicyclists traveling to or from ferry service at the Berkeley Marina.

Bicycle facilities within the Marina should be designed for bicyclists of all ages, physical abilities, and experience levels. Off-street bicycle paths that are well-marked and are protected from vehicular traffic would encourage bicycle use among people who are less willing or able to bike on a shared roadway or in mixed traffic.

Traffic calming measures on all roads within the Marina would make bicycling safer and accessible for all types of users. Traffic calming features to support bicycling in the Marina could include:

- Road humps that reduce vehicle speed, especially along straight and wide road segments
- Chicanes can reduce speed along segments using horizontal deflection
- Bulb-out reduces pedestrian and bicycle crossing distances and reduce vehicular speeds by narrowing roadway at intersections

Bicycle Parking

Secure and convenient bicycle parking within a short walking distance of the ferry terminal would encourage and support bicycling to and from the ferry. Different types of bicycle parking can appeal to different users—some bicyclists value secure and weather-protected bike cages or lockers, while others prefer simple racks that are easy to access quickly. A mix different bicycle parking options for the ferry could include:

- Bike Racks: simple and durable bike racks for quick, easy access
- Bike Lockers: fully enclosed and weather-resistant single-bicycle lockers
- Enclosed Bike Cages: fenced enclosure containing multiple bike racks

Bike Valet and Repair Services

A bike valet service is a staffed facility where bicyclists can safely and securely store their bicycles—much like a traditional valet service. A bike valet service would make it easier, more convenient, and more appealing for ferry riders to travel to and from the Berkeley waterfront by bike. Some bike valet services charge a fee to users, while others are free. Bicycle maintenance and repair services could be integrated into a bike valet station to make bicycle use even more convenient and reliable for ferry riders.

Promotions and Marketing

Marketing campaigns, informational materials, and promotional discounts for bicyclists would help encourage ferry-riders to try biking instead of driving. On-board bicycle marketing materials are already offered on other WETA services and should be extended to Berkeley service. Special “bike to the ferry” days that provide free or discounted fares for bicyclists would raise bicycle awareness and help riders form new bicycling habits that last beyond the discounts themselves.

Bikeshare Services

Bikeshare services can make bicycling a viable option for ferry riders who may have different travel constraints for their outbound trip than they do from their return trips. A conveniently-located and easy-to-find bikeshare station should be located within sight of the ferry terminal to encourage bikeshare use. A designated space for dockless shared bicycles and other micromobility devices should be provided to mitigate sidewalk clutter and avoid any access impacts from improperly parked bicycles.

Transit and Shuttle Strategies

Estimated Mode Share Increase: 6%

Transit Facility and Access Improvements

A seamless transfer between proposed ferry service and existing AC Transit bus service would encourage transit ridership and improve non-driving access to the Marina. Sidewalks that connect the ferry pier to nearby bus service should be supported with lighting, signage, wayfinding, and other design elements that make transit service appealing and attractive to ferry riders. Bus shelters should be designed to provide shelter from the rain but should also be spacious and well-lit. Bus boarding areas should be level, unobstructed, and easy to access for people with all different physical abilities.

Increased Service Frequency and Schedule Coordination

Bus service on route 51B provides a direct connection from the Marina to Downtown Berkeley, the UC Berkeley Campus, and BART stations. Increasing the frequency of this route to reduce wait times for ferry passengers would make transit a more reliable and convenient alternative to driving and parking.

Bus schedules and ferry schedules should be coordinated to minimize wait times for riders connecting by transit. For bus arrivals to the marina, schedules should be planned with no more than 5 to 10 minutes between bus arrival and ferry departure. For bus departures, buses should be queued near the outbound bus stop and, if possible, should remain at the stop until the inbound ferry has arrived and all passengers have disembarked.

Free or Discounted Transfers

Free or discounted transfers between ferry service and other transit services would incentivize riders to use transit instead of driving and parking. Transfer discounts also help ensure that the cost of riding transit is not higher than the cost of driving and parking and help mitigate rider perceptions of being “double-charged” for using transit.

Today, ferry riders who pay with Clipper are reimbursed for the cost of their AC Transit bus ride to get to or from WETA ferry terminals. This transfer policy could be expanded to provide free transfers with AC transit bus service in the Berkeley Marina to support more seamless, car-free end-to-end trips for ferry riders.

Shuttle Services

Shuttle services to the Berkeley Marina would provide direct connections between ferry service and nearby employment centers or regional destinations that may not be accessible by transit. Shuttle services could include new shuttle service to the UC Berkeley campus or nearby medical centers or the extension of existing Emery Go-Round circulator service to the Berkeley Marina. Shuttle schedules should be coordinated with ferry arrival and departure schedules to minimize wait times for shuttle riders.

After a schedule for Berkeley ferry service has been refined and finalized, the City and WETA should engage local employers and Transportation Management Associations (TMAs), including emery Go-Round, to identify opportunities for shuttle service at the Berkeley Waterfront. Discussions should address:

- Shuttle scheduling and coordination
- Shuttle stop design and operational requirements
- Funding opportunities
- Branding and marketing

Carpooling, Ridesharing, and TNC strategies

Estimated Mode Share Increase: 4%

Preferential Carpool Parking

Incentivizing carpooling and ridesharing uses parking resources more efficiently by increasing the average occupancy of each vehicle. Rewarding carpoolers with preferred parking that is close to the ferry terminal can increase carpooling rates. Parking discounts can also help promote carpooling, but parking discounts should not be so large that they incentivize driving over other more sustainable travel modes.

Ride-Matching Services and Marketing

Increasing carpooling rates depends on ferry riders being able to coordinate travel plans with each other. For some riders, finding a carpool partner or group may happen through informal conversation aboard the ferry. For other riders, ride-matching services can be valuable for identifying fellow riders who have similar travel patterns and facilitating the formation of regular carpool groups for daily commuters.

Scoop and Waze Carpool are two app-based services that allow users to offer and request shared rides with other travelers. TNC companies also offer shared rides that are typically discounted relative to private rides. Marketing these services and offering discounts for ferry riders could help travelers create carpool groups and encourage shared rides to and from the ferry.

Transportation Network Companies (TNCs)

TNC services, such as Lyft and Uber, could provide private or shared rides between the ferry and nearby destinations or transit hubs. Discounts or subsidies for ferry riders who make use TNCs to get to or from the ferry terminal would make it easier to use the ferry without driving alone and parking.

Today, ferry riders in Solano county can apply to participate in a program that offers discounted Lyft rides to and from the Vallejo Ferry terminal.[4] The program is managed by Solano Mobility, and provides participants with an 80% discount (up to $25) for up to 45 eligible rides per month.

Pick-up and drop-off area

A designated pick-up and drop-off area should be provided near the ferry terminal to support ride-matching services, TNCs, and “kiss-and-ride” or private vehicle drop-off activities. The designated area should include a safe, level, and well-lit curb and sidewalk space for passenger waiting as well as clear and easy-to-recognize signage. The pick-up/drop-off area should be separated from transit and shuttle loading areas and circulation routes to prevent conflicts between these services.

Parking Management Strategies

The City of Berkeley completed a study of parking supply, demand, and management strategies in the Berkeley Waterfront in 2018 (see Appendix A). That study identified a number of recommendations for managing parking more efficiently and balancing the needs of all the different uses and activities in the waterfront. Many of the recommendations could be used to help manage ferry parking, including:

- **Priced parking,** which could help manage parking demand in the most centrally-located lots and encourage people to use underutilized lots for longer-term parking. A pricing structure could be designed to allow short-term and medium-term parking free of charge (for example, up to 4 hours) while requiring an hourly or flat rate for all-day parking (including ferry riders).

[4] For more information, visit https://sanfranciscobayferry.com/vallejo-ferry-lyft-discount-solano-mobility

- **An expanded parking permit program**, which could facilitate shared parking in facilities used by both frequent users (including slipholders and regular ferry riders) and less frequent visitors (including recreational visitors).
- **Increased enforcement,** which can make more efficient use of available supply by preventing long-term parking in violation of posted time limits. Enforcement could be funded in part by revenue from priced parking.
- **Improved information,** which is essential for helping waterfront visitors and ferry riders find available parking and adhere to posted time limits and restrictions.

Ferry parking regulations and management tools should be fully integrated into a waterfront-wide strategy that supports shared parking, minimizes complexity, and balances the needs of the many different users and activities.

MODE SHARE DEVELOPMENT

Berkeley Baseline Mode Share

To help identify and refine effective TDM strategies for future ferry service to the Berkeley Marina, a baseline mode share estimate was developed (Figure 6**Error! Reference source not found.**). This **Berkeley Baseline estimate** is based on available mode share data from on-board passenger surveys conducted by WETA on existing ferry routes (2017 and 2018), previously-completed ridership forecasts and modeling efforts for Berkeley ferry service (2012), and a review of available travel mode share data in Berkeley.

The purpose of the Berkeley Baseline is to demonstrate expected travel behavior to and from ferry service at the Berkeley Marina under typical conditions. The baseline estimate reflects existing and planned transportation infrastructure, services, and resources as described in the previous section, but does not reflect additional TDM support.

TDM-Supported Mode Share

A variety of TDM strategies were studied, evaluated, and selected based on their estimated effectiveness at supporting non-driving travel to and from the Berkeley Marina. The estimated changes in travel mode share resulting from these TDM strategies is based on trip reduction quantification guidance published by the California Air Pollution Control Officers Association (CAPCOA).[5] The expected change in travel mode share was applied to the Berkeley Baseline to calculate the expected **mode share with TDM support** (Figure 6**Error! Reference source not found.**).

Many different factors can impact the effectiveness of TDM programs on travel behavior. The TDM-supported mode share for Berkeley ferry service represents a realistic and optimized estimate of TDM effectiveness assuming robust and coordinated TDM program support. Furthermore, TDM programs are most effective when they are flexible, adaptable, and supported by regular data collection and monitoring. Over time, these TDM strategies should be modified or augmented as needed to achieve continued success.

[5] Available at http://www.capcoa.org/wp-content/uploads/2010/11/CAPCOA-Quantification-Report-9-14-Final.pdf

Figure 6 Mode Share and TDM Support Summary

Travel Mode	Berkeley Baseline	With TDM Support	Change	Rationale and Supporting TDM Programs
Walk	3%	3%	0%	No expected change
Drive Alone	54%	40%	-14%	Based on total increased use of other travel modes
Bike	18%	22%	4%	Bike network improvements, secure bike parking, bike share services, traffic calming measures, and marketing/promotional campaigns
Carpool	9%	12%	3%	Preferential parking, marketing and discounts for ride-matching services such as Waze or Scoop
Public Transit	4%	7%	3%	Increased service frequency and schedule coordination with ferry, free or discounted transfers, transit facility and access improvements
Drop Off	8%	8%	0%	No expected change
Employer Shuttle	0%	3%	3%	Coordinate with area employers and institutions to implement shuttle service (UC Berkeley, Emery Go-Round, medical centers and hospitals)
TNCs	3%	4%	1%	Circulation and access improvements, constrained parking
Other	1%	1%	0%	No expected change

PARKING AND TDM SCENARIOS

Scenario Development and Assumptions

Three parking and TDM scenarios were developed for potential ferry service at the Berkeley Marina. The purpose of these three scenarios is to demonstrate the different levels of ferry ridership that could be supported given different levels of TDM investment and parking availability. Each scenario includes:

- A **mode share estimate** that forecasts the travel behavior of ferry riders traveling to ferry service at the Berkeley Marina during weekday AM peak travel times
- A **parking supply assumption** about the number of parking spaces available for ferry riders, including shared parking spaces (where applicable)
- A **ridership estimate** that describes how many ferry riders could be supported given the mode share estimate and the parking supply assumptions (including both AM peak-direction ridership and total weekday ridership)

Ridership Assumptions

The baseline estimate used to analyze these parking and TDM scenarios is based on previous ridership forecasts completed in 2012[6] as well as current ridership on other ferry routes between San Francisco and the East Bay. Ridership estimates for the AM peak direction include all three AM trips from Berkeley to San Francisco. Total daily ridership estimates include all trips in all directions.

Regional travel patterns and land use assumptions have changed since ferry ridership forecasts were last updated, and these conditions will continue to evolve in the coming years. Ridership forecasts are used in this analysis to illustrate the potential for TDM strategies and shared parking opportunities to support increased ferry ridership. This sensitivity analysis will be updated as needed based on future changes to ferry ridership projections or service assumptions

Figure 7 Summary of Parking and Ferry Ridership for Three Scenarios

Scenario	Parking Spaces	Mode Share	Est. Weekday Ferry Riders
Scenario 1: Baseline	250	Baseline	950
Scenario 2: TDM-Supported	250	TDM-Supported	1,208
Scenario 3: TDM and additional parking	300	TDM-Supported	1,449

[6] Baseline ridership for scenario analysis is a rounded average of Alternative 2 (peak-hour service, 2015) and Alternative 3 (peak-hour service, 2035) from WETA's 2012 ridership model update.

Parking Assumptions:

Parking assumptions are based on guidance from WETA and the city of Berkeley provided during the on-site circulation workshop held on January 24, 2020, and are aligned with WETA's policies and standards. Scenarios 1 and 2 assume that 250 spaces could be allocated through a combination of parking along Seawall Drive, University Avenue, and parking lots north of University Avenue near the proposed ferry terminal location. Scenario 3 assumes that an additional 50 spaces could be allocated by implementing a shared parking arrangement to use a portion of the parking lot at 199 Seawall Drive.

Figure 8 Study Area and Existing Parking Locations

Scenario 1: Baseline

This scenario is intended to provide a baseline condition for new ferry service at the Berkeley Marina.

- The mode share estimate for this baseline scenario does not include the impacts of any TDM efforts beyond the existing programs available on other East Bay ferry services.
- The parking supply assumption for this scenario is **250 spaces**.
- The ridership estimate for this scenario is approximately **950 weekday riders.**

Figure 9 Scenario 1 - Weekday AM Travel Mode Share and Ridership

Travel Mode (AM arrival to ferry)	Mode Share	Ferry Riders
Walk	3%	13
Drive Alone	54%	231
Bike	18%	77
Carpool (avg. 2 people per vehicle)	9%	38
Public Transit	4%	17
Drop Off	8%	34
Employer Shuttle	0%	0
TNCs	3%	13
Other	1%	4
Total est. Riders (AM peak direction)*	**100%**	**427**
Total est. Riders (weekday total)**	**-**	**950**

*Includes Berkeley Ferry riders traveling from Berkeley to San Francisco on morning ferry trips

**Includes all Berkeley Ferry riders in both directions on weekdays, including est. 10% reverse-commute riders

Figure 10 Scenario 1 - Weekday AM Parking Assumptions

Travel Mode (AM arrival to ferry)	Parking Spaces	Ferry Riders
Total	**250**	**269**
Drive Alone	231	231
Carpool (avg. 2 people per vehicle)	19	38

Scenario 2: With TDM Support

This scenario demonstrates the potential benefits of TDM alone to support additional ridership on ferry service at the Berkeley Marina.

- The mode share estimate for this scenario reflects TDM impacts on ferry rider travel behavior. Increasing the rate of biking, carpooling, using public transit, and employer shuttles, allows more riders to access ferry service at the Berkeley marina without increasing the parking supply.
- The parking supply assumption for this scenario is **250 spaces**.
- The ridership estimate for this scenario is approximately **1,208 weekday riders.**

Figure 11 Scenario 2 – Weekday AM Travel Mode Share and Ridership

Travel Mode (AM arrival to ferry)	Mode Share	Ferry Riders
Walk	3%	16
Drive Alone	40%	217
Bike	22%	120
Carpool (avg. 2 people per vehicle)	12%	65
Public Transit	7%	38
Drop Off	8%	43
Employer Shuttle	3%	16
TNCs	4%	22
Other	1%	5
Total est. Riders (AM peak direction)*	**100%**	**543**
Total est. Riders (weekday total)**	**-**	**1,208**

*Includes Berkeley Ferry riders traveling from Berkeley to San Francisco on morning ferry trips

**Includes all Berkeley Ferry riders in both directions on weekdays, including est. 10% reverse-commute riders

Figure 12 Scenario 2 - Weekday AM Parking Assumptions

Travel Mode (AM arrival to ferry)	Parking Spaces	Ferry Riders
Total	**250**	**282**
Drive Alone	217	217
Carpool (avg. 2 people per vehicle)	33	65

Scenario 3: With TDM and Additional Parking

This scenario demonstrates the combined benefits of TDM and shared parking to support additional ridership on ferry service at the Berkeley Marina.

- The mode share estimate for this scenario reflects TDM impacts on ferry rider travel behavior. Increasing the rate of biking, carpooling, using public transit, and employer shuttles, allows more riders to access ferry service at the Berkeley marina without increasing the parking supply.
- The parking assumption for this scenario is **300 spaces.** This increase of 50 spaces could be achieved through a shared parking arrangement to provide weekday access for ferry riders to a portion of the lot at 199 Seawall Drive or another comparable location.
- The ridership estimate for this scenario is approximately **1,449 weekday riders.**

Figure 13 Scenario 3 – Weekday AM Travel Mode Share and Ridership

Travel Mode (AM arrival to ferry)	Mode Share	Ferry Riders
Walk	3%	20
Drive Alone	40%	261
Bike	22%	143
Carpool (avg. 2 people per vehicle)	12%	78
Public Transit	7%	46
Drop Off	8%	52
Employer Shuttle	3%	20
TNCs	4%	26
Other	1%	7
Total est. Riders (AM peak direction)*	**100%**	**652**
Total est. Riders (weekday total)**	**-**	**1,449**

*Includes Berkeley Ferry riders traveling from Berkeley to San Francisco on morning ferry trips

**Includes all Berkeley Ferry riders in both directions on weekdays, including est. 10% reverse-commute riders

Figure 14 Scenario 3 - Weekday AM Parking Assumptions

Travel Mode (AM arrival to ferry)	Parking Spaces	Ferry Riders
Total	**300**	**339**
Drive Alone	261	261
Carpool (avg. 2 people per vehicle)	39	78

Appendix A Berkeley Waterfront Parking Study

Revised Short-Term Recommendations for Parking Management

MEMORANDUM

To: City of Berkeley Department of Parks, Recreation and Waterfront (PRW)

From: Nelson\Nygaard Project Team

Date: September 11, 2018

Subject: Revised Short-Term Recommendations for Waterfront Parking Management - DRAFT

INTRODUCTION

The purpose of this memo is to identify a clear path forward over the next two years for the City of Berkeley's Waterfront with regards to managing their public parking supply. Based on a number of solutions currently employed and recommended for the Waterfront, this path will help achieve a better balance between the existing supply of parking, and the extreme peaks of parking demand during the busiest seasons, days, and times of the year at the Berkeley Waterfront by various user groups.

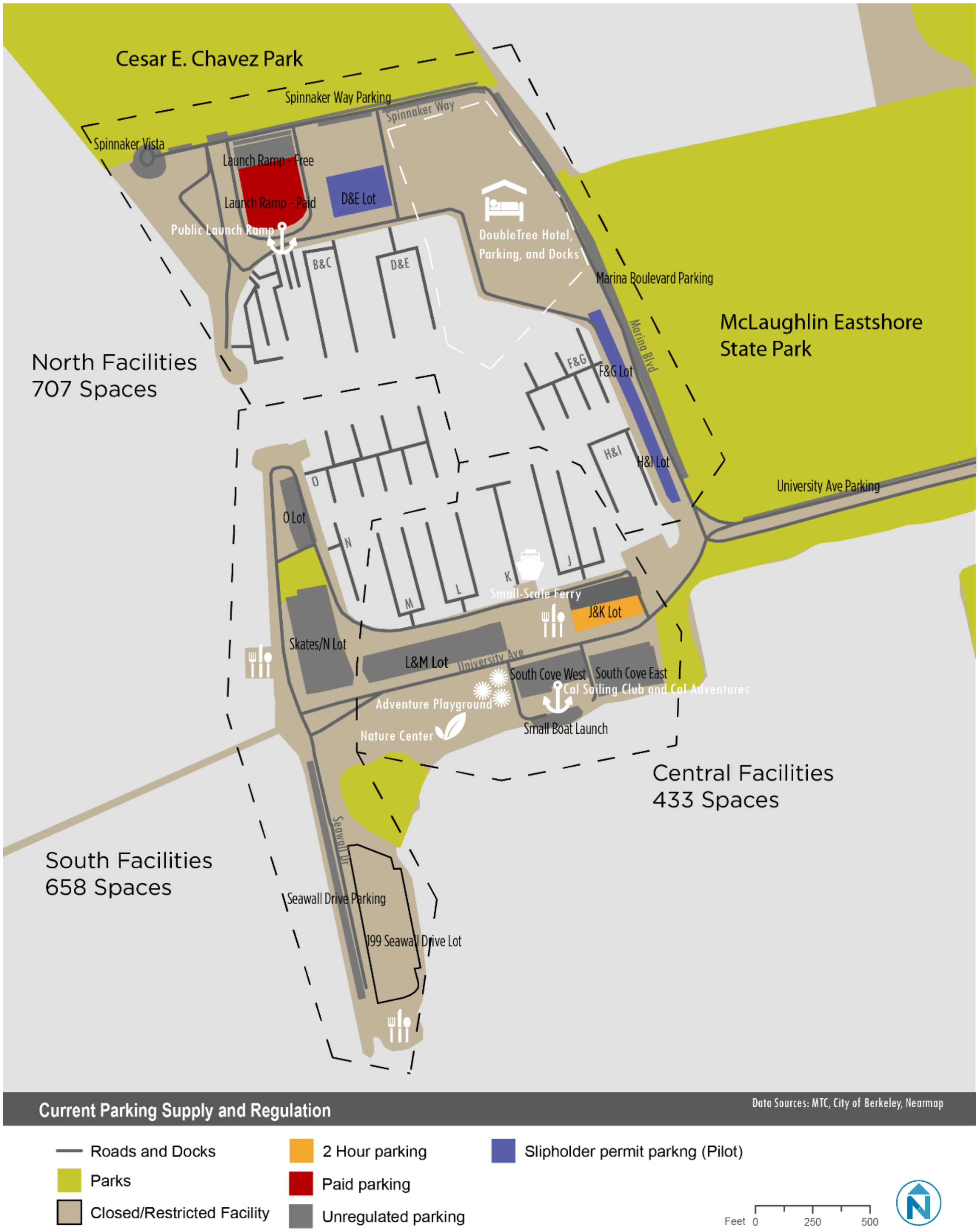
Context

The Berkeley Waterfront is three miles west of downtown Berkeley between the San Francisco Bay and the Eastshore Freeway (Interstate 80/580) and accessible by vehicle via University Avenue, the pedestrian overcrossing bridge, and the Bay Trail for people walking and riding bikes. The Waterfront surrounds the Berkeley Marina, and essentially comprises three distinct sections (North, South, and Central). Each section of the Waterfront evaluated by this study (excluding the University Avenue Approach) is accessible by a single two-lane road. Parking lots are well distributed throughout the Waterfront, combining to approximately 1,700 spaces across 14 off-street facilities. Figure 1 on the following page illustrates the existing parking inventory.

Our team reviewed satellite data, which indicated peak parking demand met or exceeded 85% in the Central Parking Lots during days when the Waterfront is especially popular with a variety of visitors (such as Sunday afternoons in August and September). During weekdays, centrally-located lots, particularly the J&K Lot and L&M Lot, experience as much as 89% and 93% occupancy, respectively[1]. These findings were corroborated by City of Berkeley Parks Recreation and Waterfront (PRW) Staff.

[1] See Appendix of Satellite Parking Utilization Counts

Figure 1 Existing Parking Inventory



KEY ISSUES AND RECOMMENDED STRATEGIES

Summary of Waterfront Parking Issues and Needs

As expected in a dynamic recreation area containing a variety of amenities, parks, services, and destinations, the Berkeley Waterfront has several distinct users, each with unique needs.

1. **Overcrowding at South Cove lots due to mixed uses/user groups.** The South Cove lots have multiple users that come to the Waterfront at similar or overlapping times, resulting in a peak period in which the lots are full. Users of South Cove include Adventure Playground patrons, ferry passengers, and employees who work on the Waterfront.
2. **All-day parking (charter and ferry customers) occupy spaces for relatively long periods of time in order to seek access to central docks and locations.** Ferry and charter boat customers tend to arrive early and utilize the highest demand spots closest to the K-Dock. Their vehicles remain in the prime spots in excess of eight hours per day and leave no room for turnover. This creates an issue for those making quicker trips to the South Cove, Adventure Playground, Nature Center, Summer Camp drop off, and customers of the marina office, Berkeley Sportsman's Center, and the 125-127 University Avenue office buildings. Many ferry and charter boat customers show a preference for the newly paved South Cove East Lot over the unpaved South Cove West Lot, in addition to J&K and J&M Lots. Ferry customers have not heeded recent signage (placed on South Cove, J&K, and L&M Lots) to park on Marina Boulevard instead.
3. **Locations needed for watersports community to park.** Many recreational watersports activities (such as windsurfing) require the use of the new green turf area on the northern edge of the South Cove East lot (to prepare and rig their large equipment), the adjacent parking stalls (for convenient loading and unloading), and the adjacent wide path of travel (to access the launching docks in the South Sailing Basin). The parking spaces adjacent to the green space are also desirably located spaces for ferry and charter customers because of their proximity to K-Dock and attractive appearance. Over the summer, many watersports users reported that they were unable to find parking next to the green space on weekday afternoons. Several complaints by watersports users seeking safe and convenient access to the rigging area from their vehicles were filed with PRW Staff in the months of June, July, and August of 2018. A-Frame signs placed in August 2018, have since been moderately effective at reserving the parking stalls adjacent to the green space for watersports users.
4. **Importance of maintaining adequate slipholder parking close to docks.** Every dock at the Marina has a nearby shared parking lot. Some shared lots fill with the vehicles of other park users, limiting access for slipholders at peak times.
5. **Importance of maintaining parking for Hana Japan customers in lot.** Hana Japan is only open for dinner when other Waterfront users tend to be leaving. However, in the summer, parking for Hana Japan customers often overflows to the unlit South Cove lots across University Avenue. This is an issue, as stakeholders have reported multiple vehicle break-ins over the course of an average week at the Marina.[2]

[2] See Appendix of Stakeholder Survey Results

6. **Minimize overnight parking/camping, long-term parking, and vehicles as storage.** Although overnight parking is permitted only for slipholders and their guests, there are people are staying overnight in RVs and other vehicles.[3]

Overall, there is a consistent need to optimize and facilitate convenient parking for Waterfront user groups.

Solutions Currently Employed

Efforts to date to remedy current imbalances between parking supply and demand include a permit program for slipholders and guests. This pilot permit program became effective on June 4, 2018 for four of the North Lots (B&C, D&E, F&G, H&I Lots)[4]. For slip-holders at those locations, hangtags are distributed to slipholders by Marina staff, and guest permits are granted by request. Waterfront staff have issued citations at the aforementioned locations as well as the Paid Launch Ramp to vehicles parked without a permit in B through I Lots, or without payment in the Launch Ramp lot. Plans are being made to roll out a similar program for J&K lot, L&M lot, and N&O Lot..

Since the implementation of the pilot permit program, vehicle counts have indicated:

- a **60% reduction of illegitimately parked vehicles** in B through I Lots.[5]
- a **reduction of up to 20% for all vehicles** parked in B&C, D&E, F&G, and H&I Lots on summer weekend afternoons.[6]

Additional solutions were employed with the initiation of Small Scale Ferry Service.[7] With as many as 91 passengers[8] using Prop SF services and 129 passengers using Tideline services[9], the ferry has increased demand for all-day parking at the Waterfront, particularly surrounding K-Dock, where ferries depart.

During the reconstruction of South Cove East Lot (from November 20th, 2017 to May 31st, 2018), all ferry passengers and charter boat users were directed to the J&K and L&M Lots, which have a combined capacity of 229 cars. However, during summer month weekdays, office staff, Adventure Playground patrons, and summer camp staff could not access these lots because they were usually full. For example, aerial images on Thursday, May 10th, 2018 showed J&K Lot to be 88% occupied, despite the two-hour time limit in effect in half of that lot. Meanwhile, on the same day, the 200-space Marina Boulevard Lot (the southern end of which is approximately 1,000 feet walking distance from K-Dock) was only 31% occupied. [10] During this timeframe, several complaints were made by slipholders about congestion in J&K and L&M Lots.

In June, upon the reopening of the South Cove Lot in June, ferry passengers were directed to park in the South Cove Lots to reduce the burden on J&K and L&M Lots from all day parkers. This

[3] Overnight parking is permitted for up to three consecutive nights (72 hours) in parking lots at the Waterfront (BMC 6.20.250). Overnight camping, however, and vehicles used as storage, are not permitted by the Berkeley Municipal Code (BMC 6.20.260).

[4] The Parking Permit Program does not apply to the paid launch ramp lot.

[5] Counts were conducted by PRW Staff

[6] See Appendix of Satellite Parking Utilization Counts

[7] Small Scale Ferry Service began in November 2016 with the introduction of Tideline.

[8] One-way ridership count from Tuesday, July 24, 2018

[9] One-way ridership count from Tuesday, February 6, 2018

[10] See Appendix of Aerial Parking Utilization Counts

coincided with the busiest months at the Waterfront for the South Cove Lots and resulted in substantial congestion, and limited access for watersports and recreational users at South Cove. Since re-opening, South Cove East Lot experiences as much as 90% occupancy (Figure 2).

Since August 29th, 2018, ferry passengers have been directed to park in the Marina Boulevard Lot with signage and communication by PropSF and Tideline to their customers. However, very few users, if any, have heeded this request. Ferry customers continue to park in South Cove East, J&K, and L&M Lots due to a lack of enforcement. Since re-opening, South Cove East Lot experiences as much as 90% occupancy (Figure 2).

Figure 2 Aerial of South Cove East Lot after Reconstruction (July 7th, 2018)[11]

Lastly, signage was recently placed on many facilities (including South Cove Lots) stating applicable parking regulations. However, this signage should be improved with larger fonts and less information. In Figure 3, the new sign can be seen on the light pole above the old sign and in Figure 4, the new sign is the only one on the light pole.

[11] Source: Nearmap

Figure 3 Photo of South Cove East Lot with New Sign

Figure 4 Photo of South Cove West Lot with New Sign

Proposed Policies

The policies in this memo are proposed to be employed over the next two years.

Progressive Pricing

When employed in any context, pricing should be seen as a means to encourage safe and legal use of parking facilities, as well to promote sufficient turnover to ensure adequate access to a location across the course of a day. The primary goal of pricing parking should *not* be a source of revenue, as the price needed to cover program expenses vs. that to promote turnover are not always aligned. In the case of the Berkeley Waterfront, the key need is to reduce overcrowding in centrally-located facilities and encourage all-day users to park their car at slightly more distant facilities, thus opening up more central access to short-term parkers.

Fees

There are precedents for user fees in Berkeley, on the Berkeley Waterfront, and nearby East Bay marinas. For example, the City Council has approved a $1 entry fee for Adventure Playground (although it has yet to be implemented). There is also a gate-controlled parking and launch ramp area on the northern side of the Waterfront, charging $15 per entry, along with Doubletree Hotel parking charging $20 per day for self-parking and $9 for the first three hours[12]. Nearby marinas, including Richmond and Emeryville, charge $10 for 24-hour access to the launch and central slips.

To that end, a $10 fee is proposed for users that need all-day parking at the South Cove Lot, a centrally-located, high-demand, and recently paved facility on the Waterfront. Users who desire to park for fewer than four hours would not have to pay a fee, thus ensure that casual visitors to Hana Japan and the Adventure Playground are not deterred from visiting those destinations.

Payment Methods

The most advantageous payment method is a pay-by-phone mobile app service, because it bears the lowest capital and implementation costs. Payments should be linked to a registered vehicle and license plate, and should produce no physical receipts, reducing the risk of additional trash on the Waterfront. Visitors without a smartphone or credit card should have the option of paying in cash at the Waterfront offices.

In the immediate implementation timeline (Phase 1), an attendant/ambassador should be stationed at the South Cove Lots from 5 am to 9 am, accepting flat fee payments in cash.

Perhaps in the future (Phase 2), a shared automatic pay station could be installed to serve the South Cove Lots and Adventure Playground.

[12] http://doubletree3.hilton.com/en/hotels/california/doubletree-by-hilton-hotel-berkeley-marina-JBKCADT/about/policies.html

Figure 5 Example Mobile Payment Signage

Increased Enforcement

Parking Compliance

Violations of existing codes may be cited by PRW staff. However, from an efficiency standpoint, after Phase 1, staff should look into City of Berkeley Parking Enforcement playing a broader role. If the City's budget limits the ability of Parking Enforcement to incorporate the Waterfront, PRW should consider having a third-party conduct enforcement, which the City of Berkeley is empowered to do as a Charter City in California.

The enforcement of parking elsewhere in the City of Berkeley is currently performed by parking enforcement officers using mobile license plate recognition (mLPR) and handheld ticketing equipment. These technologies recently replaced the use of chalk markings, a low-tech method, of tracking compliance with a time limits. This approach is easy to defeat and can cause repetitive strain injuries (RSI) in enforcement personnel.[13]

The Berkeley Waterfront staff has been conducting parking enforcement at the Waterfront, however, in doing so, this team bears the opportunity cost of staff not tending to other important work. The amount of time spent on enforcement will also increase if Waterfront staff continue using outdated technologies, such as handwritten triplicate tickets and chalk markings (with colored chalk corresponding to specific days and times). To the extent that the City can furnish

[13] http://losgatos.granicus.com/MetaViewer.php?view_id=2&clip_id=1137&meta_id=123143

PRW staff with handheld devices with LPR capability, implementation will be much smoother and cost-effective over the long run.

In the immediate implementation timeline (Phase 1) PRW staff should continue to enforce regulations. In doing so, PRW may be able to more-cost-effectively cover parking enforcement on bicycles and document violations with a camera or handheld device. To optimize use of staffing time, we recommend that the PRW staff establish a random enforcement schedule that minimizes staff time, and prevents users from predicting enforcement patterns and thus avoiding payment/time limits.

From the standpoint of continuing to increase efficiency during and after Phase 1, PRW should look into the City of Berkeley's Parking Enforcement playing a broader role in enforcing parking on the Waterfront, as it will continue to be a location of significant public parking demand within City Limits. If the City's budget limits the ability of Parking Enforcement to incorporate the Waterfront into their routes, PRW should consider having a third party conduct parking enforcement, which the City of Berkeley is empowered to do as a Charter City in California.

Parking Security

Simultaneous with all other short-term policies, the Waterfront must improve the perception of safety for people parking and/or walking greater distances from their parking spot to their final destination. Simply placing signs which expect people to call the police to report suspicious activity places a reactive burden on visitors and may encourage unnecessary confrontations, while placing cameras may invite vandalism and visitor discomfort. To that end, the following tactics are proposed:

- Consistent pedestrian-scaled lighting and regular trimming of all overgrowth and berms, particularly along the walkways between:
  - South Cove Lots and Hana Japan Restaurant
  - 199 Seawall Drive Lot and South Cove
  - Skates / N Lot and J&K Lot
  - Marina Boulevard and J&K Lot
- Establishing the placement of parking lot security personnel as part of future restaurant operational agreements and contracts

Improved Parking Information

As PRW communicates parking regulations to the public, it is important to ensure that information is updated, aesthetically consistent (using a limited palette of colors, and a maximum of two typefaces), and also available online. The following examples of signage and pamphlets are just two components of a larger conceptual design plan for the entire Waterfront which extends beyond the phasing of the initial parking regulations. Nevertheless, good practice in information design and communications should be utilized at any phase, including on temporary signage.

Wayfinding and Signage

Clear and concise signage is a key piece of any parking communications plan. Signage should serve two primary functions. The first is to complement wayfinding, in providing essential details on parking options for drivers arriving with little or no information. By complementing effective wayfinding elements, this information should be visually discrete and textually concise, while effectively guiding parking searches. The second function is to confirm to each driver that the space she/he has found is indeed priced and regulated as expected. Preferably, this happens without the drivers having to leave their cars.

As the most prominent component of a wayfinding system, signage must take advantage of its prominence while accounting for the limited amount of time one can safely and reasonably devote to reading a sign. Different types of signage should be thoughtfully placed at each decision point of the process in which somebody arrives at a location until they finish the parking transaction. At gateways to facilities, a general sign with hours and the most important regulations (capped at just two or three) may be displayed as shown in Sedona (Figure 6 below). Text must be at a size to be easily read by a driver in a moving vehicle without causing distraction.

Figure 6 Example Parking Gateway Signage

Upon entering a facility, a sign at the entrance should contain the most important regulations specific to the facility, including a “P” icon conveying that public parking is available, as well as the price, payment process, and primary destination served (Figure 7). Entrance signage to each facility should include the name of the lot to ensure parkers successfully navigate to a directed location, as well as remember the location where they parked.

Figure 7 Example Facility Entrance Sign

Icons should also be used to convey the availability of overnight parking along with other regulations, as shown in Figure 8.

Figure 8 Example Icon Signage for Overnight Parking

Increasing the prominence and visibility of signage within parking lots to concise statements when spaces are available to the public – rather than just where members of the public cannot park – will increase the public's awareness of available supply/location.

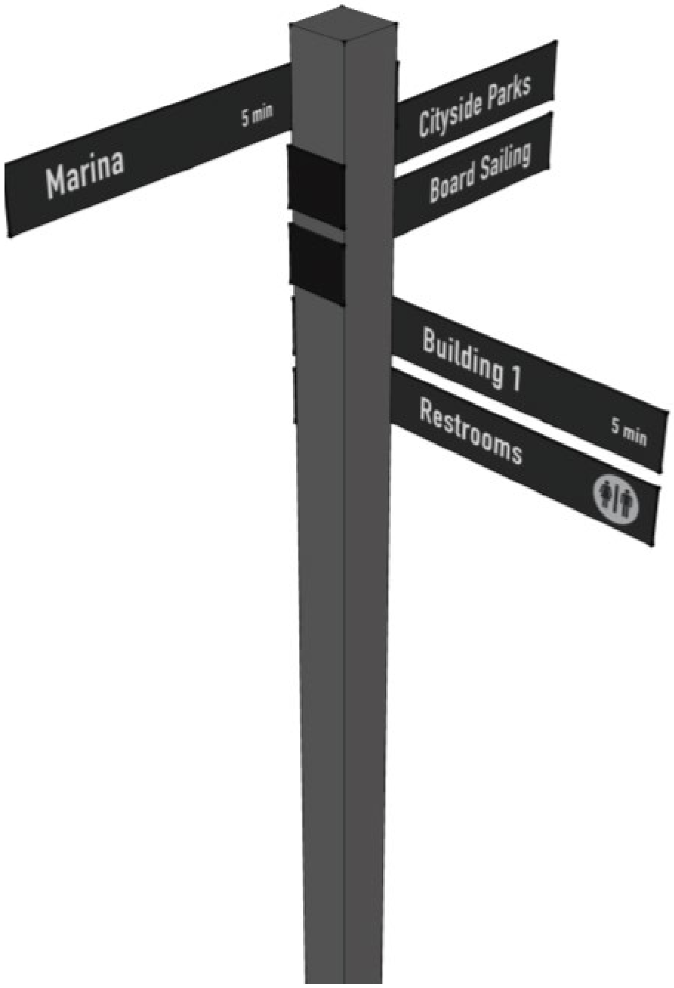
In locations where there may be two regulations applicable to two different types of users (e.g., visitors and slipholders), the leading information should always be targeted towards irregular and first-time users of the Waterfront are less familiar with the Waterfront's parking regulations. The placement of permit information should be secondary to short-term, visitor-oriented information, because visitors may be unfamiliar with their parking options; most permit users should already be familiar with their options. In Figure 9 below, the regulations for public users are posted above the regulations specific to permit holders.

Because of the volume of information and complexity regarding permit options, it may be more useful to direct interested parties to a phone number or website for permit-related information.

Figure 9 Example Sign Showing Parking For Two User Types

To encourage the use of more remote parking facilities, wayfinding signage with estimated walking times to important Waterfront destinations and other land uses should be provided at the sidewalk/pedestrian exits of parking facilities (Figure 10). Approximate walking times (e.g., "Five minutes") are generally more relatable than walking distances, which are fixed to a specific amount (e.g., "0.3 miles").

Figure 10 Example Directional Signage



Pamphlets

All-day parkers, including ferry patrons, will need to be informed of upcoming changes to parking regulations. The message should be positive and progressive. Although a notice that citations will be provided for noncompliance, a map should also be provided showing future parking options for people who are parking all day. Additionally, these pamphlets should be provided for all first-time violations as part of a "grace period" or "one-time exemption" for each vehicle. Redwood City engages in this practice for people parking in its downtown (Figure 11 and Figure 12).

Figure 11 Example Informative Parking Warning Pamphlet (Obverse)

Why Have I Received a Warning?

Downtown Redwood City has recently made some changes to its parking system. You have violated one or both of the following new regulations:

1. Failure to properly pay the new "pay-by-space" parking meters.

2. Failure to pay during new extended hours of meter enforcement in the Downtown "Core" zone. The new hours of meter enforcement in the Core are 10am to 10pm every day.

We understand that this is new, so ***<u>you have NOT received a citation</u>*** for this violation. Tips for avoiding citations in the future are included in this flyer for your convenience.

We hope you have a great experience in our Downtown and we look forward to seeing you again!

Sincerely,
The City of Redwood City

For more information go to
www.redwoodcity.org/parking

OFFICE OF PARKING VIOLATIONS

WARNING

YOU HAVE COMMITTED A PARKING VIOLATION BUT YOU HAVE NOT RECEIVED A CITATION

READ REVERSE SIDE TO LEARN HOW TO AVOID CITATIONS IN THE FUTURE

Figure 12 Example Informative Parking Warning Pamphlet (Reverse)

Using the New Pay-By-Space Parking Meters

If your parking space doesn't have an old-fashioned parking meter, it is regulated by our new "Pay-By-Space" meters. These meters are very convenient and offer many benefits, such as credit card payment, cell phone payment, dollar bill payment, the ability to add time from any meter, and less sidewalk clutter.

How to use them:

1. Note your stall number (for on-street parking it is on the curb, for parking lots it is at the back of the stall).

2. Go to any pay-by-space meter and enter the stall number.

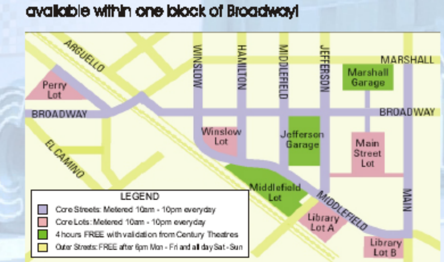
3. Pay and go!

Free Parking on Nights and Weekends

Yes, in Downtown Redwood City we now charge for parking in some areas on nights and on weekends. We know that many of you want to park right in the heart of the action and keeping the meters on helps ensure that you can get a spot as close as you want. What good is free parking if it is all full?

But if you are a connoisseur of FREE PARKING, don't worry! We've got something for everyone!

The map below shows which areas are free at night and on the weekends, and which areas aren't. Freebies are available within one block of Broadway!

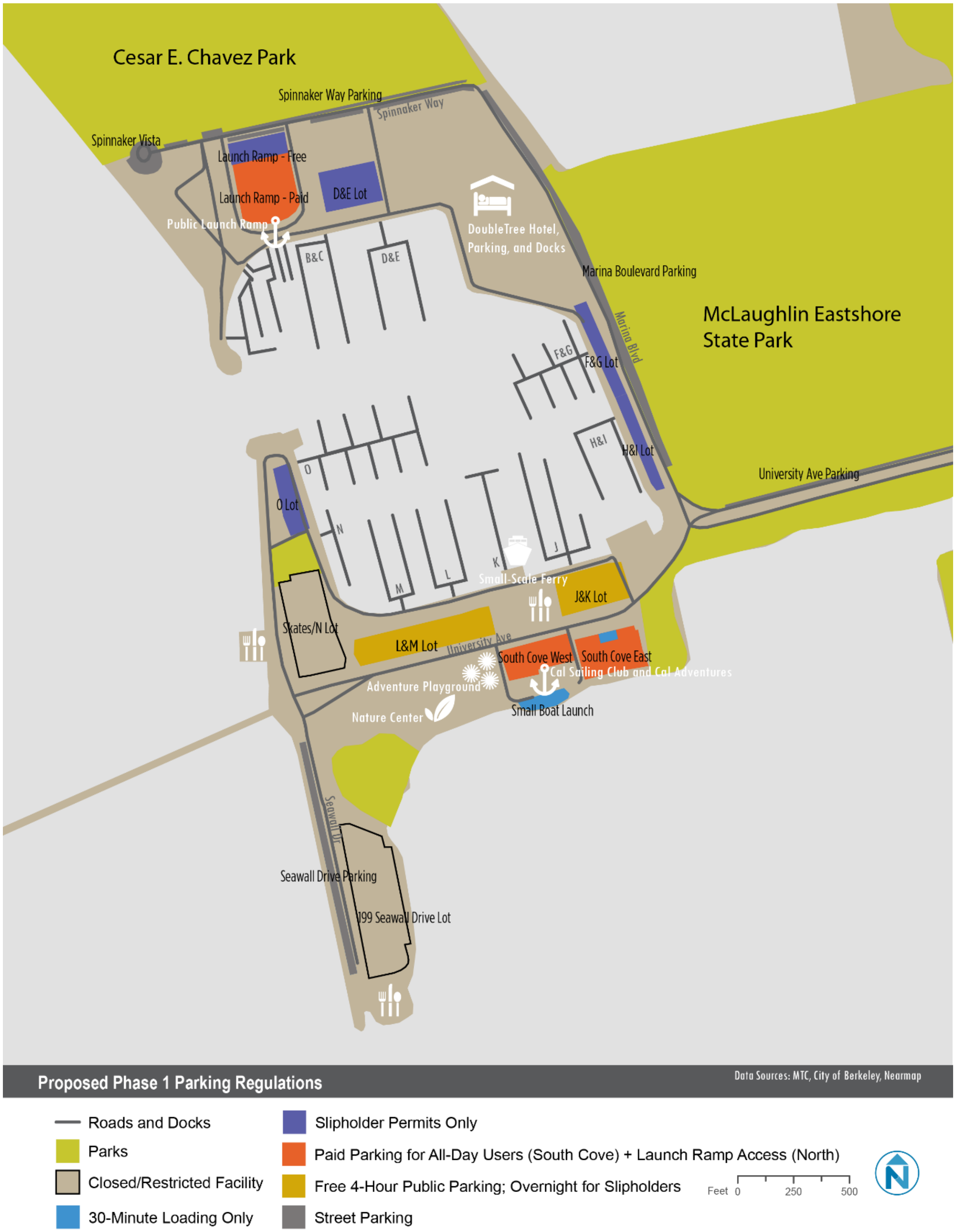


Summary of Proposed Policies (By Lot)

Figure 13 Summary of Proposed Policies

Facility	Existing Policy	Proposed Policy (Phase 1)	Future Considerations (After Phase 1 Evaluation)
South/Central Facilities North of University Avenue			
O Lot	Slipholder & Public Parking	Slipholder Permit Parking & Yacht Club Member/Staff Parking Only	Increased enforcement (in the form of citations and warnings) as needed.
Skates / N Lot	Primarily Skates Customers and Slipholders	N/A	Increase security through pruning and lighting. Incorporate parking management and security into future restaurant leases. Possible designation for ferry passengers. Increased enforcement (in the form of citations and warnings) as needed.
L&M Lot	Public Parking Allowed	Daytime: 4-Hour Public Parking Overnight: Slipholders Only	Increased enforcement (in the form of citations and warnings) as needed.
J&K/Hana Japan Lot	Public Parking Allowed (2-Hour Parking in Selected Spaces).	Daytime: 4-Hour Public Parking Overnight: Slipholders Only	Increased enforcement (in the form of citations and warnings) as needed.
South/Central Facilities South of University Avenue			
South Cove East and West Lots	Public Parking Allowed	Free parking up to 4 hours (Northern row adjacent to rigging area 9 am-9 am weekdays, Entire lot 9 am-10 pm weekdays and 5 am-10 pm weekends) $10 for 4 hours and above, charged 5 am-9 am weekdays.	Increased enforcement (in the form of citations and warnings) as needed. Implementation of automated pay system as warranted.
South Cove East Lot Rigging Area	Public Parking Allowed	30-minute loading for recreational watersports users in selected spaces adjacent to rigging area and crosswalk along northernmost rows, 4-hour maximum at all times	Increased enforcement (in the form of citations and warnings) as needed. Implementation of automated pay system as warranted.
Small Boat Launch	Public Parking Allowed	30-minute loading for recreational watersports users	Increased enforcement (in the form of citations and warnings) as needed.
Seawall Drive	Public Parking Allowed	Street Parking	Increase security through pruning and lighting. Post "No Parking 2 am to 6 am" signs per current regulations. Increased enforcement (in the form of citations and warnings) as needed.
199 Seawall Drive Lot	Temporarily Closed	N/A	Increase security through pruning and lighting. Incorporate parking management and security into future restaurant leases. Changes may be affected by master plan process. Increased enforcement (in the form of citations and warnings) as needed.
North Facilities off Marina Boulevard			
F&G Lot	Slipholder Parking Only	Slipholder Permit Parking	Increased enforcement (in the form of citations and warnings) as needed.
H&I Lot	Slipholder Parking Only	Slipholder Permit Parking	Increased enforcement (in the form of citations and warnings) as needed.
Marina Boulevard	Public Parking Allowed	Street Parking (Direct ferry and commuter passengers here)	Post "No Parking 2 am to 6 am" signs per current regulations. Increased enforcement (in the form of citations and warnings) as needed.
North Facilities off Spinnaker Way			
Launch Ramp (Public)	Public Parking Allowed	N/A	Increase security through pruning and lighting. Increased enforcement (in the form of citations and warnings) as needed.
Launch Ramp (Paid)	$15 / day (Vehicles with trailers only)	N/A	Continued enforcement (in the form of citations and warnings) as needed.
B&C Lot	Slipholder Permit Parking and Paid Access to Public Ramp	Slipholder Permit Parking	Continued enforcement (in the form of citations and warnings) as needed.
D&E Lot	Slipholder Permit Parking	Slipholder Permit Parking	Continued enforcement (in the form of citations and warnings) as needed.
Spinnaker Way and Vista	Public Parking Allowed	Street Parking	Increased enforcement (in the form of citations and warnings) as needed.

Figure 14 Proposed Parking Regulations (Phase 1)



Conclusion

Going forward, there will continue to be an ongoing need to calibrate the correct balance between existing supply and seasonal demand, but it is important that Phase 1 lasts at least a half year, and ideally a full year (to include the peak season at the Waterfront between May and October). People parking on the Waterfront should be given ample opportunity to adjust their choices in parking location based on the information they have received and their preferences based on convenience, price sensitivity, and willingness/ability to walk to their destination. Parking occupancy data collected in those locations (ideally during a "peak" period) will help inform which adjustments need to be made afterwards.

By the time the master planning process enters a new stage, restaurant leases make progress, and stakeholders have registered their feedback on the adjusted parking regulations, it will be appropriate to consider future regulatory adjustments beyond Phase 1.

Appendix of Aerial Parking Utilization Counts

	Supply	Weekend Utilization Counts				Weekday Utilization Counts				
Date		7/7/18	10/22/17	9/24/17	8/31/14	5/10/18	3/9/17	8/8/16	10/30/15	9/9/15
Day of Week		Saturday	Sunday	Sunday	Sunday	Thursday	Thursday	Monday	Friday	Wednesday
Source		Nearmap	Nearmap	Nearmap	Nearmap	Google Earh	Nearmap	Nearmap	Nearmap	Nearmap
Time of Day		Afternoon	Afternoon	Near Noon	Early Afternoon	Near Noon	Late Morning	Near Noon	Afternoon	Late Morning
Central Facilities										
L&M	**135**	99	87	66	105	91	126	73	62	62
J&K	**94**	84	43	90	86	83	25	42	26	51
South Cove West	**98**	75	74	108	115	55	37	24	7	16
South Cove East	**96**	86	18	84	73	--	17	55	8	3
Small Boat Launch	**10**	11	11	12	11	6	11	11	7	2
South Facilities										
Skates N Lot	**100**	59	60	78	84	39	20	22	37	32
O Lot	**70**	49	59	48	66	21	55	33	28	34
199 Seawall Drive Lot	**320**	90	174	170	170	313	52	21	30	30
Seawall Drive	**168**	43	28	46	67	82	21	37	24	19
North Facilities										
H&I Lot	**52**	32	33	36	26	34	32	24	29	23
F&G Lot	**47**	30	30	40	39	46	30	13	24	22
Marina Blvd	**200**	130	50	49	21	61	52	19	24	11
D&E Lot	**138**	51	53	65	66	53	59	30	40	38
Launch Ramp	**112**	69	50	69	72	52	36	13	21	36
Spinnaker Vista	**25**	29	15	24	25	48	22	19	21	11
Spinnaker Way	**108**	105	66	81	67	18	55	24	35	23
University Ave	**25**	0	1	0	1	5	0	3	2	1

Appendix of Stakeholder Survey Results

The following pages contain a complete export of ten responses to a survey electronically distributed (via SurveyMonkey) to Waterfront stakeholders in March and April of 2018.

Note: Survey results to be omitted from public drafts to maintain confidentiality as promised in the survey prompt.

Berkeley Waterfront Parking and Access User Survey

#1

COMPLETE

Collector:	Web Link **1** (Web Link)
Started:	Monday, March 05, 2018 5:04:48 PM
Last Modified:	Monday, March 05, 2018 5:08:30 PM
Time Spent:	00:03:41
IP Address:	67.212.128.186

Page 1

Q1 What is the name of your business or organization. Your name will be kept confidential and data from this survey will only be presented in aggregate.

Skates On The Bay

Q2 In terms of customers/visitors, what is your busiest...

time of year (month or months?)	**December, May thru Sept**
day(s) of the week?	**Sat & Sun**
time of day (morning, afternoon, evening)?	**Evenings both on weekends**

Q3 Estimate the number of employees on site during your busiest time — **30-50**

Q4 Please estimate the percent of employees who get to work by...

Driving alone (%)	**60**
Taking all other modes of transportation (e.g. walk, bike, carpool, taxi/Uber/Lyft, transit) (%)	**40**

Q5 Estimate the number of visitors or customers during your busiest time — **76-100**

Q6 Your business and visitors may have special needs and locations for loading and access to your site. Please list any such issues the City should be aware of moving forward.

Other issues	**Car Break in deterrents**

Q7 Is the availability of parking an issue on the Berkeley Waterfront for... — **Respondent skipped this question**

1 / 20

Berkeley Waterfront Parking and Access User Survey

Q8 Is there anything else you would like to share about your business access and parking experience on the Berkeley Waterfront?

The biggest parking threats come from car break ins for us

Berkeley Waterfront Parking and Access User Survey

#2

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Monday, March 05, 2018 5:07:49 PM
Last Modified:	Monday, March 05, 2018 5:14:20 PM
Time Spent:	00:06:31
IP Address:	172.58.91.153

Page 1

Q1 What is the name of your business or organization. Your name will be kept confidential and data from this survey will only be presented in aggregate.

Cal sailing club

Q2 In terms of customers/visitors, what is your busiest...

time of year (month or months?)	**Spring, summer and fall**
day(s) of the week?	**Monday, Thursday, holidays, and weekends**
time of day (morning, afternoon, evening)?	**All of the above**

Q3 Estimate the number of employees on site during your busiest time

1-5,
Additional comments on number of employees:
Plus up to 30 volunteers

Q4 Please estimate the percent of employees who get to work by...

Driving alone (%)	**60**
Taking all other modes of transportation (e.g. walk, bike, carpool, taxi/Uber/Lyft, transit) (%)	**40**

Q5 Estimate the number of visitors or customers during your busiest time

greater than 100,
Additional comments on number of visitors or customers:
Open house Sunday's happen once a month from spring to fall months

Berkeley Waterfront Parking and Access User Survey

Q6 Your business and visitors may have special needs and locations for loading and access to your site. Please list any such issues the City should be aware of moving forward.

Freight loading and deliveries	**Weekly**
Tour buses	**None**
Taxi/Lyft/Uber pick-up and drop-off	**Few weekly pickup/drop off**
Other issues	**We use lots of bike racks**

Q7 Is the availability of parking an issue on the Berkeley Waterfront for...	**Respondent skipped this question**
Q8 Is there anything else you would like to share about your business access and parking experience on the Berkeley Waterfront?	**Respondent skipped this question**

Berkeley Waterfront Parking and Access User Survey

#3

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Monday, March 05, 2018 6:56:08 PM
Last Modified:	Monday, March 05, 2018 7:01:14 PM
Time Spent:	00:05:06
IP Address:	208.87.217.154

Page 1

Q1 What is the name of your business or organization. Your name will be kept confidential and data from this survey will only be presented in aggregate.

Leventhal Kline Management Inc.

Q2 In terms of customers/visitors, what is your busiest...

time of year (month or months?)	**have very few visitors**
day(s) of the week?	**M-F**
time of day (morning, afternoon, evening)?	**11AM-5PM**

Q3 Estimate the number of employees on site during your busiest time

6-10,
Additional comments on number of employees:
have 6 total employees

Q4 Please estimate the percent of employees who get to work by...

Driving alone (%)	**100%**

Q5 Estimate the number of visitors or customers during your busiest time

Less than 15 ,
Additional comments on number of visitors or customers:
Never have more than 8-10 visitors at a time

Q6 Your business and visitors may have special needs and locations for loading and access to your site. Please list any such issues the City should be aware of moving forward.

Freight loading and deliveries	**Occasional (2-3 times per year) for food delivery, office supplies - 2X month, FedEX - 2-3X per monoth**

Berkeley Waterfront Parking and Access User Survey

Q7 Is the availability of parking an issue on the Berkeley Waterfront for...

If you marked an answer, please explain your understanding of the issue:

No - except you are paving the wrong lot - should pave lot by Cal Sailing, Adventure Playground

Q8 Is there anything else you would like to share about your business access and parking experience on the Berkeley Waterfront?

Ferry has led to greatly increased parking demand.

6 / 20

Berkeley Waterfront Parking and Access User Survey

#4

COMPLETE

Collector:	Web Link **1** (Web Link)
Started:	Tuesday, March 06, 2018 6:24:31 AM
Last Modified:	Tuesday, March 06, 2018 6:29:39 AM
Time Spent:	00:05:08
IP Address:	45.21.17.195

Page 1

Q1 What is the name of your business or organization. Your name will be kept confidential and data from this survey will only be presented in aggregate.

Cal Sailing Club

Q2 In terms of customers/visitors, what is your busiest...

time of year (month or months?)	**May to August**
day(s) of the week?	**Saturday and Sunday**
time of day (morning, afternoon, evening)?	**10-6**

Q3 Estimate the number of employees on site during your busiest time

1-5,
Additional comments on number of employees:
We typically have 1-5 people in "working shifts" as volunteers

Q4 Please estimate the percent of employees who get to work by...

Driving alone (%)	**75%**
Taking all other modes of transportation (e.g. walk, bike, carpool, taxi/Uber/Lyft, transit) (%)	**25%**

Q5 Estimate the number of visitors or customers during your busiest time

76-100

Q6 Your business and visitors may have special needs and locations for loading and access to your site. Please list any such issues the City should be aware of moving forward.

Respondent skipped this question

Q7 Is the availability of parking an issue on the Berkeley Waterfront for...

Respondent skipped this question

7 / 20

Berkeley Waterfront Parking and Access User Survey

Q8 Is there anything else you would like to share about your business access and parking experience on the Berkeley Waterfront?	**Respondent skipped this question**

Berkeley Waterfront Parking and Access User Survey

#5

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Tuesday, March 06, 2018 8:53:05 AM
Last Modified:	Tuesday, March 06, 2018 8:57:36 AM
Time Spent:	00:04:31
IP Address:	208.87.223.190

Page 1

Q1 What is the name of your business or organization. Your name will be kept confidential and data from this survey will only be presented in aggregate.

Zorro Productions

Q2 In terms of customers/visitors, what is your busiest...

time of year (month or months?)	**No**
day(s) of the week?	**Weekdays**
time of day (morning, afternoon, evening)?	**9-5**

Q3 Estimate the number of employees on site during your busiest time

1-5,
Additional comments on number of employees:
3 employees

Q4 Please estimate the percent of employees who get to work by...

Driving alone (%)	**66.7**
Taking all other modes of transportation (e.g. walk, bike, carpool, taxi/Uber/Lyft, transit) (%)	**33.3**

Q5 Estimate the number of visitors or customers during your busiest time

Less than ,
15
Additional comments on number of visitors or customers:
Visitors to the office are rare. We have three employees, two fo whom drive to work.

9 / 20

Berkeley Waterfront Parking and Access User Survey

Q6 Your business and visitors may have special needs and locations for loading and access to your site. Please list any such issues the City should be aware of moving forward.

Access for people with disabilities (ADA)	**n/a**
Freight loading and deliveries	**n/a**
Tour buses	**n/a**
Taxi/Lyft/Uber pick-up and drop-off	**n/a**

Q7 Is the availability of parking an issue on the Berkeley Waterfront for...

Employees?,

If you marked an answer, please explain your understanding of the issue:

Yes, two of us park here

Q8 Is there anything else you would like to share about your business access and parking experience on the Berkeley Waterfront?

Respondent skipped this question

Berkeley Waterfront Parking and Access User Survey

#6

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Thursday, March 22, 2018 1:54:25 PM
Last Modified:	Thursday, March 22, 2018 2:00:33 PM
Time Spent:	00:06:07
IP Address:	209.232.48.165

Page 1

Q1 What is the name of your business or organization. Your name will be kept confidential and data from this survey will only be presented in aggregate.

The Berkeley Marina

Q2 In terms of customers/visitors, what is your busiest...

time of year (month or months?)	**Summer months**
day(s) of the week?	**Saturday and Sunday**
time of day (morning, afternoon, evening)?	**Morning & afternoon**

Q3 Estimate the number of employees on site during your busiest time

6-10,
Additional comments on number of employees:
Shifts start at 0630 and end generally at 1630

Q4 Please estimate the percent of employees who get to work by...

Driving alone (%)	**97%**
Taking all other modes of transportation (e.g. walk, bike, carpool, taxi/Uber/Lyft, transit) (%)	**3%**

Q5 Estimate the number of visitors or customers during your busiest time

greater than 100,
Additional comments on number of visitors or customers:
Marina customers & guests, commercial tenants and customers, and visiting public

Berkeley Waterfront Parking and Access User Survey

Q6 Your business and visitors may have special needs and locations for loading and access to your site. Please list any such issues the City should be aware of moving forward.

Tour buses	**We provide occasional parking for tour and school buses in our lots**

Q7 Is the availability of parking an issue on the Berkeley Waterfront for...	**Customers?,** If you marked an answer, please explain your understanding of the issue: Sometimes spaces in close proximity to particular docks are hard to find; some lots are shared by marina customers and commercial tenants (employees & customers)
Q8 Is there anything else you would like to share about your business access and parking experience on the Berkeley Waterfront?	**Respondent skipped this question**

12 / 20

Berkeley Waterfront Parking and Access User Survey

#7

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Thursday, March 22, 2018 4:33:54 PM
Last Modified:	Thursday, March 22, 2018 4:41:20 PM
Time Spent:	00:07:26
IP Address:	67.218.96.102

Page 1

Q1 What is the name of your business or organization. Your name will be kept confidential and data from this survey will only be presented in aggregate.

Genentech

Q2 In terms of customers/visitors, what is your busiest...

time of year (month or months?)	**October**
day(s) of the week?	**Monday thru Thursday**
time of day (morning, afternoon, evening)?	**Morning and evening**

Q3 Estimate the number of employees on site during your busiest time — **30-50**

Q4 Please estimate the percent of employees who get to work by...

Driving alone (%)	**75**
Taking all other modes of transportation (e.g. walk, bike, carpool, taxi/Uber/Lyft, transit) (%)	**25**

Q5 Estimate the number of visitors or customers during your busiest time

31-50,
Additional comments on number of visitors or customers:
Our employees are our customers and our boats hold 48 ppl and 2 crew max

13 / 20

Berkeley Waterfront Parking and Access User Survey

Q6 Your business and visitors may have special needs and locations for loading and access to your site. Please list any such issues the City should be aware of moving forward.

Access for people with disabilities (ADA)	**The ramps can be difficult to maneuver and can become very slippery**
Taxi/Lyft/Uber pick-up and drop-off	**It would be nice to have a designated spot for pickup and drop off**
Other issues	**Not enough public transit connections close by**

Q7 Is the availability of parking an issue on the Berkeley Waterfront for...

If you marked an answer, please explain your understanding of the issue:

None

Q8 Is there anything else you would like to share about your business access and parking experience on the Berkeley Waterfront?

The marina is in a great location and if it had more direct access to public transportation like the bus or a shuttle to BART a lot more people would want to take those instead of drive. Another nice amenity would be bike lockers to protect bikes from the elements.

Berkeley Waterfront Parking and Access User Survey

#8

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Friday, March 23, 2018 4:01:35 PM
Last Modified:	Friday, March 23, 2018 4:10:10 PM
Time Spent:	00:08:34
IP Address:	76.103.245.110

Page 1

Q1 What is the name of your business or organization. Your name will be kept confidential and data from this survey will only be presented in aggregate.

California Dawn Sportfishing.

Q2 In terms of customers/visitors, what is your busiest...

time of year (month or months?)	**April through January**
day(s) of the week?	**5**
time of day (morning, afternoon, evening)?	**We depart at 6 am and return at 4pm**

Q3 Estimate the number of employees on site during your busiest time

1-5,
Additional comments on number of employees:
Well we have up to 30 passengers. As many as 15 cars. Most folks come in groups

Q4 Please estimate the percent of employees who get to work by...

Driving alone (%)	**100**
Taking all other modes of transportation (e.g. walk, bike, carpool, taxi/Uber/Lyft, transit) (%)	**Not possible**

Q5 Estimate the number of visitors or customers during your busiest time

15-30,
Additional comments on number of visitors or customers:
It's more like 8 to 30

15 / 20

Berkeley Waterfront Parking and Access User Survey

Q6 Your business and visitors may have special needs and locations for loading and access to your site. Please list any such issues the City should be aware of moving forward.

Access for people with disabilities (ADA)	**Yea. We do take out the disabled and Sr citizens**
Freight loading and deliveries	**Daily we carry coolers and other items to the boats**
Tour buses	**Charter Fishing**
Taxi/Lyft/Uber pick-up and drop-off	**Small percentage**
Other issues	**Security. A number give to me by the Berkeley PD. Is that ther is an average of 4 breaki ins a week in the marina. My vehicles have been vandalized 5 times over the y are. We need security cameras as a deturant to all the break ins on the vehicles.**

Q7 Is the availability of parking an issue on the Berkeley Waterfront for...

If you marked an answer, please explain your understanding of the issue:

Not really. We get there early.

Q8 Is there anything else you would like to share about your business access and parking experience on the Berkeley Waterfront?

Just the security issues. I have had my customers cars and trucks broken into quite a few times.

Berkeley Waterfront Parking and Access User Survey

#9

COMPLETE

Collector:	Web Link **1** (Web Link)
Started:	Thursday, April 12, 2018 12:15:50 AM
Last Modified:	Thursday, April 12, 2018 12:23:20 AM
Time Spent:	00:07:30
IP Address:	173.228.119.163

Page 1

Q1 What is the name of your business or organization. Your name will be kept confidential and data from this survey will only be presented in aggregate.

Berkeley Yacht Club

Q2 In terms of customers/visitors, what is your busiest...

time of year (month or months?)	**Spring, Summer, Fall**
day(s) of the week?	**Friday evening, Saturday and Sunday**
time of day (morning, afternoon, evening)?	**Friday evening, all day Saturday and Sunday**

Q3 Estimate the number of employees on site during your busiest time — **1-5**

Q4 Please estimate the percent of employees who get to work by...

Driving alone (%)	**80**
Taking all other modes of transportation (e.g. walk, bike, carpool, taxi/Uber/Lyft, transit) (%)	**20**

Q5 Estimate the number of visitors or customers during your busiest time — **greater than 100**

Q6 Your business and visitors may have special needs and locations for loading and access to your site. Please list any such issues the City should be aware of moving forward. — **Respondent skipped this question**

Q7 Is the availability of parking an issue on the Berkeley Waterfront for...

Customers?,

If you marked an answer, please explain your understanding of the issue:

The O-Dock lot frequently fills up for rental and club events, and overflow into the Skates lot is required.

17 / 20

Berkeley Waterfront Parking and Access User Survey

Q8 Is there anything else you would like to share about your business access and parking experience on the Berkeley Waterfront?

With so many different activities in such close proximity, the trend to privatize parking is counterproductive. Restricted parking anywhere results in the restricted lot being under-utilized at the expense of more crowding and reduced access to activities served by nearby lots. Example: DoubleTree Hotel charges for parking, so "their" lot is often half empty while there's no parking at all for Cesar Chavez Park.

Berkeley Waterfront Parking and Access User Survey

#10

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Friday, April 20, 2018 12:07:50 PM
Last Modified:	Friday, April 20, 2018 12:12:20 PM
Time Spent:	00:04:29
IP Address:	12.249.117.122

Page 1

Q1 What is the name of your business or organization. Your name will be kept confidential and data from this survey will only be presented in aggregate.

Neptune Society of Central California

Q2 In terms of customers/visitors, what is your busiest...

time of year (month or months?)	**May-September**
day(s) of the week?	**Saturday and Sunday**
time of day (morning, afternoon, evening)?	**Afternoon**

Q3 Estimate the number of employees on site during your busiest time — **1-5**

Q4 Please estimate the percent of employees who get to work by...

Driving alone (%)	**100**

Q5 Estimate the number of visitors or customers during your busiest time — **31-50**

Q6 Your business and visitors may have special needs and locations for loading and access to your site. Please list any such issues the City should be aware of moving forward.

Access for people with disabilities (ADA)	**None**
Freight loading and deliveries	**None**
Tour buses	**None**
Taxi/Lyft/Uber pick-up and drop-off	**None**

Berkeley Waterfront Parking and Access User Survey

Q7 Is the availability of parking an issue on the Berkeley Waterfront for...

Customers?,

If you marked an answer, please explain your understanding of the issue:

Parking is limited during peak fishing season

Q8 Is there anything else you would like to share about your business access and parking experience on the Berkeley Waterfront?

No

20 / 20

Appendix E

Budgetary Level Cost Estimates

ROUGH ORDER MAGNITUDE COST ESTIMATE
FOR
Berkeley Municipal Pier and Ferry Terminal Facility
Waterside Concept 1A - Sword

ITEM	DESCRIPTION	QTY	UNIT	UNIT PRICE	AMOUNT
1	Demo Existing Pier	1	LS	$3,700,000	$3,700,000
2	Dual-Purpose Pier	13,000	SF	$1,508	$19,600,000
3	Integrated Breakwater	1	LS	$9,600,000	$9,600,000
4	Ferry Berthing Facility	1	LS	$11,000,000	$11,000,000
5	Berthing Facility - Guide and Dolphin Piles	1	LS	$2,900,000	$2,900,000
6	Dredging	45,000	CY	$102	$4,600,000
7	Ferry Facility Electrification	1	LS	$4,200,000	$4,200,000
8	Ferry Vessels	2	EA	$18,000,000	$36,000,000
9	Recreational Pier Extension	11,000	SF	$1,264	$13,900,000
	TOTAL ESTIMATED PROJECT COST				**$105,500,000**

Assumptions:

1. Demolition cost includes removal of entire existing pier
2. Dual Purpose Pier - 580' long, 22' wide, essential facility seismic design, steel pipe piles, concrete deck
3. Recreational Pier extension - 500' feet long, 22' wide, steel pipe piles, concrete deck
4. Breakwater - 400' length and 12' wide walkway
5. Ferry Berthing Facility - includes gangway, float platforms and ramps, two single berth steel floats, 80'x33'

Date Prepared:	12-Oct-21
Cost Estimate Purpose:	Feasibility Study
Anticipated Start of Construction:	30-Jun-25

ROUGH ORDER MAGNITUDE COST ESTIMATE

FOR

Berkeley Municipal Pier and Ferry Terminal Facility

Waterside Concept 1B - Sword

ITEM	DESCRIPTION	QTY	UNIT	UNIT PRICE	AMOUNT
1	Demo Existing Pier	1	LS	$3,700,000	$3,700,000
2	Dual-Purpose Pier	13,000	SF	$1,508	$19,600,000
3	Integrated Breakwater	1	LS	$9,600,000	$9,600,000
4	Ferry Berthing Facility	1	LS	$11,000,000	$11,000,000
5	Berthing Facility - Guide and Dolphin Piles	1	LS	$2,900,000	$2,900,000
6	Dredging	50,000	CY	$102	$5,100,000
7	Ferry Facility Electrification	1	LS	$4,200,000	$4,200,000
8	Ferry Vessels	2	EA	$18,000,000	$36,000,000
9	Recreational Pier Extension	11,000	SF	$1,264	$13,900,000
	TOTAL ESTIMATED PROJECT COST				**$106,000,000**

Assumptions:

1. Demolition cost includes removal of entire existing pier
2. Dual Purpose Pier - 580' long, 22' wide, essential facility seismic design, steel pipe piles, concrete deck
3. Recreational Pier extension - 500' feet long, 22' wide, steel pipe piles, concrete deck
4. Breakwater - 400' length and 12' wide walkway
5. Ferry Berthing Facility - includes gangway, float platforms and ramps, two single berth steel floats, 80'x33'

Date Prepared:	12-Oct-21
Cost Estimate Purpose:	Feasibility Study
Anticipated Start of Construction:	30-Jun-25

ROUGH ORDER MAGNITUDE COST ESTIMATE

FOR

Berkeley Municipal Pier and Ferry Terminal Facility

Waterside Concept 2 - Dog Leg

ITEM	DESCRIPTION	QTY	UNIT	UNIT PRICE	AMOUNT
1	Demo Existing Pier	1	LS	$3,700,000	$3,700,000
2	Dual-Purpose Pier	21,600	SF	$1,508	$32,600,000
3	Integrated Breakwater	1	LS	$7,530,000	$7,500,000
4	Ferry Berthing Facility	1	LS	$12,000,000	$12,000,000
5	Berthing Facility - Guide and Dolphin Piles	1	LS	$2,500,000	$2,500,000
6	Dredging	52,000	CY	$102	$5,300,000
7	Ferry Facility Electrification	1	LS	$4,200,000	$4,200,000
8	Ferry Vessels	2	EA	$18,000,000	$36,000,000
9	Recreational Pier Extension	11,000	SF	$1,264	$13,900,000
	TOTAL ESTIMATED PROJECT COST				**$117,700,000**

Assumptions:

1. Demolition cost includes removal of entire existing pier
2. Dual Purpose Pier - 980' long, 22' wide, essential facility seismic design, steel pipe piles, concrete deck
3. Recreational Pier extension - 500' feet long, 22' wide, steel pipe piles, concrete deck
4. Breakwater - 650' length
5. Ferry Berthing Facility - includes gangway, float platforms and ramps, single berth steel floats, 135'x42'

Date Prepared:	12-Oct-21
Cost Estimate Purpose:	Feasibility Study
Anticipated Start of Construction:	30-Jun-25

ROUGH ORDER MAGNITUDE COST ESTIMATE
FOR
Berkeley Municipal Pier and Ferry Terminal Facility

Waterside Concept 3 - Fish Hook

ITEM	DESCRIPTION	QTY	UNIT	UNIT PRICE	AMOUNT
1	Demo Existing Pier	1	LS	$3,700,000	$3,700,000
2	Dual-Purpose Pier	21,100	SF	$1,508	$31,800,000
3	Integrated Breakwater	1	LS	$10,070,000	$10,100,000
4	Ferry Berthing Facility	1	LS	$15,210,000	$15,200,000
5	Berthing Facility - Guide and Dolphin Piles	1	LS	$3,360,000	$3,400,000
6	Dredging	65,000	CY	$102	$6,600,000
7	Ferry Facility Electrification	1	LS	$4,200,000	$4,200,000
8	Ferry Vessels	2	EA	$18,000,000	$36,000,000
9	Recreational Pier Extension	11,000	SF	$1,264	$13,900,000
	TOTAL ESTIMATED PROJECT COST				**$124,900,000**

Assumptions:
1. Demolition cost includes removal of entire existing pier
2. Dual Purpose Pier - 980' long, 22' wide, essential facility seismic design, steel pipe piles, concrete deck
3. Recreational Pier extension - 500' feet long, 22' wide, steel pipe piles, concrete deck
4. Breakwater - 650' length
5. Ferry Berthing Facility - includes gangway, float platforms and ramps, single berth steel floats, 135'x42'

Date Prepared:	12-Oct-21
Cost Estimate Purpose:	Feasibility Study
Anticipated Start of Construction:	30-Jun-25

ROUGH ORDER MAGNITUDE COST ESTIMATE

FOR

Berkeley Municipal Pier and Ferry Terminal Facility

Waterside Concept 4 - Circle

ITEM	DESCRIPTION	QTY	UNIT	UNIT PRICE	AMOUNT
1	Demo Existing Pier	1	LS	$3,700,000	$3,700,000
2	Dual-Purpose Pier	21,000	SF	$1,508	$31,700,000
3	Integrated Breakwater	1	LS	$11,910,000	$11,900,000
4	Ferry Berthing Facility	1	LS	$15,890,000	$15,900,000
5	Berthing Facility - Guide and Dolphin Piles	1	LS	$3,500,000	$3,500,000
6	Dredging	55,000	CY	$102	$5,600,000
7	Ferry Facility Electrification	1	LS	$4,200,000	$4,200,000
8	Ferry Vessels	2	EA	$18,000,000	$36,000,000
9	Recreational Pier Extension	11,000	SF	$1,264	$13,900,000
	TOTAL ESTIMATED PROJECT COST				**$126,400,000**

Assumptions:

1. Demolition cost includes removal of entire existing pier
2. Dual Purpose Pier - 960' long, 22' wide, essential facility seismic design, steel pipe piles, concrete deck
3. Recreational Pier extension - 500' feet long, 22' wide, steel pipe piles, concrete deck
4. Breakwater - 750' length
5. Ferry Berthing Facility - includes gangway, float platforms and ramps, single berth steel floats, 135'x42'

Date Prepared:	12-Oct-21
Cost Estimate Purpose:	Feasibility Study
Anticipated Start of Construction:	30-Jun-25

ROUGH ORDER MAGNITUDE COST ESTIMATE

FOR

Berkeley Municipal Pier and Ferry Terminal Facility

Landside Concept A - Clustered Parking

ITEM	DESCRIPTION	QTY	UNIT	UNIT PRICE	AMOUNT
1	Non-Motorized Watercraft Access Point	1	LS	$1,500,000	$1,500,000
2	Restroom Plaza & Pier Entrance Facility	1	LS	$1,200,000	$1,200,000
3	Bay Trail (Adventure Playground Entrance to Pier Plaza)	1	LS	$1,800,000	$1,800,000
4	Seawall Drive (199 Seawall Drive Terminus to University Ave)	1	LS	$3,400,000	$3,400,000
5	University Ave (South Cove West Lot to Seawall Drive)	1	LS	$1,100,000	$1,100,000
6	199 Seawall Drive - Amphitheater/Event Stage	1	LS	$1,000,000	$1,000,000
7	199 Seawall Drive Ferry Parking	1	LS	$4,000,000	$4,000,000
	TOTAL ESTIMATED PROJECT COST				**$14,000,000**

Date Prepared:	12-Oct-21
Cost Estimate Purpose:	Feasibility Study
Anticipated Start of Construction:	30-Jun-25

ROUGH ORDER MAGNITUDE COST ESTIMATE
FOR
Berkeley Municipal Pier and Ferry Terminal Facility

Landside Concept B - Dispersed Parking

ITEM	DESCRIPTION	QTY	UNIT	UNIT PRICE	AMOUNT
1	Non-Motorized Watercraft Access Point	1	LS	$1,500,000	$1,500,000
2	Restroom Plaza & Pier Entrance Facility	1	LS	$1,200,000	$1,200,000
3	Bay Trail (Adventure Playground Entrance to Pier Plaza)	1	LS	$1,700,000	$1,700,000
4	Seawall Drive (199 Seawall Drive Terminus to University Ave)	1	LS	$3,400,000	$3,400,000
5	University Ave (South Cove West Lot to Seawall Drive)	1	LS	$1,100,000	$5,300,000
6	Docks F and G Parking Lot	1	LS	$550,000	$550,000
7	Bay Trail Extension (West of Berkeley Meadow Fence)	1	LS	$1,100,000	$1,100,000
8	Marina Blvd Street Improvement (from Western Sidewalk to Eastern Parking	1	LS	$4,700,000	$4,700,000
	TOTAL ESTIMATED PROJECT COST				**$19,500,000**

Date Prepared:	12-Oct-21
Cost Estimate Purpose:	Feasibility Study
Anticipated Start of Construction:	30-Jun-25

Appendix F

Terminal Electrification Feasibility Study

F.1 Purpose

The purpose of this memorandum is to present the findings of GHDs review of the existing site electrical infrastructure in the proposed location of the conceptual Berkeley ferry facility. The City of Berkeley requested this review to examine the existing Utility infrastructure in the area of the Berkeley Marina to determine if it is feasible to add a single vessel ferry terminal for commuter travel between Berkeley and San Francisco. The proposed ferry facility would be constructed as part of the conceptual dual-purpose pier near the intersection of Seawall Drive and University Ave, Berkeley CA.

This feasibility study is primarily concerned with the basic estimation of utility service capacity and major infrastructure requirements to support the charging systems required for an electric ferry system. As the proposed facility has not been designed, estimates of facility and ferry charging load requirements are included and referenced in the appendix at the end of this document. In addition, as a specific ferry vessel has not been selected, charge parameters, loading, and turnaround times are all estimated based on email information received from Arup on 7/29/2021.

F.2 Existing System

The existing Berkeley Pier has minimal electrical loading, consisting of pier lighting and some small ancillary loads. These are fed by a local secondary tap from the transformer that serves the adjacent privately operated restaurant (Skates on the Bay). This small secondary service has no appreciable capacity for additional loading and will not be considered a viable source for future work. It may serve as a source for convenience power during construction.

Local utility power for the area is fed by the PG&E El Cerrito G1103 feeder, energized at 12,470 volts, 3-phase. An existing transformer at Skates and an existing transformer at the former HS Lordships restaurant (currently closed) are the nearest utility transformers to the proposed project site. Neither is sized to support more than very minor additional service capacity. For example, either could support a temporary construction trailer and minor additional loads, but neither would be a suitable service location permanently.

In our research on the El Cerrito feeder, we requested background information from PG&E, and we reviewed the PG&E GIS service data mapping website. The GIS site indicates that the El Cerrito feeder is at its maximum capacity, with zero capacity for expansion. Typically, when a feeder is noted as having zero capacity, that means that it will be unable to support any notable additional loads without significant offsite infrastructure upgrades such as increasing the size of the feeder conductors along its entire length. It is generally assumed that only very small (residential, small commercial) loads can be added to such a feeder without an infrastructure upgrade, and any additional load is subject to Utility approval and may not be allowed. Emails after that review have indicated that PG&E is confident the line could support a 400-kilowatt (kW) new load. See Appendix B for the GIS map snapshot and reference emails.

The El Cerrito feeder itself runs underground along the length of Seawall Drive in front of the proposed area. Due to the location of the feeder, there is easy physical access at the proposed project site, so making the actual physical cable connection would not be difficult.

F.3 Proposed Electrical Loading

The major electrical loads of the conceptual facility are divided into two major elements:

F.3.1 Proposed Ferry Facility

F.3.1.1 Ferry Facility Description

The potential ferry facility has not been designed but is not anticipated to require a significant electrical service on its own. General descriptions and concepts largely revolve around general site lighting, simple ticketing and queuing spaces, and potentially a small convenience shop and/or café space or other coffee shop analogue. It is not anticipated that this space would support commercially operated restaurant tenant.

F.3.1.2 Ferry Facility Electrical Load

A possible conceptual breakdown of the areas in the ferry operations portion of the pier is described below. It is anticipated to be a relatively low electrical load. Load calculations are shown below in Appendix A, based on the following assumptions:

- 5,000 square feet of covered seating area for ferry passengers, open to the exterior, with general purpose area lighting, a small allowance for local convenience receptacles, and an allowance of four vending machines.
- A 1,000 square foot light retail style space serving simple food/drink for traveler convenience (no production kitchen or major cooking systems).
- A 500 square foot storage area, typically unmanned, but with basic electrical provisions for local maintenance and cleaning.
- Site area lighting, covering approximately 20,000 square feet of parking, facility access approach and other miscellaneous site elements.
- Provisions for four electric vehicle charging stations, rated for 3-kW load each.

Per the calculations performed, the total anticipated load of the small system described above is estimated to be approximately 100-kW, which will in turn be carried into the service loading calculations described below. Note that this is a preliminary estimate and should be reviewed and updated as the ferry facility concept is further developed.

F.3.2 Proposed ferry charging infrastructure

F.3.2.1 Charging Infrastructure description

The electrical infrastructure to charge a ferry vessel is highly dependent on the following key elements:

- Charging load of the proposed ferry vessel.
- Charging time allowed during a particular stop at the terminal.
- Number of trips the electric ferry will make in a given day.
- Available electrical service capacity.
- Available capacity from alternate power sources (i.e., battery storage systems)

F.3.2.2 Charging Infrastructure Electrical Load

The following estimated loads were provided by Arup to GHD via email on 7/29/2021 and used to form the basis for the calculations in Appendix A.

- The ferry vessel will charge at the terminal approximately 10 times per day, for approximately 10 minutes a charge.
- The overall power usage of this system will draw a minimum of 6.5 Megawatt Hours (MWh) of power per day.
- The estimated charge for a single trip, given the above information, is 0.65MWh.
- The calculations break all loads across 1-hour time increments, for ease of use and calculation. It is also assumed that due to travel and loading/unloading time, no more than one trip is possible per hour.
- For the purposes of the calculations, GHD has created a concept terminal schedule, including a series of trips and associated charging periods over the course of a given week. This schedule breaks down the energy use on an hourly basis.
  – The schedule started with the proposed 10 trips/day, and added additional trips to simulate a typical week, favoring more trips during commute hours, with a late day trip for final travelers, a special Friday night trip (similar to the dedicated ferry for SF Giants' games) and a final trip to return the ferry to the storage location.
  – Reducing the number of trips has a significant effect on the calculations, so determining the exact number and timing of the trips is crucial to any refinement of the calculations performed here.

F.3.2.3 Storage Battery Considerations

Given that the 0.65MWh load is drawn over the course of approximately 10 minutes, the instantaneous load at that time is 3.9 Megawatts (MW, 3,900kW), which is significantly more power than the 400-kW service PG&E has indicated it can supply as a power service. Based on the noted feeder capacity and the response from PG&E, it is not anticipated that PG&E could support the ~5,000-amp service required for directly charging the ferry vessel from the grid. It is also worth noting that none of the local feeders in the area indicated the available capacity for the size of service direct charging would require.

As direct charging does not appear feasible, some form of local land-based battery storage will be required to reduce the peak loading on the system. While proposed storage battery capacities are noted in the options below, the exact size and design of the battery system will require further engineering effort. For the purposes of determining basic feasibility, GHD has proposed four scenarios that have varying service size and battery system size combinations. The selection of an option as a base to begin design will depend on the review of generalized cost of each option, and of the final determination by PG&E as to how large a new service can be supported in that location. The calculations supporting each option are included in Appendix A. Note that the calculations include the ferry facility load as both that and the charging system will be supported by the service.

Battery system sizing is described below, but was generally configured along the following parameters:

- A minimum size of 1 megawatt hour, or approximately 1.5 times the total estimated single charge capacity for the vessel. This is to ensure that, at the minimum, a 10-minute discharge can cover the vessel and allow a recovery charge over the remainder of the given hour.
- Various charging rates based on potential service sizes in KW, broken into the options described below. Note that since the calculations are broken into 1-hour intervals, all kilowatt ratings correspond to the same number of kilowatt hours (i.e., a 420-kilowatt service provides 420-kilowatt hours of total power in an hour). This simplifies the calculations.
- The calculations include overnight charging to "catch-up" with daytime usage.

- Note that the calculations are based on available charge of the battery system, which will decline over time. To accommodate that, in the cost estimates, the actual battery system will be sized 50% larger than the calculated required capacity. This additional capacity will reduce the number of complete charge/discharge cycles imposed on the battery system and will account for degradation over time.
- The calculations further highlight all times that the given array would have less than 1 full charge stored and available for use.

F.3.2.3.1 Option 1 – Minimum service and battery storage system

This system would be composed of a PG&E service rated to supply a continuous load of 420-kW, generally consisting of an 800-amp 480-volt PG&E service and local infrastructure. The system would be connected to charge a 2.5 MW land-based battery storage array dedicated to charging the ferry. Based on the service size, the system would be continuously charging throughout the week, with the battery storage only reaching complete charge a few times in the week and being discharged to various levels depending on the frequency of ferry trips.

The battery system size is intended to minimize the times that the batteries have less than one full charge stored. This is to retain some flexibility to address a single unplanned change in ferry schedule, allowing an off-sequence charge. At the available charge rate a single unplanned charge would leave the battery storage operating with little or no spare margin for days afterward, even given the level of catch-up charging received each night. Increasing the battery storage capacity can assist with this slightly, but the service size is the bottle neck in this system.

Note that the 400-kW service noted in the PG&E emails is not quite enough to maintain the charge throughout the week. This minimum calculation is based on 420-kW. If 400-kW or a smaller service is all that is available, the number of trips would have to be reduced to allow the battery energy storage charge to recover.

F.3.2.3.2 Option 2 – Increase service size to decrease battery storage requirement

This system would be composed of a PG&E service rated to supply a continuous load of 500-kW, generally consisting of a 1,000-amp 480-volt PG&E service and local infrastructure. The system would be connected to charge a 1.5 MW land-based battery storage array dedicated to charging the ferry.

Based on the service size, the battery storage would be continuously charging throughout the week, though in this case the smaller battery system would reach peak charge several times throughout the week.

Similar to Option 1, this system lacks significant resiliency to accommodate schedule changes, but the larger service does allow more flexibility. As it charges the system faster, the battery storage system can recover from an unexpected usage in a few hours, rather than the days of Option 1. Other than during later morning commute times each weekday, when hourly trips are anticipated, the battery storage has capacity for a complete extra charge through most of the week.

This option requires significantly less battery capacity than Option 1 and will result in lower construction costs, provided PG&E can support the larger service size.

F.3.2.3.3 Option 3 (GHD recommendation) – Increase service size and maintain Option 1 battery sizing

Similar to Option 2, this system would be composed of a PG&E service rated to supply a continuous load of 500-kW, generally consisting of a 1,000-amp 480-volt PG&E service and local infrastructure. The system would be connected to charge a 2.5 MW land-based battery storage array dedicated to charging the ferry. Based on the service size, the battery storage would be continuously charging throughout the week, reaching and maintaining peak charge through much of the weekend, and maintaining a comfortable charge margin for flexibility through weekday commute times.

This system has greater resiliency to accommodate schedule changes, with both faster charging times than option 1, and greater stored capacity than option 2. Note that with this option, changing the installed battery size up or down is a trade between cost and flexibility, but there would be minimal return beyond installing 3MWh of total battery capacity.

This option is also contingent on PG&E supporting the larger service size.

F.3.2.3.4 Option 4 – Largest reasonable service size to minimize battery requirements

This system would be composed of a PG&E service rated to supply a continuous load of 750-kW, generally consisting of a 1,200-amp 480-volt PG&E service and local infrastructure. The system would be connected to charge a 1 MW land-based battery storage array dedicated to charging the ferry. This service is sized to cover the 1-hour power requirements of both charging and supporting the facility. In this case, the battery only serves to spread the charging load out over the entire hour, to cut the peak utility load to a manageable level.

Any larger service would also improve flexibility, but the smallest reasonable battery size would be 0.65MWh, or one complete ferry charge. Having less than one stored charge at any time would mean that any disruption in the service would immediately affect operations.

The resiliency of this system is mainly based on the fact that it recovers from each charge within the hour that the trip takes, meaning more ferry trips can be made any time they are required (provided no more than one per hour). Increasing the battery array capacity can provide additional resiliency, with 2-3MWh being the largest reasonable capacity suggested, similar to Option 3.

This system requires a significant PG&E service and is contingent on PG&E supporting the larger service size.

F.3.2.3.5 Variations

- On any option, larger batteries could be provided to allow for stored charge flexibility given the conditions mentioned for each option. Larger battery systems could also be leveraged in agreements with PG&E to provide utility back feed during power emergencies, but since the ferry load is likely to be highest during the same times the grid is already stressed (weekday commute, particularly in the afternoon), such considerations may require significantly more battery capacity at higher cost.
  - Note that the 50% additional battery size calculated into the cost is not reflected in the option sizing above but will aid in resiliency of each system in the early years of use. As the capacity will diminish over time, we are taking the approach that it will not be available later and all sizing should be determined based on the reduced future capacity.
- PV System(s)
  - Covered parking could be installed which could include PV canopies, or potential PV systems on the roof area of the any structure(s) could be used to further offset total service size. As PV is not always available at the time a vessel is in and charging, the service and battery storage systems must be sized to accommodate charging without PV support. That way the system would meet minimum functionality even when PV was offline or unreliable due to weather. A PV system would help offset overall energy costs of the system.

- Larger Services
  – Services larger than the 750-kW noted in Option 4 may be available, but it is unlikely that a 3.9MW service large enough to support direct charging of a vessel (without battery support) is feasible. Assuming that is the case, services 750-kW and 4-MW do not significantly improve the performance of the system and are not recommended.

F.4 Planning-Level Cost Estimates

Base Service

As described above, the proposed utility services range from 800 to 1200 amps at 480-volts. As electrical system hardware is very similar in cost in those ranges, we have focused on the varying cost of the described battery systems. Without a more comprehensive facility design to review, providing electrical system costs for facility electrical infrastructure would not be accurate.

In researching battery costs for large systems, we have primarily referenced a National Renewable Energy Laboratory (NREL) study produced in 2019 specifically analyzing the ongoing price decrease of grid scale battery storage solutions (Appendix C). While this study is focused on certain backup power solutions, rather than a peak shaving charging system, the cost data is a good starting point for feasibility purposes. Note that the study focuses on battery and support structure hardware costs, so our estimates have used those costs and increased them by 100% to account for the cost of supporting electrical infrastructure and construction costs. The costs noted below are calculated on the spreadsheets used for system sizing.

The NREL report indicates that system costs for equipment purchased in 2021 are approximately $353 per kWh of storage capacity.

As noted above, the costs include an overall battery capacity 50% higher than the required capacity to account for battery degradation over time with a goal of retaining the required capacity for 15-20 years.

1. Option 1 battery storage system estimated cost: $2,660,000
2. Option 2 battery storage system estimated cost: $1,340,000
3. Option 3 battery storage system estimated cost: $2,660,000
4. Option 4 battery storage system estimated cost: $1,060,000

F.5 Conclusion

GHD believes that constructing and operating an electric ferry system, including the terminal facility and ferry charging infrastructure, is feasible given the information reviewed, calculations prepared, and calculations based on that information. While our cost estimating information focused on the battery system alone, standard cost estimating practices could readily define a proposed building cost once a concept layout has been determined. Further, the electrical infrastructure costs are close enough between the various options discussed that the battery systems are the main differential factor.

Appendix G

Community Outreach Process

G

G.1 Approach

The public engagement program was designed to solicit feedback from frequent users of the Berkeley Marina and the broader Berkeley community on the concept design and programming ideas for the potential new dual-use recreation/ferry pier. The program consisted of three small focus group meetings in early January 2021, three community workshops - one each in January, August, and October - and an online questionnaire open to the general public posted on the project website from March until June. Workshops were conducted via Zoom video. Presentations were made by staff from the City and WETA and project team consultants. A summary of key outcome for each of the three workshops and the questionnaire are available on the project webpage: https://berkeleyca.gov/your-government/our-work/capital-projects/berkeley-pier-ferry-access-project

G.2 Community Noticing and Communications

The City developed and regularly updated a project website (https://berkeleyca.gov/your-government/our-work/capital-projects/berkeley-pier-ferry-access-project) to keep the public apprised of the planning study. Posted information included presentation slides from each of the three community workshops, summary of public comment, background data and exhibits about the old pier, staff reports for city council meetings, and relevant planning information.

In addition to the City's required steps for public noticing, the City and WETA advertised each community workshop in Berkeleyside, the City's project website, and the City's Community Events webpage, and via email announcements to the Marina stakeholders, recreation groups, and Measure T1 mailing lists. Community meeting poster boards and flyers were posted at several locations at the Marina and the City's community centers. WETA staff posted the community meeting announcements in their newsletter and their social media channels.

G.2.1 Workshops and Questionnaire

G.2.1.1 Focus Group Meetings – January 5, 6, 7

In January of 2021, using the online Zoom format, the City conducted three small focus groups with highly active community users of the Berkeley Waterfront (both water and landside users) to hear about key concerns and interests. About seven to ten community users— each with a deep knowledge of the Marina — participated in one of three small group meetings. Each meeting consisted of a technical presentation from City and WETA staff followed by a facilitated discussion. Key outcomes include:

– defining areas where watersports and boating occur currently;
– listing potential new recreation uses on/around a potential new pier;
– ways to limit impacts to existing recreational programs/uses;
– ideas for circulation and parking; and,
– ideas for amenities, programming, and commercial activity.

G.2.1.2 Community Workshop #1 – January 21

About 95 people participated in Workshop #1. The project team first introduced the feasibility study scope, objectives, existing conditions, potential ferry routes, and five pier schemes. After the presentation, attendees broke into small groups to discuss the schemes. Key topics discussed:

- how and where commuters may use the ferry;
- qualities of the existing Waterfront to preserve;
- parking, transit, and bicycle access ideas;
- environmental considerations; and,
- the merits/disadvantages of the each of the five pier configurations.

After breakout sessions, participants reconvened to hear the highlights from each group.

G.2.1.3 Online Questionnaire – March 22 to June 6

An informal questionnaire was posted on the project website consisting of ten multiple choice and open-ended questions on ferry use, access, and pier design. Key outcomes:

- 377 respondents, 83% from Berkeley, remainder from adjacent communities;
- strong interest in ferry commute and pleasure travel to San Francisco and Marin;
- support for accessing the ferry terminal via public transit, shuttle, and bicycle;
- support for multiple recreational uses at the pier; and,
- support for food/drink concessions, events, and event programming at the pier.

G.2.1.4 Community Workshop #2 – August 10

The project team presented two land use concept plans — one with clustered and one dispersed parking — and five new pier schemes that had evolved based on comments from Workshop #1. After the presentation, the approximate 90 attendees broke into small groups to discuss the merits of the schemes. Key outcomes from the small groups:

- people requested more data on ridership projections, feasibility of a new ferry service, and information on the financial implications of a ferry on the Marina Fund;
- there was stronger support for clustered over dispersed parking; and,
- most participants supported a straight pier with berthing on the north side.

G.2.1.5 Community Workshop #3 – October 27

Approximately 85 people attended this workshop. During the first segment City staff and project consultants responded to community requests from Workshop #2. Following a brief Q&A on the presentations, the Preferred Conceptual Alternative was presented and consisted of renderings and a site plan of the pier, parking, and terminal. In a full group format, the workshop facilitator guided questions and open discussion on the plan. Key responses included:

- concern that parking demand may be greater than available capacity at the former HS Lordships site;
- concern that ferry parking could negatively impact the existing character of the Marina; and
- general support for the pier scheme presented (over prior configurations).

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